U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

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

SOIL SURVEY OF CHASE COUNTY, NEBRASKA.

BY

R. F. ROGERS, OF THE U. S. DEPARTMENT OF AGRICULTURE, IN CHARGE, AND LOUIS A. WOLFANGER, OF THE NEBRASKA SOIL SURVEY.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

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

WASHINGTON:
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1919.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., December 3, 1918.

SIR: I have the honor to transmit herewith the manuscript report and map covering the survey of Chase County, Nebr., and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1917, as authorized by law. This work was carried on in cooperation with the University of Nebraska.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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MAP.

SOIL SURVEY OF CHASE COUNTY, NEBRASKA.

By R. F. ROGERS, of the U. S. Department of Agriculture, In Charge, and LOUIS A. WOLFANGER, of the Nebraska Soil Survey.—Area Inspected by THOMAS D. RICE.

DESCRIPTION OF THE AREA.

Chase County is situated in the southwestern part of Nebraska, bordering the State of Colorado. It is rectangular in form, approximately 37¼ miles long from east to west and 24 miles wide from north to south, and comprises 899 square miles, or 575,360 acres. The county lies within the Great Plains, on the eastern edge of the division known as the High Plains. The general surface configuration is that of a plateau, sloping eastward, whose original constructional surface has been modified by wind and stream erosion and deposition into high divides or table lands, separated by valleys of moderate depth, and, in general, moderate steepness of slope.

About one-fourth of the county is occupied by sand hills, which represent outlying areas of the vast Sand Hill region that covers north-central Nebraska. They consist of a succession of rounded or choppy hills and irregular ridges, ranging from 10 to 120 feet in height, occasionally capped by drifting sand and pitted by "blowouts." The billowy topography is relieved here and there by level valleys or basins of varying sizes, which often contain excellent farming lands. The outlets of these depressions are usually obstructed by sand dunes, and the drainage escapes through the porous substratum. The sand dunes occur throughout the northeast, north-central, central, and southwest portions of the county.

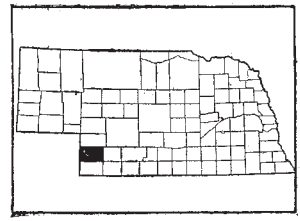

FIG. 1.—Sketch map showing location of the Chase County area, Nebraska.

Over the northwestern part of the county, in the vicinity of Lamar, the surface is almost flat to gently rolling, with a few intermittent stream valleys and shallow depressions, and low gravelly hills and small mounds. This extensive stretch of country has a typical prairie landscape, but there is an undulating swell sufficient to insure good drainage. The upper courses of the drainage ways, or "draws," are simply broad, shallow depressions with no definite or continuous channels, but along their lower courses the larger draws have sharply cut valleys bounded by steep slopes or bluffs, which

are occasionally rugged and nearly barren of soil. The floors of the small valleys are moderately wide and nearly level, as a result of partial filling with alluvium during flood periods. In the more rolling portions of this plain there are small, isolated, level-topped hills and low, rounded knolls seldom rising more than 10 to 30 feet above the general level. These are erosional, and probably represent a local capping of more resistant rocks. There are also numerous depressions without drainage outlets scattered over the plain. These lie 15 to 40 feet below the surrounding land, and vary in size from a fraction of an acre to about 30 acres, most of them being less than 7 acres in extent. This broad plain, which for convenience may be designated the Lamar plain, may be considered as extending through the center of the county. The plain becomes narrower toward the center of the county. At Imperial it is only about 2 miles wide and is bordered by a rolling to hilly country composed chiefly of sand hills.

In the upper reaches of the streams the valleys are rather narrow and the adjacent slopes are usually not very eroded, but toward the lower stream courses in the southeastern part of the county the valleys become broader and their slopes are dissected by numerous canyons and small hollows, giving a bold aspect to the general topography. Where the divides are composed of loess they are steep sided, deeply gullied, and often bounded by nearly bare cliffs and slopes. The valleys are characterized by steep upper slopes, or bluffs, becoming gentler at the base and merging into a nearly level terrace or bottom, the valley profile being roughly U-shaped. All the large valleys have well-defined terraces or benches, which lie 15 to 40 feet above the streams. The streams are also bordered by first bottoms, which range from one-sixteenth to three-eighths of a mile wide. The first bottoms represent recent alluvial material, while the second bottoms or terraces consist of older deposits laid down by the streams during their earlier history.

Striking features of the landscape in the eastern part of the county are the high divides or tables popularly referred to as the East and South Divides and the divide east of Stinking Water Creek. The surface of these tables is level to undulating, and there is a strong contrast between their topography and that of the rough, eroded country along their borders, where the slopes are often precipitious and the relief great. The table lands are really remnants of the old loess plain. The drainage channels are frequently not well defined on the smoother parts of the tables, but they break into deep ravines in their lower courses. In the southeastern and eastern parts of the county the divides are separated from the bottoms by long, rather steep slopes which are completely dissected by

numerous canyons and small ravines. The slopes vary in width from 1½ to 3 miles or more. The slopes between the stream terraces or benches and the bottoms are often abrupt, especially where the stream impinges against them, and the slopes between the upland and bottom lands are often steep to almost precipitous where capped by bedrock. Such slopes are largely confined to the eastern part of the county. The slopes to the streams in the western and northwestern parts are often comparatively smooth, but in places steep.

Chase County has an average elevation of approximately 3,200 feet above sea level. Its general slope is southeastward. The altitude at Imperial is 3,281 feet, at Enders 3,136 feet, and at Wauneta 2,935 feet, according to the records of the Chicago, Burlington & Quincy Railroad. Elevation ranges from about 3,500 feet in the northwestern part of the county to approximately 2,920 feet in the Frenchman Valley east of Wauneta.

Chase County is drained by Frenchman Creek and its tributaries, the chief of which are Stinking Water Creek and Sand Creek. Frenchman Creek follows a general southeastward course across the county. Its valley floor varies in width from one-sixteenth of a mile along the upper part of the stream to about one-half mile along its lower course in this county. The channel of the creek in its lower course is 15 to 20 feet wide. In general it is rather deeply intrenched, but the first-bottom land is subject to occasional overflows. It lies 60 to 200 feet below the bordering upland. Frenchman Creek is fed by springs and has a constant flow. It falls about 500 feet within the county, the drop averaging about 12½ feet per mile.

Stinking Water Creek is composed of two forks which come together near the Hayes County line, 6 miles northeast of Wauneta. Both are fed by springs and have a continuous flow in their lower courses. These streams have carved out narrow valleys, generally bordered by narrow strips of bottom land and frequently by terraces. The valley floors range from one-sixteenth to one-half mile in width. These streams have a slower current than Frenchman Creek, and consequently much of their bottom land is poorly drained. The bottoms lie 150 to nearly 200 feet below the average level of the upland plain. Sand Creek, the second most important tributary of Frenchman Creek, has a valley approximately 22 miles long in Chase County. Its bottom land ranges from three-sixteenths to about five-sixteenths of a mile in width. The bed of this stream is composed of gravel and sand and is dry except during high floods. Sand Creek has not cut as deep a valley as the other streams, but like them it is bordered by terraces which vary in width from a few rods to one-half mile.

Some water-power and irrigation developments have been made along Frenchman Creek. There are two flour mills operated by water power, one at Champion and the other at Wauneta. There are also two hydroelectric-power plants, one at Wauneta and the other 3½ miles southeast of Champion, which furnish electric power for Wauneta and Imperial, respectively. The developed irrigation projects along Frenchman Creek supply sufficient water to irrigate several thousand acres, and there are good sites for dams along this stream. There are no public ditches, but farmers have cooperated in the construction of systems to supply water to small areas of first-bottom and terrace land. Considerable more land could be brought under irrigation.

Drainage conditions are good over practically the whole county, but there are some poorly drained first-bottom areas and small depressions in the upland. In the sandiest areas drainage is largely accomplished through underground percolation and there is a marked absence of drainage ways. The streams afford excellent watering places for stock.

A valuable asset to the county is the supply of "sheet" water obtainable everywhere at depths ranging from 10 to 325 feet, depending upon the topography. This water is wholesome. The underground water supply is in the Ogallala formation on the uplands, and in the alluvial deposits in the stream valleys.

Chase County was organized in 1886. Most of the early settlers came from eastern Nebraska, Iowa, Illinois, Missouri, and other more eastern States, but immigrants have since come from many European countries and Canada. The predominating foreign nationalities are German, Swedish, Scotch, and English. The rural population is fairly evenly distributed outside the sand hills proper and the rough, broken slope country. Settlement is densest in the vicinity of Imperial and in the larger valleys.

The total population of the county in 1890 is reported as 4,807, in 1900 as 2,559, and in 1910, as 3,613. In the latter year it averaged 4 persons per square mile. Approximately 80.5 per cent of the population consists of white persons of native parentage, 14.9 per cent of native white of foreign or mixed parentage, and 4.6 per cent white of foreign birth.

Imperial, the county seat, is situated near the center of the county, at the terminus of a branch of the Chicago, Burlington & Quincy Railroad. Its population in 1910 was 402. Wauneta is a locally important town, situated in the Frenchman Creek valley in the southeastern corner of the county, and on a branch of the Chicago, Burlington & Quincy Railroad. It had a population of 327 in 1910.

Both towns have a municipally owned waterworks system and electric-light plant, and have increased in population in recent years. They have grain elevators, agricultural-implement stores, lumber yards, and other business enterprises. Wauneta has a flour mill with a capacity of 125 barrels per day, operated by hydroelectric power. Lamar, Champion, and Enders are locally important trading centers. Enders is on the Chicago, Burlington & Quincy Railroad. Champion is situated on Frenchman Creek.

Chase County has several rural mail delivery routes, and all important points are reached by telephone lines. The county has a fairly good rural-school system. Good graded and high schools are maintained in the towns. Churches are conveniently located throughout the greater part of the county.

A branch of the Chicago, Burlington & Quincy Railroad crosses the county from Wauneta to Imperial, joining the main line at McCook, in Redwillow County.

All the public highways are earth roads. The main roads are in moderately good condition, but some of the less important roads receive very little attention. All the streams and drainage ways are bridged at necessary places. Wagon roads usually follow section and property lines, but in the sand hills and rougher parts of the county it is often necessary to make detours to avoid hollows, steep hills, and bluffs. There is an abundance of gravel, limestone, and other road-building material, but it is rarely used except for filling holes and washouts along the roads. Automobiles can travel over most of the roads throughout the greater part of the year, as it rarely rains hard enough to affect travel for any great length of time. The Omaha, Lincoln, and Denver Highway passes through Wauneta, Imperial, and Lamar.

The principal local markets are Imperial and Wauneta, but some farm produce is handled at Lamar, Champion, and Enders. There is a local demand among stockmen and others for much of the farm produce. The outside markets for live stock and other farm products are chiefly Omaha, which is 290 miles to the east, St. Joseph, Kansas City, Lincoln, and Denver. There is a demand in neighboring towns for dairy products.

CLIMATE.

The following table, compiled from the records of the Weather Bureau Station at Imperial, gives the normal monthly, seasonal, and annual temperature and precipitation.

Normal monthly, seasonal, and annual temperature and precipitation at Imperial.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1915).
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	27.7	64	— 17	0.69	0.57	0.32
January	26.2	72	— 32	.44	.40	.47
February	27.3	71	— 19	.70	.10	1.34
Winter	27.1	72	— 32	1.83	1.07	2.13
March	47.0	87	— 10	1.33	.38	1.82
April	49.3	94	11	2.35	.71	5.56
May	58.5	102	15	2.96	1.98	7.54
Spring	51.6	102	— 10	6.64	3.07	14.92
June	68.6	108	34	3.48	2.51	7.86
July	74.6	108	37	2.92	.72	3.64
August	73.5	107	34	2.91	2.82	4.51
Summer	72.2	108	34	9.31	6.05	16.01
September	64.6	101	25	1.32	1.58	1.44
October	49.7	94	2	1.19	T.	2.35
November	38.1	82	— 5	.50	T.	.29
Fall	50.8	101	— 5	3.01	1.58	4.08
Year	49.6	108	— 32	20.79	11.77	37.14

The principal climatic features that have a bearing on agriculture are temperature, precipitation, length of growing season, winds, and evaporation. Chase County lies in a region which has a wide range in monthly and annual extremes of temperature. The climate is characterized by cold winters and short, hot summers. The extremely low winter temperatures occur in the form of cold waves or blizzards, accompanied in the beginning by high winds and usually lasting from three days to a week. These were once very destructive to range animals, but at present they seldom cause much loss, as the live stock is better protected and fed. The mean annual temperature as recorded at Imperial is 49.6° F. January and February are the coldest months, and July is the warmest. The lowest temperature on record is —32° F., recorded in January, and the highest 108° F., recorded in June and July.

The amount of seasonal rainfall is of vital importance, as the average precipitation is near the minimum required for profitable agriculture. Yields are often curtailed by drought, and occasionally

there is a total failure from this cause. The summer rains usually come as local showers and a particular locality may be passed by for several years and have poor crops or failures, while near-by communities may have unusually large yields. These local showers are frequently in the form of thunderstorms, and hail occasionally does serious damage over local areas. Sometimes the rainfall is torrential. Three-fourths of the mean annual rainfall of 20.79 inches comes during the growing season, which lasts from April to September, inclusive. The wettest month is June, but almost as much rain falls in May, July, and August. The driest year on record was 1910, with only 11.77 inches of precipitation, and the wettest year 1915, with 37.14 inches. The snowfall is comparatively light, and snow rarely covers the ground during the entire winter. Cattle are seldom prevented from grazing by the snow, as the winds remove the snow from the more exposed areas as fast as it falls.

The average date of the last killing frost in the spring is May 11, and that of the first in the fall, September 24, giving a normal growing season of 136 days. The earliest recorded killing frost in the fall occurred on August 25 and the latest in the spring on May 21. The grazing season lasts ordinarily from about May 1 to November 1, but some of the grasses cure on the range and furnish some sustenance for stock throughout the winter.

The prevailing winds are from the northwest, but during the summer months from the south and southwest. High winds are of common occurrence throughout the year, but tornadoes are practically unknown. The winds are of value to the farmers in pumping water, in curing the grasses for winter pasture, and in other ways, but the benefits are greatly overbalanced by the injurious effect in accelerating the rate of evaporation from the soil and plants. The moisture conditions are often critical on account of the excessive evaporation favored by the low relative humidity, the almost continuous sunshine, and the prevalence of strong and sometimes hot winds.

Most of the land in Chase County is productive, and the climate is the principal controlling factor in agricultural development. While the rainfall is not usually sufficient for the production of as good yields as are obtained in the eastern counties of the State, the best farmers have adopted methods whereby fairly good returns can be depended upon even in some of the driest years. The disadvantage of the high altitude and a short growing season has been partly overcome by substituting hardier and medium-early varieties of crops, which are possibly less productive. Alfalfa is largely confined to the subirrigated stream valleys. Millets and sorghums are well suited to the climate. There are only a few species of forest trees. While these will grow on the uplands, it is very difficult

to keep most of them alive in the early stages of growth. Nearly all tree fruits, except possibly cherries, are very uncertain in yield.

AGRICULTURE.

The early settlers in this region engaged in ranching, which was favored by the abundance of nutritious grasses, crop production was of little importance until the late nineties. As in other parts of the Great Plains, the waves of settlement have advanced and receded. Following a few years of good yields, culminating in the exceptionally large crops of 1891, immigration was so stimulated that much of the agricultural land became well settled. These good years were followed by the most disastrous droughts the county had ever known, ending in the extremely dry years of 1893 and 1894. At that time there was practically a total failure of all crops, and settlers left the county in large numbers. In 1880 there were only 13 farms in the county. The number had increased to 931 in 1890, but by 1900 had fallen to 464. The early population was larger than that enumerated as late as 1910, although it is doubtless exceeded at present. The droughts probably would not have retarded development so seriously if the present dry-farming methods had been practiced. The settlers did not understand the best methods of conserving soil moisture, had no knowledge of the crops best adapted to the soils and climate, and used seed from humid regions which was not suited to local conditions. Also the present system of stock raising in connection with grain farming was not well established. In addition to these obstacles the general financial depression then prevailing over the entire country caused low prices for all agricultural products. Much of the land fell into the hands of a comparatively few men, whose holdings were used for grazing under a system of combined grain farming and stock raising. Many of the large tracts have been gradually broken up as the population has increased, but a large proportion of the county, including the rough areas and the sand hills, is still used for stock raising in connection with grain and hay farming. Most of the public land in the county passed into private ownership many years ago, but resettlement of the remainder was hastened by the passage of the Kincaid Act in 1905. This increased the size of the homestead available under the public-land laws to 640 acres, and made it profitable to take up land valuable chiefly for pasture. Within a short time the remaining public land passed into private ownership.

In 1910 over 73 per cent of the area of Chase County was in farms, and 20 per cent of its area is now under cultivation. The agriculture consists of grain production and general farming, usually in connection with dairying. The leading crops are corn, wheat, grain

sorghum, barley, millet, wild hay, emmer, rye, alfalfa, oats, and potatoes. A total area of about 200 acres in 1909 was devoted to broom corn, flax, onions, popcorn, and kafir.

Corn has always been the leading crop. It is grown with some success on all the agricultural soils and seems to be the most profitable grain crop on the sandy types, which are better adapted to corn than to small grains. The 48,564 acres devoted to corn in 1917 produced 1,165,536 bushels, or an average of 24 bushels per acre.[1] Warm dry winds and droughts in some years cause considerable damage, and the corn is sometimes soft and not properly matured, owing to the comparatively short growing season and the cool nights. Medium-early acclimated varieties give best results, although the varieties grown produce smaller stalks and smaller ears than are obtained in the eastern part of the State. Both dent and flint corn are grown. The most popular varieties include Reids Yellow Dent, White Dent, White Flint, and Dent Squaw. The white varieties are considered to yield best, but the yellow corn is said to be of better quality. Some farmers have grown corn on the same field for 20 years or more without any appreciable decrease in yield, but the crop does best where grown for 2 years in a systematic rotation with a small grain or leguminous crop. The corn is used for feeding hogs, cattle, and horses, and it is in great demand by those engaged in stock raising. Many farmers, especially the tenant farmers, have a surplus for sale. Corn is generally husked from the standing stalks and stored in cribs. Occasionally the fields are pastured during the fall and winter. A few farmers cut some corn for winter roughage.

Wheat ranks second in importance among the grain crops. In 1917 winter wheat was grown on 23,290 acres and produced 349,350 bushels, or an average of 15 bushels per acre. Spring wheat occupied 4,833 acres and produced 57,996 bushels, or an average of 12 bushels per acre. The wheat acreage in 1917 was nearly four times greater than in 1889, and twice as large as in 1909, and there is at present a tendency to increase the acreage by bringing under cultivation soils of heavier texture, which are better suited to this crop than to corn. On the sandy soils there is considerable danger of drifting by the heavy winds of the fall and spring. Wheat gives best results in this region on a deep, mellow soil with a heavy, though friable subsoil. The average yield of spring wheat is less than that of winter wheat, largely on account of the introduction of the Turkey Red and Kharkof varieties of hardy and productive Russian winter wheats. The spring wheats, however, seem better adapted to the sandy lands, and the durum varieties of spring wheat are popular owing to their drought-resisting qualities. Of the winter varieties the Turkey Red

[1] Annual Report, Nebraska State Board of Agriculture, 1917.

is grown almost exclusively. The early maturing of the wheat crop enables it to avoid the droughts and dry winds which sometimes occur in summer. Winter wheat is also popular because it is sown at a time when the work does not conflict with the work of caring for other crops. Wheat constitutes an important source of income. A small proportion of the crop is used by the two water-power flour mills in the county, but most of it is shipped to outside markets. The quality of the grain usually is good.

Barley is the third most important grain. This crop was grown on 6,959 acres in 1917 and produced 139,180 bushels, or an average of 20 bushels per acre. Barley has gradually increased in acreage since 1889. It seems to be more hardy than oats, and is frequently used as a substitute for that crop. The six-row barleys seem to be a profitable type. Barley and emmer have gained in favor largely on account of their seemingly great resistance to drought. The acreage in emmer is about half that of barley. The average yield per acre is probably less than that of barley or durum wheat. In addition, emmer does not have as high a feeding value as barley, and is not as easily marketed, and the acreage will probably not increase to any great extent. The early varieties of spring emmer and barley give the best results.

Rye ranks fifth in importance among the grain crops. It is grown on a small scale in nearly all parts of the county. In 1917 it occupied 2,868 acres, and yielded an average of 19 bushels per acre. Rye has been grown since the earliest times, 1,043 acres being devoted to the crop in 1889. It yields better than the other small grains on the sandy soils, and here it is more needed as a forage crop. If sown in the fall or early spring it furnishes green feed when nothing else is available. To a much less extent it is grown for grain.

Oats were grown on 1,844 acres in 1917, and gave an average yield of 21 bushels an acre. The acreage in 1889 and 1909 was larger than in 1917. Most farmers do not consider oats a profitable crop, but they fit in well with any plan of rotation and are needed as feed for stock, especially horses. On the average oats are less profitable than either corn, wheat, or barley. The crop does not withstand drought as well as the other small grains, and it is frequently damaged by warm, dry winds or droughts at heading time. Oats do well on the irrigated lands, where they afford a valuable step in the crop rotation. The Kherson, a short, stiff-strawed variety, is commonly grown. The Burt is considered one of the earliest and best yielding varieties. Most of the crop is fed to horses and other live stock.

Sorghum is the chief forage crop. Its acreage has gradually increased since 1889 and it now ranks third among the cultivated crops. The average yield for the county is about 1.8 tons per acre, but the returns are much larger under favorable circumstances. Sorghum

is considered the most satisfactory annual forage crop, and it is grown on practically every farm. It seems to be profitable on nearly every soil type, but the yields are much greater on the "hard lands." The average returns are much larger than those of millet. Sorghum has about the same feeding value as any prairie hay other than wheat grass. Where there is no alfalfa to mix with the sorghum it is commonly fed with corn or some small grain. The chief objection to sorghum as a green feed is that when stunted by drought it may contain enough prussic acid to be poisonous to cattle. Sorghum hay, however, is never poisonous. Sorghum also has the reputation of exhausting the soil and drawing heavily on the soil moisture. The crop is very drought resistant, as it belongs to the class of plants that remain dormant in dry seasons and resume their growth when moisture is again supplied. In order to secure the best forage, the crop is cut when the earliest heads begin to ripen. The early black amber is one of the principal varieties grown.

Millet ranks fifth in acreage. This crop has been grown to some extent since the earliest days, and the acreage has gradually increased from 2,386 acres in 1899 to 5,461 acres in 1917. The average yield is about 1.2 tons per acre. German millet is the leading variety. Millet is grown on all the soil types, but does best on the "hard lands," or stronger soils. It can be sown at almost any favorable time before late summer, and produces a crop of hay within a short period.

Wild hay is a relatively unimportant crop as compared with the hay production of most of the other counties of the State, but it ranks sixth in acreage among the crops of Chase County. Wild hay is cut on nearly all the soil types, and the yields vary widely. The average is about 1 ton per acre. A large proportion of the bottom land, especially where poorly drained, is used for hay production, as well as the so-called lagoons and other poorly drained upland areas. The soils here are particularly adapted to hay grasses and produce good yields if most of the weeds are kept out. The valuable western wheat grass forms a large part of the hay, particularly in the uplands. The hay crop is consumed locally on the farms and cattle ranches. Cultivated or tame grasses occupied only 165 acres in 1917.

Alfalfa occupied a total of 1,884 acres in 1917, with an average yield of 2.3 tons per acre. This is the most valuable forage crop wherever it can be grown to advantage. There are a few fields of alfalfa on all the agricultural soils, but the crop is largely confined to the stream terraces or first bottoms, where the land is irrigated, or where the water table is near enough to the surface to be reached by the roots. On the valley lands, where the ground water is not more than 30 feet below the surface, alfalfa usually does well, producing

3 or 4 cuttings each season and averaging about 1 ton per cutting. Considerable difficulty is experienced in obtaining a stand during the drier years. Where the water table is close to the surface the weeds are apt to be so abundant that it is hardly safe to sow alfalfa until these have been destroyed by tillage. Alfalfa has not generally proved profitable on the uplands, but some farmers have grown the crop successfully by seeding it in rows and cultivating it. On the uplands alfalfa gives 1 and occasionally 2 or 3 cuttings of about 1 ton each. Shallow depressions in the table-land, which receive flood waters, can often be profitably used for alfalfa if not too wet. Alfalfa is generally seeded the latter part of May or in June, but the crop seems to do best when sown in August, provided the rainfall is favorable. A good stand of alfalfa is obtained only where the weeds have been destroyed and the seed bed has received thorough preparation, and in August the weeds are not likely to crowd out the plants as they would earlier in the season. A nurse crop is not generally grown with alfalfa on unirrigated land except occasionally on sandy areas. The requirements for obtaining and maintaining a stand of alfalfa, viz, a deep, fertile, well-drained soil rich in lime and reasonably free from weeds[1] are met by a large number of soil types in Chase County, and rainfall is the controlling factor.

Irish potatoes were planted on a total of 317 acres in 1917 and produced 25,677 bushels, or 81 bushels per acre. Potatoes are grown to a small extent on all the agricultural soils, but do best on the friable sandy types. The best results are obtained when the crop is grown in rotation after alfalfa or some other soil-enriching plant. Yields as high as 225 bushels or more per acre are occasionally obtained, especially on irrigated lands. The Early Ohio, a hardy variety, is grown most extensively. Potatoes are generally free from disease, but occasionally the black beetle and bugs cause damage, and the scab sometimes appears where infected seed has been used. On unirrigated land potatoes are planted as early as possible, but on irrigated areas the planting season extends from the latter part of April to May 15 or even June 1. Potatoes are considered a profitable crop, but they are produced only for local consumption.

Nearly all kinds of vegetables can be grown successfully, but the yields are uncertain except under irrigation. Most farmers have a small garden to supply vegetables for home use. Beans are grown to a small extent on a commercial scale. The Pinto is the leading variety. The crop seems to do well under favorable conditions on many of the soils.

There are a few small orchards of apples, peaches, cherries, pears, and plums scattered over the county, mainly on the divides in the

[1] Bul. 396, Bureau of Plant Industry, U. S. Dept. of Agr.

eastern and southeastern part and on the terrace lands of the Frenchman Valley. The cherry is about the only tree fruit that appears to be an entire success. The Early Richmond, a sour cherry, is most commonly grown. Apples and plums seem to do better than peaches or pears, but even they are generally unprofitable, except in a few favored localities, on deep, fertile soils where the trees are protected from the wind. Currants and gooseberries do fairly well, but strawberries and other small fruits and berries are not a success without irrigation. Few orchards are properly cultivated or otherwise well managed.

Live-stock raising is an important industry in Chase County. The value of all crops produced in 1909 exceeded the value of all live-stock products by only $61,396. The Nebraska State Board of Agriculture reports a total of 2,470 milk cows in Chase County in 1917, with a value of $185,250, and 13,482 other cattle, with a value of $808,920. The number of horses in the same year was 5,640, valued at $564,000, and the number of mules 928, valued at $102,080. The number of hogs amounted to 8,270, with a value of $248,100, and there were 200 sheep, valued at $2,000.

Stock raising is highly profitable, as the animals generally are remarkably free from all kinds of disease. Cattle and horses are the chief sources of income. Some horses and mules are raised on nearly every ranch, if not for the market, at least to supply the necessary work animals. They rarely need to be fed during the winter, while cattle usually require 2 to 3 months or more of winter feeding, especially if the range is well stocked. Many of the horses are sold to buyers who come into the county, but most of the cattle are shipped to eastern markets in the fall as 2 or 3 year old feeders. The most popular breeds of cattle are the Hereford, Polled Angus, and Shorthorn. The grade Hereford is the type of beef cattle most generally raised, although there are many Polled Angus and Shorthorn grades. There are a number of pure-bred herds, which have a marked influence on the general quality of the stock in the county. The largest cattle ranch contains about 2,000 head, and there are several others with 500 to 700 head or more. The ordinary farmer keeps 20 to 30 head of cattle. The type of horses has been improved from the western broncho to medium draft horses weighing 1,200 to 1,300 pounds. The Percheron is recognized as the best breed under existing conditions.

The high altitude, healthful climate, and isolation have prevented losses from cholera and other malignant diseases, and some farmers have been very successful in hog raising. The chief breed is the Poland China, but there are many Duroc Jersey and Hampshire animals. Hogs are especially profitable where alfalfa can be grown, as

alfalfa pasturage is sufficient to maintain hogs, with a comparatively low grain ration, until they can be fattened for market or shipped as feeders. On many farms all the corn produced is fed to hogs and other stock. Many farmers keep 30 to 40 hogs, and the largest hog farm has about 3,000 head of the Hampshire breed.

There are no strictly dairy farms in the county, but nearly every farmer keeps a few cows, the average number for the 670 farms in the county being nearly 4 cows per farm. Cream and sometimes butter are marketed, but milk rarely. The products find a ready market, being shipped to Hastings, Omaha, Lincoln, Denver, or other eastern or western cities. Dairying has proved a profitable adjunct to general farming. Silos are becoming more common. Most of the dairy cows are Shorthorn grades, but there are also some Jersey and Holstein grades. The dry, temperate climate, good water, and variety of foods combine to keep cattle diseases at a minimum.

Heretofore sheep raising has not been considered a profitable industry, and there are only a few hundred sheep in the county. The Rambouillet Merino and other Merino breeds and crosses seem to be the most popular. Sheep are affected by stomach worms and grubs in the head. The worms seem likely to occur each season, but both diseases can usually be controlled if the flocks are kept in good condition and well fed. Sheep can be run on range land from about April 15 to December 15, but they must be winter fed. The sand-hill areas support about 1 sheep to the acre. It is generally considered that 8 head of sheep can be pastured on an area that would support 1 steer. Needle grass (stipa) when fruiting is very harmful to sheep, as the needles work their way through the wool and into the flesh of the animal. The worst period is from June 15 to July 15, after which the effects are negligible. The needle grass occurs in patches, and if the sheep are inclosed in small areas during the early summer they prevent it from forming seed by trampling it down. It is claimed that the lack of development in sheep raising is due largely to the ravages of dogs and coyotes, to injury by needle grass, and to the fact that many ranchmen believe sheep destroy the pastures, particularly in the sand hills.

The climatic and soil conditions seem well suited to poultry raising, and there is apparently no reason why the industry should not be greatly extended. On practically every farm some chickens are kept, and on many farms poultry is a valuable asset. The total number of poultry on farms in 1917 is reported as 33,936, an average of 50 per farm. Chickens are the principal fowl, but turkeys, ducks, guineas, and a few geese are also raised. The value of the poultry and eggs produced in 1909 is reported by the census as $54,433.

There is a sparse natural growth of willow, cottonwood, elm, ash, and box elder along the principal streams. The trees planted on the

timber claims include mainly box elder, ash, honey and black locust, white elm, and catalpa. Fires and cattle have done much damage here and few plantings were irrigated, so that most of the trees have died. It is said that forest trees on the upland should be cultivated for several years.

The Russian thistle, pigweed, and dwarf sunflower are the most abundant harmful weeds on the cultivated areas. Cocklebur now occurs abundantly in certain localities. *Gaertneria tomentosa*,[1] a weed introduced about 15 years ago, occurs chiefly in wet depressions in the upland and is very harmful to crops. The poisonous loco weed is encountered on the rough grazing lands outside the sand hills, and occasionally on the "hard lands" in the more level regions. This weed is chiefly harmful to horses, but also affects cattle. Stock avoid the plant unless forced to eat it by lack of other forage. After acquiring a taste for the weed the animal often refuses to eat anything else, and in extreme cases dies. In eradicating the weed a sharp spadelike instrument with a narrow blade is used to cut the stem below the ground.

Topographic and soil conditions have influenced the extent and distribution of the farmed areas more closely than they have affected the distribution of the various crops. The tendency toward excessive drainage in parts of the upland and in some cases poor drainage in the bottom lands have hindered the development of farming on some soils. Certain positions on slopes, hills, or other situations where crops are less likely to suffer damage from winds and frosts are probably well adapted for orchards and trees, where there is sufficient moisture. The farmers realize that the heavy soils or "hard lands" are adapted to small-grain and forage crops and that the sandy lands are best suited to such crops as corn, rye, and potatoes. The sandy, shifting nature of the sand dunes makes farming unprofitable here, and the land is devoted to grazing. No farming is done in the rough, eroded, sloping country, and profits are possible only where large tracts are used for grazing. The wet bottom lands are used for pasture and for hay production. It is known that alfalfa is especially adapted to the terrace soils and well-drained bottom soils, owing to the subirrigation, and it does fairly well in certain favorably situated valleys and moist upland depressions.

The agricultural methods followed by the best farmers are based on experience. They understand that the essential features of dry-farming are thorough preparation of the land and the prevention of the growth of weeds. The sandy lands are not deeply plowed and they are not cultivated as much as the heavier soils to form a mulch. Some farmers on these types run the rows east and west, at right

[1] The plants for which scientific names are given in this report have been identified by Dr. Raymond J. Pool, of the University of Nebraska.

angles to the course of the prevailing winds, and leave the surface rough. Soils which blow readily are not summer tilled, as the frequent high winds cause the soil to drift. Cultivation always follows a rain that is heavy enough to wet through the mulch and destroy it, and during a period of prolonged drought it is often necessary to cultivate between rains. A rather rough surface is advantageous on the heavy soils, as it prevents the water from running off during heavy rains. The heavier soils hold more moisture than the sandy types, but it is less available for crop use, and there are other reasons which tend to make many crops more certain on the sandy soils in this climate. Moisture is largely lost through vegetation rather than from the surface of the soil. Moisture conditions are the chief factor controlling yields, and rotations, fertilization, and tillage methods are of secondary importance.

As a rule the farm buildings are moderately good, and the barns and other outbuildings are usually sufficiently large to house the crops. Most of the fences are of barbed wire, and they are frequently not in good condition. The farms generally are adequately equipped with modern implements. In 1917 there were 17 gasoline and steam tractors in the county, 384 cream separators, and 3 butter-making machines. More than half the farmers have automobiles. On most farms the work stock consists of fairly good horses and mules.

Corn is usually planted between May 5 and 20. The soil is disked or double disked early in the spring, and the crop listed as early as possible, usually on old corn or stubble land. Occasionally the heavy soils are plowed before disking. The crop is cultivated one to three times, usually twice, with a 2-row cultivator. Much depends upon getting the soil properly prepared before listing and upon keeping the corn free from weeds.

Winter wheat is best seeded between September 1 and 15, depending upon the moisture conditions, and spring wheat between March 20 and May 1, the earlier seeding being considered the safer. Sod land properly prepared generally gives a greater net return with winter wheat than with corn, but sod is more easily planted in corn and often gives a good yield. Wheat is usually sown on stubble or corn ground and double disked in, but this method does not insure as good a stand as plowing or disking the soil and drilling in the seed. Barley, oats, and emmer are usually seeded between April 1 and 15, but occasionally as late as May 10. Oats are grown only on old ground. These small grains are usually sown on corn stubble prepared by disking. The best farmers seed with a press drill, but some farmers still sow broadcast and harrow in the seed or cover it by disking. Rye is usually sown broadcast in the fall, on old

stubble ground, and is covered by double disking, in the same manner as wheat. Wheat harvesting begins about the 15th of July, but barley, emmer, and oats mature somewhat later, depending largely on the variety sown.

Sorghum is seeded a few days later than corn, when the ground has become warmer, and is often sown on new land broken in the spring. The crop is either drilled thickly or sown in rows and cultivated. Thick seeding with a press drill gives larger yields and a better grade of forage, provided there is sufficient moisture, but forage and also a crop of seed may be had by sowing in rows.

Millet is seeded from May 20 to July 1 or even later, but usually about May 25 to June 10. The land is plowed or disked as early as possible and then harrowed, as the weeds must be eradicated before the crop is seeded. The crop is sowed with a press drill.

No definite and systematic crop rotation is practiced. In some cases corn has been grown continuously on the same land for 20 years or more, and wheat almost as long on some farms. Corn is usually grown for 2 years or more, followed by wheat, oats, barley, and sorghum or some other forage crop. No grasses or leguminous crops are introduced in the rotation for enriching the soil, but alfalfa is extensively grown on the bottom lands and terraces. A rotation recommended for western Nebraska is as follows:[1] "Summer tillage, winter wheat, corn, spring grain, cane.[2] Summer till and sow winter wheat; disk and fall plow the wheat stubble for corn the next year; apply manure during the winter, disk the corn stubble for a spring grain—oats, wheat, or barley; disk in spring and plow for cane,[2] which crop completes the rotation. To practice this rotation a farm should have at least five fields."

Commercial fertilizers are not used, and only a small proportion of the manure produced is applied to the land. The best farmers spread the manure as evenly as possible and mix it with the surface soil by disking.

Most of the farm work is done by the farmers and their families. Farm labor is somewhat difficult to obtain. Of the 609 farms in the county in 1909, 276 used hired labor, at an average expense of $261. Farm hands hired by the year receive $30 to $40 a month, with board. During harvest season day wages range from $2 to $3 or more. Some farmers and ranchmen employ entire families in order to obtain more efficient and reliable help, paying from $40 to $60 a month, with a house and garden and the privilege of keeping a cow, horse, and chickens.

The State census for 1917 reports 670 farms in the county. These include 112,537 acres of cultivated land and 241,046 acres of unculti-

[1] Bul. No. 118, Nebraska Agr. Expt. Sta., Growing Crops in Western Nebraska.
[2] Sorghum.

vated land. There are some large holdings, one comprising several thousand acres. The ranchmen generally own one or more square miles, and in the greater proportion of farms the area is between 320 and 1,600 acres. The consensus of opinion is that the most profitable unit for a one-man farm is 320 acres, most of which should be arable land. If a farmer expects to combine farming with the raising of considerable stock he could profitably handle 640 acres, over half of which could be nonagricultural. The best farmers state that one man, with extra help at harvest time, can profitably handle 100 acres of corn, 100 acres of wheat and barley or other small grain, and 50 acres of millet, sorghum, or other forage crops.

The percentage of farms operated by owners decreased from 100 to 73.9 per cent between 1880 and 1910, but there has been a slight increase since the latter year. The share system is generally followed in renting farms. Unimproved pasture land owned by nonresidents rents for $25 to $50 a quarter section.

There has been a marked increase in the value of farm property since 1880. The value of farm land at present ranges from $12.50 an acre for the poorest areas to over $100 an acre for irrigated land. Ranch land varies in value from about $6.50 an acre for very rough tracts to $15 an acre for the best grades of strictly pasture land.

SOILS.

The geological formations appearing at the surface in Chase County consist of silts, sands, soft sandstone, calcareous grits and conglomerates, and mixtures of sand, gravel, and silt. They are of relatively modern geological age, the oldest being the Ogallala formation of the Pliocene epoch of the upper Tertiary period. This underlies the entire area of the county and appears at the surface over the high plains or plateau in the northwest part of the county, and over the greater part of the slopes to the streams. The next formation in geological sequence is the western remnant of the great loess deposit of Nebraska. This formation was at one time more extensive, but it now occurs only on the high tablelands and divides and in the rough broken areas in the eastern and southeastern parts of the county. The most recent formation of Pleistocene age comprises the alluvial and colluvial deposits of the stream terraces or bench lands and the more recent alluvium forming the first bottoms.

In its typical development the Ogallala formation is an impure calcareous grit or soft limestone containing more or less interbedded and intermixed clay and sand. Throughout its mass there are scattered pebbles of many kinds of crystalline rocks, streaks of pebbly sand, and thin ledges of sandstone. These were probably brought from the Rocky Mountains and deposited by streams in past geologic

epochs. The harder calcareous beds or conglomerates are of a whitish or cream color, and outcrop in irregular cliffs along the slopes of depressions. Some softer intercalated sandy beds are light pinkish in color. Among the minerals which compose the pebbles are free quartz and orthoclase. Feldspar pebbles are noticeable on certain residual slopes and on pebbly benches. Mica and hornblende, derived from the granitoid rocks, also occur. There are also fragments of granite, syenite, gneiss, rhyolite, basalt, hornblendic schist, and quartzite. The thickness of the Ogallala formation ranges from 150 to 300 feet, being greater toward the west. As the surface has been more or less eroded, the original thickness is unknown.

The loess deposit lies unconformably over the eroded surface of the Ogallala formation. It consists of a light yellowish gray or pale brownish yellow, calcareous very fine sandy loam containing a high content of silt. The deposit is of a remarkably uniform texture and moderately compact structure. It is composed of fine sand, silt, and clay rather loosely cemented with carbonate of lime and occasionally stained with iron oxide. The material is coherent where undisturbed, but breaks up easily into a loose, floury, silty dust. Occasionally it contains streaks of sand and old soil, and some portions of the mass are slightly more clayey than others. Deposits of volcanic ash occur in the lower part of the formation. Much of the water falling upon the surface is absorbed, but on steep slopes erosion is rapid when gullies have once formed. The loess tends to erode in steep, vertical bluffs where exposed to running water. The changes which have taken place in its weathering are the accumulation of organic matter in the surface material and the decomposition of the fine material into clay, which tends to concentrate below the surface. Loess deposits cover more than one-third of the entire area of Nebraska. Their origin has been a matter of much dispute among geologists, and probably varies, at least in the source of the materials, in different parts of the State.

Sand dunes are extensively developed in this county, overlying the Ogallala formation and in places the loess deposits. Altogether the sandhill districts comprise about one-fourth of the area of the county. The sand has been blown into ridges and hills, but there are many intersecting valleys and basins of various sizes. The dunes are largely composed of fine to medium sand of a loose and incoherent structure. The sand grains have been derived from a varied assortment of rocks similar to those contributing to the Ogallala formation. There is a large proportion of quartzitic minerals, but pinkish and brownish-yellow feldspathic minerals seem to predominate. The sands are in part derived from the disintegrated sandy material of the Ogallala and other sandy formations in the western part of the State and in part from river sands.

The alluvial and colluvial deposits of the stream valleys are mainly sands, silts, and loams, usually intermixed with pebbles, and occasionally associated with local clay beds and peat lenses. The older alluvium of the present stream valleys is represented by the terraces or bench lands now lying above overflow.

Strong winds have played an important part in the distribution and assortment of the soils. There is not a soil type in the county that has not been modified to a marked degree by the addition of wind-blown materials. The surface soils are prevailingly brown, with grayish or pale yellowish gray lower subsoils. In general the soils have a loose, friable structure, although the heavier types may be moderately compact at the surface. The material is usually calcareous, particularly in the subsoil, but there is practically no accumulation of injurious alkali except in a few places in the first bottoms. The organic content of the soils is rather high for a semiarid region, but low as compared with that of most prairie soils of humid regions.

The soils of Chase County are broadly separated on the basis of derivation into the following groups: Residual soils; soils derived chiefly from wind or eolian deposits; soils of miscellaneous or mixed origin; soils derived from stream-laid terrace deposits; and soils derived from recent alluvial floodplain deposits. Soils of similar origin, basic color, structure, and topography are grouped in series.

The residual soils belong in the Rosebud series. The Holdrege and Colby series have been derived from loess, which some geologists hold is wind-laid, but they represent an advanced stage of weathering of this material. The soils of the Valentine series and Dunesand belong to the recent wind deposits. The soils of miscellaneous origin include the Canyon, Scott, and Dawes series. The terrace soils are correlated with the Tripp series and recent alluvial soils with the Laurel series.

The Rosebud series includes types with brown, moderately calcareous surface soils, and highly calcareous whitish, floury subsoils. Angular and waterworn gravel occurs abundantly in the subsoil and frequently in the soil. The topography ranges from gently undulating to very hilly and broken, and drainage is thorough to excessive.

The surface soil of the types included in the Holdrege series are dark brown, and the subsurface layer is dark brown or brown, and in virgin areas has the rather compact, granular structure typical of prairie soils of subhumid or semiarid climates. The color fades gradually downward and the lower subsoil becomes grayish brown or light grayish brown. The lower subsoil is highly calcareous. This series is derived from loess. The soils differ from the Colby

in the greater depth and darker color of the surface and the heavier subsoil.

The soils and upper subsoils of the types in the Colby series are brown. The deeper subsoil is a pale yellowish gray to dark-gray, silty and very fine sandy material of a highly calcareous nature, with a smooth feel and an open structure. This series is of wind-laid origin, and derived from loessial deposits. The topography is comparatively level to sharply rolling, and the soils are well drained.

The types in the Valentine series are characterized by brown to dark grayish brown surface soils, brown to dark-brown upper subsoils, and light-brown to yellowish-brown lower subsoils. They are not highly calcareous to a depth of 3 feet or more. The subsoils are friable and only moderately compact, and grade at about 3 feet into loose sand. The Valentine soils occupy level to gently rolling valleys and basins in the sandhill region, where their position has favored the accumulation of much organic matter. They are closely associated with the extensive sand dunes, occurring among them or along their borders, and it is very probable that they have a similar origin. The soils have been derived by weathering from the sandy strata of the Tertiary formations, from the washed-out sandy material of the adjacent hills, and from fine wind-blown material from sand dunes.

The soils of the Canyon series are grayish brown or dark gray to gray, and the subsoils are yellowish gray or light gray. These soils are quite variable in both texture and color. They occupy rolling to hilly areas, with many steep slopes, and drainage is apt to be excessive. The material is of colluvial origin, derived mainly from calcareous conglomerates, sands, and finer deposit of the Tertiary formations and also in places from loessial material.

The soils of the Scott series are dark brown to almost black in color, and heavy and refractory in texture. The upper subsoil is a dull-brown to black silty clay, grading at about 30 inches into a friable, grayish, lighter textured material which is mottled with yellow and rusty brown. The subsoils are sticky and plastic when moist, but hard and brittle when dry. Both soil and subsoil have a bluish-gray or slate colored shade when thoroughly dry. The soils are poorly drained, and subject to periodical overflow. They consist of lake-laid material eroded from higher lying soils and deposited by sheet surface water or intermittent streams in lakes or ponds occupying depressions in the upland plains.

The surface soils of types correlated with the Dawes series are grayish brown or brown to dark brown. The upper subsoils are brown to dark brown to black with a moderately friable and compact structure and a heavier texture than the surface soils. At an average depth

of 20 to 30 inches they grade into a light-gray, highly calcereous, silty and clayey material which is chalklike when thoroughly dry. In certain areas, largely residual in origin, the lower subsoil consists of the whitish floury, silty, highly calcareous material encountered in the Rosebud soils. A marked feature of the Dawes soils is the removal by weathering of nearly all the lime from the surface soil and upper subsoil and its concentration in the lower subsoil. The soils of the Dawes series characteristically occur in basinlike depressions and valleylike areas of the upland or on the higher parts of the level and less eroded table lands. They are of varied origin. Certain areas occupying the level, little eroded high plains, or tablelands. have doubtless been formed by the deeper weathering of the more calcareous and less gravelly portions of the Ogallala formation; the surface soils of the sandy types have been derived almost entirely from wind-blown material; and some of the low-lying areas consist of weathered colluvial wash. Drainage channels are either absent or poorly developed on the Dawes soils.

The surface soils of the Tripp series are brown to dark grayish brown, frequently with a dark ashy gray appearance at the surface. The upper subsoils are slightly lighter and the lower subsoils are light gray to gray. Both surface soil and subsoil have a high lime content. The substratum consists largely of gray stratified highly calcareous fine sand and silt, with a relatively small portion of coarse sand and fine gravel. The Tripp soils are of alluvial origin and occupy high terraces or bench lands along streams above the reach of overflows. They consist of old sediments derived chiefly from the Ogallala and loess formations, modified by colluvial wash and wind-laid material. The topography is comparatively level, but drainage is fairly well established.

The Laurel soils are light brown to gray or light grayish brown, with subsoils of similar or slightly heavier texture but lighter in color, often with a yellowish tinge. Both soil and subsoil contain a high percentage of lime and often alkali. The topography is flat to undulating, but underdrainage is generally good, except occasionally in the heavier types. The Laurel series occurs in first-bottom situations subject to overflow.

In following pages of this report the various soils of Chase County are described in detail and their relation to agriculture discussed. The distribution of the soils is shown on the map accompanying this report. The following table gives the name and the actual and relative extent of each type mapped:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Dunesand	192,512	33.5	Dawes fine sandy loam	13,504	2.3
Rosebud loam	80,768	14.0	Dawes sandy loam	10,432	1.8
Colby very fine sandy loam:			Tripp loam	7,872	1.4
Rolling phase	45,760	10.5	Tripp very fine sandy loam	7,616	1.3
Broken phase	14,400		Valentine loamy fine sand	7,488	1.3
Canyon sandy loam	26,048	4.5	Rosebud silt loam	6,912	1.2
Valentine sandy loam	25,792	4.5	Tripp sandy loam	5,376	0.9
Dawes loam	24,256	4.3	Laurel fine sandy loam	4,736	0.8
Holdrege very fine sandy loam	22,144	3.8	Laurel loam, poorly drained phase	3,456	0.6
Holdrege loam	21,824	3.8	Rosebud sandy loam	3,392	0.6
Valentine loamy sand	17,728	3.1	Scott silty clay	576	0.1
Valentine fine sandy loam	17,280	3.0			
Rosebud fine sandy loam	15,488	2.7	Total	575,360	.....

ROSEBUD SANDY LOAM.

The Rosebud sandy loam is a brown loamy sand to a depth of 10 to 15 inches, underlain by light-gray to almost white, highly calcareous sandy and silty material which passes into the weathered "mortar beds" of the Ogallala formation locally known as "magnesia." Small rounded pebbles, chiefly pinkish in color, usually occur in the subsoil and often in the soil.

The surface soil has been modified by wind action, and for this reason it is apt to vary somewhat. Some areas have a dark-brown surface soil and a heavier upper subsoil. In other areas the depth to the highly calcareous, light-gray subsoil may be more than 15 inches, while in certain patches the so-called "magnesia" may be on or near the surface. There is an abrupt change from the darker top soil to the light-gray or almost white subsoil.

This type occurs mainly in the north-central and central parts of the county, in areas ranging in size from less than 40 acres to 1,000 acres or more. It is frequently encountered close to the sand hills, and much of the material has doubtless been derived from the sand dunes through wind action. The type has a level to gently rolling or slightly hilly topography, which combined with the open nature of the soil tends to promote excessive drainage.

The greater part of the Rosebud sandy loam is in cultivation. The chief crop is corn, but wheat, barley, millet, sorghum, and other crops are grown. Corn and rye do better than wheat, oats, and some other small grains, but yields of all crops average rather low. Corn yields 10 to 18 bushels per acre, averaging about 12½ bushels; wheat, 8 to 10 bushels; barley, 10 to 15 bushels; emmer, 12 to 20 bushels; rye, 10 to 15 bushels; oats, in favorable seasons, 12 to 20 bushels; millet, one-half to 1 ton; and sorghum, 1 to 1½ tons per acre.

In general this is not a good agricultural type, and much of it should remain in pasture. When brought under cultivation the soil is apt to drift, exposing the whitish, calcareous subsoil which lies only a short distance below the surface. The soil is droughty and shallow, but its sandy nature makes it easy to cultivate and the sandy mulch helps to prevent excessive evaporation. The type contains a moderate amount of organic matter, which helps to prevent drifting. The native vegetation consists chiefly of sand grasses or bunch grasses, yucca or soap weed, sagebrush, and a comparatively sparse growth of grama grass and buffalo grass. The type affords better grazing than the Canyon sandy loam, but is not as desirable as the other members of the Rosebud series. Unimproved land of this type is held at $12.50 to $15 an acre. It is usually sold in conjunction with adjoining areas of other types.

ROSEBUD FINE SANDY LOAM.

The surface soil of the Rosebud fine sandy loam is a brown to dark grayish brown very fine sandy loam to fine sandy loam, containing a relatively large proportion of silt. A characteristic feature is the loamy, slight sticky character imparted by the presence of a small quantity of finely divided clay, which gives the soil sufficient adhesiveness to retard removal by the wind, but does not make the surface compact. The subsoil begins at an average depth of 8 inches and consists of a grayish-brown or brown, heavier very fine sandy loam to light loam, which at 15 to 18 inches passes into the light-gray to almost white, highly calcareous fine sandy and silty material of the partially decomposed Ogallala formation.

The type varies somewhat in different localities. In some places the heavier upper subsoil may be nearly or entirely absent, in which case the light-gray, calcareous material may approach so near the surface as seriously to affect the agricultural value of the land, while in other places the whitish material may be encountered at a depth of 2 feet. These variations are due to weathering or wind action, or a combination of these agencies. In places small patches and gravelly knolls or mounds of white, calcareous rock occur, as well as stony ledges exposed by the wind.

The soil of the Rosebud fine sandy loam is loose and mellow, and easily tilled. It has a slight tendency to clod, owing to the clay and other fine material present, but the clods break up readily when the land is properly cultivated. The soil typically contains a fair amount of organic matter and is reasonably retentive of moisture, but the open structure of the subsoil causes the droughtiness characteristic of the Rosebud series. The organic matter helps to prevent drifting by the wind.

The Rosebud fine sandy loam occurs in large areas bordering the large streams or covers the eroded slopes where the High Plains or table lands begin to break toward the valleys. A large and typical area lies near Chase, in the north-central part of the county, and another 4 miles southwest of this place. A third important area is mapped in the southwestern part of T. 5 N., R. 38 W., near Enterprise School. Large areas are encountered south of Enders and northwest of Blanche. The type occupies nearly level to rolling country composed of low hills and ridges, with occasional shallow depressions. In general the slopes are steeper and the surface is more uneven than in the heavy soils of the series, but the topography is favorable for farming and the land is not eroded or gullied to any appreciable extent. The topography and the open character of the lower subsoil allow a relatively rapid loss of moisture, but the sandy surface layer tends to check excessive evaporation and to promote absorption of the rainfall.

Probably 75 per cent of this type is under cultivation, the remainder being in sod. The chief crops grown are corn, wheat, barley, rye, millet, emmer, and sorghum. Crops are apt to suffer severely from lack of moisture in unfavorable seasons, though as a rule the type stands drought quite as well as, or better than, the heavier Rosebud soils. Moderately fair yields are obtained in seasons of normal rainfall. Corn yields 15 to 25 bushels per acre, or even 35 bushels under exceptional conditions. Fall wheat yields 10 to 15 bushels, and occasionally 18 to 22 bushels, per acre; barley 10 to 30 bushels; and emmer 12 to 25 and occasional 35 bushels. Rye is a rather sure crop, yielding 12 to 15, and occasionally 18 to 20 bushels per acre. Millet yields 1 to 1¾ tons per acre, or 15 to 20 bushels of seed; sorghum, 1½ to 2½ tons per acre, occasionally as much as 3 or 4 tons; and oats under favorable circumstances 25 to 30 bushels. Alfalfa has been grown in an experimental way, with varying success. It appears to do well for a time, but may die out during a dry season. One and sometimes two cuttings are obtained, the yield ranging from three-fourths ton to 1½ tons per acre for each cutting. Irish potatoes generally do well and are grown for home use.

The native vegetation on this soil consists of the grasses common to the heavier soils and also certain varieties that thrive on the sandy soils. The heavy areas of the type produce a good growth of grama and buffalo grass. Western wheat grass grows where the sod has been broken. The grasses yield from one-half to three-fourths ton of mixed hay per acre.

The Rosebud fine sandy loam is friable and easy to till. A system of cultivation should be followed which protects the small grains from injury through drifting. The productiveness of the soil should

be maintained by applying manure and by other means. On account of its topography and rather shallow depth this soil is apt to deteriorate rapidly if it is not properly handled and protected from the wind. Land of this type sells for $15 to $20 an acre without improvements, and for $25 to $35 an acre where improved.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Rosebud fine sandy loam:

Mechanical analyses of Rosebud fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
372601	Soil	0.6	3.6	3.5	15.6	38.6	28.6	9.6
372602	Subsurface	.8	4.4	4.0	18.4	34.8	26.6	11.2
372603	Subsoil	1.2	4.2	3.9	18.4	38.4	22.4	11.6

ROSEBUD LOAM.

The Rosebud loam, to 5 or 6 inches, is a brown, friable, mellow loam, underlain to a depth of 8 to 15 inches (usually about 10 inches) by a brown, friable silt loam. This passes rather abruptly into a gray, sandy, and silty product of the partly disintegrated Ogallala formation. The upper part of the subsoil is moderately compact and friable, but the lower part is a loose, floury material. Some small rounded quartzitic and pinkish feldspathic gravel, such as commonly occurs in the other members of this series, is present in the subsoil and frequently in the soil, but much of the type is free from gravel, except in local spots, where it has been brought to the surface usually by burrowing animals. The white subsoil color is due to the large content of lime, but the typical surface soil is only slightly calcareous, seldom effervescing with acid. Only about 18 to 20 inches of the 3-foot section has a structure favorable for the retention of moisture.

The depth of the soil varies from place to place. The heavy upper subsoil layer may be lacking, but a rather abrupt change from the brownish top soil to the lighter colored, highly calcareous subsoil practically always takes place at less than 15 inches. In some areas the subsoil may contain considerable coarse sand and waterworn gravel, together with limestone fragments and lime concretions. The gravel and limestone fragments may be present in such quantity as to form patches an acre or more in size of gravelly loam or sandy loam. There are some small areas, particularly on slopes to drainage ways, on hillsides, or on small knolls, where the underlying light-colored material of the deeper subsoil lies near the surface or is exposed, giving rise to a grayish soil. In such situations the agricultural value of the land is seriously impaired, especially when the

underlying formation is hard rock or is composed largely of frag mentary rock. Where the underlying rock is encountered at 20 inches or less the soil is less productive in dry seasons on account of the lack of storage room for moisture. Disregarding minor local variations the Rosebud loam retains its typical color, texture, and other essential features uniformly over extensive areas.

The Rosebud loam is the most extensive and one of the most uniform agricultural soils in the county, and contains the largest bodies of undeveloped agricultural land. The type is widely distributed over the upland plains and table lands, being most extensively developed in the northwestern section of the county, where it occupies the greater part of several townships.

The topography in most places is nearly level or gently rolling, but parts of the type are somewhat hilly. The larger areas occupy a smooth, undulating plain. The more rolling and hilly areas lie on the eroded slopes along streams.

The entire type has ample surface and under drainage, and in places, owing to the porous lower subsoil and substratum, it is excessively drained. Where drainage channels have not been well established the natural surface relief is sufficient to dispose of the rainfall. Much of the type is traversed by intermittent streams having a general southeasterly trend.

Only about 20 per cent of this soil is under cultivation, the remainder being used for grazing and hay production. The original vegetation included no shrubs or timber, but the surface is thickly covered with nutritious pasture grasses, principally buffalo grass, grama grass, and wire grass. Blackroot grass is common in certain localities, and the poisonous loco weed is occasionally met with. After the sod is broken western wheat grass often appears in old fields in such abundance as to afford excellent hay in connection with the other native grasses. The wheat grass does best in low places where there is likely to be more moisture, and in such favored spots grama grass sometimes attains sufficient height to be cut for hay. The yield of native hay ranges from one-fourth to 1 ton per acre, the average being between one-half and three-fourths ton. The Rosebud loam has a carrying capacity the year round of one cow or steer to 12 or 15 acres, or 40 to 50 head to one square mile of land, except where the grass is injured by an unusual drought. About 5 to 8 acres are required for one cow or steer when the live stock is fed for $2\frac{1}{2}$ to 3 months during the winter.

Yields show wide variation from year to year. The soil seems adapted to small-grain and forage crops. Wheat, barley, millet, and sorghum do exceptionally well in years of normal rainfall. Corn is the most important of the grain crops, followed by wheat, millet,

oats, and barley. Other crops grown include emmer, rye, potatoes, kafir, beans, alfalfa, feterita, milo, and Sudan grass, many of which are grown only in an experimental way. Corn rarely yields more than 20 bushels per acre, and frequently the grain fails to mature properly. The yield ranges from 10 to 35 bushels per acre, averaging about 15 bushels. Winter wheat is being grown more extensively each year. In normal seasons it yields 12 to 15 bushels per acre, and under exceedingly favorable circumstances the yield ranges up to 30 bushels or even more. Spring wheat is not generally as successful as winter wheat; it ordinarily yields 8 to 10 bushels per acre. Millet gives 1 to 2½ tons of hay per acre or 10 to 35 bushels of seed. It is considered a desirable and rather dependable crop for this soil. Barley is another rather certain crop, yielding 10 to 40 bushels per acre, the average being between 20 and 25 bushels. Sorghum ordinarily yields 2 to 3 tons of forage, and occasionally 5 or 6 tons, per acre, and emmer 15 to 25 or even 35 bushels per acre. Kafir forage averages 2 to 3 tons or more per acre. It does not mature seed in this climate. Potatoes yield 50 to 225 bushels per acre, averaging about 75 bushels. Oats often succeed, but are sometimes injured by warm, dry winds or drought. The yield ranges from 8 to 35 bushels per acre, and averages about 22 bushels. Rye yields 12 to 15 bushels. The chief value of rye on the heavy soils lies in making possible a change of crops and in furnishing green feed when nothing else is available. There is some question as to the profitableness of alfalfa. It is apt to die out quickly, but withstands considerable drought if it is well set and rooted. Alfalfa ordinarily yields 1 cutting a season, with an average of 1 ton per acre, but sometimes 2 or 3 cuttings are obtained. Pinto beans were grown on this type this year as an experiment with varying results. Most orchard fruits and forest trees do not succeed, but cherries and gooseberries thrive. Certain varieties of the elm and the honey locust will do well. Cabbage and many other vegetables succeed if supplied with sufficient moisture. The tendency on this soil is to grow less corn and more wheat and forage crops, and to keep more live stock.

In certain places, as on small knolls and elevations, where the whitish calcareous material lies at or near the surface, certain crops, especially corn, are reported to produce reasonably well in moderately dry years, but in very wet seasons the crop turns yellow. The soil here is sandier than typical, and it is probable that the good results obtained in so-called moderately dry years are due to the cooling and moist condition produced by the thin sandy stratum which forms a mulch. In wet years such spots are apt to be too cold.

Sod land of this type is usually broken to a depth of about 4 inches, and as soon as possible thereafter it is disked and worked

over with a harrow or roller, to prevent excessive loss of moisture. The surface is maintained in a lumpy or slightly rough condition to prevent drifting. Under favorable moisture conditions the soil is mellow and easily handled, but after periods of drought it becomes more compact, so that plowing and the preparation of a good seed bed are difficult. For corn the land is disked in the early spring, usually about the 15th of April, in order to kill the weeds and conserve moisture. The corn is listed after disking. The best farmers recommend growing wheat, millet, or sorghum, rather than corn or oats on sod land. Oats appear to thrive much better on old ground. It is not considered a good plan to follow millet with wheat. Many farmers do not advocate much deep plowing, but state that a deeper plowing every 4 or 5 years may prove beneficial. Oats are usually disked and drilled on land previously devoted to corn, on which the stalks still remain. The ground for millet is plowed just before sowing or drilling, in order to destroy the weeds. Lands for millet is seldom disked, on account of weeds.

The sale value of unimproved land of this type ranges from $22 to $30 an acre, depending upon local conditions. Improved land is valued at $35 to $40 an acre. Much of this type has recently changed ownership, and a large proportion is held by nonresident speculators and investors.

The Rosebud loam is classed by the farmers with the "hard lands," or heavy soils. Owing to its high capillarity and the greater difficulty of maintaining a dust mulch to conserve moisture, this type, although it is naturally quite rich in organic matter and lime, and naturally more productive, is not so popular with the farmers as the sandy loams, which are more retentive. The type requires the utmost care in farming to insure success, as it really has a droughty nature, owing to the open structure of its subsoil. It produces best in moderately wet years. Applications of barnyard manure have proved beneficial if made at the proper time. Better tillage methods should be employed for conserving soil moisture, and a better seed bed should be prepared for small grains, even at the expense of decreased acreage in crops if necessary. In order to insure success with corn and other intertilled crops frequent stirring of the surface is necessary. The rolling or hilly areas close to drainage channels should be protected from erosion, as otherwise the shallow soil will eventually be removed and the land will become gullied and unfit for crop production.

In the following table are given the results of mechanical analyses of samples of the soil, subsurface soil, and subsoil of the Rosebud loam:

Mechanical analyses of Rosebud loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
372607	Soil	0.0	3.0	2.0	8.6	39.5	33.6	13.2
372608	Subsurface	.4	1.9	1.6	6.6	30.3	39.7	19.5
372609	Subsoil	.5	1.4	1.3	5.1	41.9	34.4	14.5

ROSEBUD SILT LOAM.

The upper 3 or 4 inches of the Rosebud silt loam is a dark-brown, mellow loam. Below this, to a depth of 8 to 10 inches, the material is a brown, friable silt loam of a rather compact structure. The subsoil consists of a layer, 5 to 8 inches thick, of light-brown to grayish-brown, moderately compact, friable silt loam to silty clay loam, grading abruptly into the weathered, light-gray, highly calcareous material derived from the Ogallala formation. This in many places has a slightly yellowish or yellowish-gray tinge, as is often the case in the lower subsoil of the other Rosebud soils.

The Rosebud silt loam is quite variable, there being no large areas of uniform texture. The type is spotted with small bodies of Rosebud loam, and has some of the characteristics of the Dawes loam. The soil material is deeper over the light-colored calcareous layer, on an average, than in the Rosebud loam, and the soil has a slightly higher agricultural value. Like the other members of the Rosebud series, the silt loam frequently has a small quantity of coarse sand and fine gravel in the subsoil and occasionally a light sprinkling on the surface where the material has been brought up from the distintegrated Ogallala formation by burrowing animals or other agencies.

The Rosebud silt loam is confined almost entirely to the northwestern part of the county, where it is associated with areas of the Rosebud loam, but there is an area of about 600 acres one-half mile south of Champion. Owing to its very limited extent the type is of little or no importance in the agriculture of the county. It has the same topography and drainage conditions as the Rosebud loam, and gives practically the same yields of crops. If it were more extensive and uniform in its occurrence it would have a greater agricultural value than the loam.

The following table gives the results of mechanical analyes of samples of the soil, subsurface, and subsoil of the Rosebud silt loam:

Mechanical analyses of Rosebud silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
372610	Soil	0.7	3.5	2.4	10.8	34.3	33.5	15.0
372611	Subsurface	.2	1.4	1.1	6.9	38.4	34.4	17.8
372612	Subsoil	.2	.9	5.8	5.5	42.9	40.8	8.9

HOLDREGE VERY FINE SANDY LOAM.

The surface soil of the Holdrege very fine sandy loam is a dark-brown, smooth, silty very fine sandy loam. There is usually no well-marked change in texture between the soil and subsoil, but at 12 to 15 inches the material becomes somewhat lighter in color and slightly more compact, and at 20 to 30 inches the subsoil passes into an ashy-gray or pale yellowish gray, highly calcareous, silty very fine sand, of a loose structure. The substratum consists of the light yellowish gray or light buff-colored loess, of great thickness.

There are some minor variations, but the type has a rather uniform texture and color over large areas. On ridges, slopes, or near the borders of the eroded country the subsoil, and frequently the soil, may be lighter in color than in the typical smoother areas. In the flat or nearly level situations the soil is always dark in color, and has the appearance of being heavier than it really is. Here the dark color may extend to a depth of 3 feet or more, varied in places by white particles of calcareous material which give it a speckled appearance. The upper subsoil may occasionally approach a loam in texture, especially near areas of Holdrege loam.

The soil contains sufficient organic matter and fine material to prevent excessive drifting. If it is cultivated when not in the proper moisture condition it may clod to some extent, but the clods readily break down. The soil is easily handled and works into good tilth under proper cultural methods.

The Holdrege very fine sandy loam occurs on the high table lands in the eastern and southeastern parts of the county known as the East and South Divides, and also on the divide east of Stinking Water Creek. It is encountered only in that part of the county occupied by the loess formation, from which it is derived. Most of the type occupies smooth ridges and hills, with gentle slopes, and is gently undulating. Drainage is well established, but little of the type can be said to be excessively drained. The soil conditions and

topographic features are favorable for the accumulation and retention of much of the rainfall.

This is a valuable agricultural type, and the greater part of it is under cultivation. The native vegetation consists largely of a thick covering of nutritious pasture grasses, which include grama grass, buffalo grass, black-root grass, and western wheat grass. The native hay consists largely of western wheat grass, which yields one-half to 1 ton per acre, but it is not considered profitable to produce hay where other crops can be grown. The principal cultivated crops are corn, wheat, barley, forage crops (principally sorghum and millet), and alfalfa. The soil seems well adapted to general farming, and in normal years yields are usually fairly good, although they average lower than on the Holdredge loam. Corn, the chief crop, yields 12 to 25 bushels, and occasionally as much as 35 bushels per acre; wheat, ranking second in importance, yields 9 to 22 bushels; millet, 1 to 1¾ tons; sorghum, 1¼ to 3½ tons; and potatoes, 65 to 135 bushels. Barley is a profitable crop and its acreage is increasing. It yields 8 to 33 bushels per acre and occasionally more. Emmer is grown in a small way, but it is not as profitable as barley and the production is decreasing. Alfalfa is grown in an experimental way. It does not appear profitable on a large scale, but the soil would be suited to alfalfa if there was sufficient moisture. Alfalfa often affords two cuttings, and sometimes three, and yields 1 to 1¾ tons per acre at each cutting. Oats do well in a favorable season, yielding 15 to 35 bushels per acre.

There are a few orchards on this soil, mainly apple, pear, plum, and cherry. The small fruits include strawberries, currants, raspberries, and gooseberries. Cherries and gooseberries seem to do best, but apples are moderately successful. Many orchard fruits have been successfully produced without irrigation when the orchards were cultivated and otherwise received good treatment.

The soil is handled in about the same way as the Holdrege loam. It is easier to handle and it forms and holds a mulch with less cultivation. It is a desirable type, although it is less productive and lacks the lasting qualities of the loam.

Unimproved land of this type sells for $30 to $35 an acre, and improved areas for $40 to $50. Little of the type has recently changed ownership.

The table below gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Holdrege very fine sandy loam:

Mechanical analyses of Holdrege very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
372647	Soil.....	0.0	0.1	0.1	2.4	56.5	31.7	9.2
372648	Subsoil.....	.0	.1	.0	2.2	60.4	28.0	9.4
372649	Lower subsoil...	.0	.0	.0	1.5	53.4	31.6	13.6

HOLDREGE LOAM.

The Holdrege loam consists of a dark-brown, friable, mellow loam, 10 to 12 inches deep, underlain by a brown to dark-brown, moderately compact, friable silt loam or sometimes silty clay loam, changing at 22 to 36 inches into a dark ashy gray or pale yellowish gray, lighter textured material. The material in this lower horizon is speckled with white carbonate of lime particles, giving it a splotched appearance. Below 3 feet there is a gradual change to the pale-yellow or light yellowish gray, partly decomposed loess. The soil has a high content of organic matter.

There is a constant variation in texture, from silt loam to very fine sandy loam. The typical soil is intermediate between the two extremes, but in the field it is very difficult to define the boundaries between the textures, and for that reason they have not been separated. It is probable that a large part of the type would show by analysis sufficient very fine sand to justify its classification as a very fine sandy loam. The sand everywhere is of an exceedingly fine grade, and there is little or no coarse sand. This, together with the high silt content, gives such a silty, smooth texture that a fine distinction in texture is not of any great importance. This is another reason for not attempting a more detailed classification.

Over the more level parts of the divides covered by the Holdrege loam there are a few small depressions which are now or formerly were inundated in wet seasons. Here the soil is darker and usually heavier in texture, and the upper subsoil may be a compact, heavy clay loam or even clay, of a nearly black color. The light buff colored, mealy, highly calcareous weathered loess here is not encountered within the 3-foot soil profile. Where the heavy stratum is very hard and compact and rather tough it is called "hardpan" by the farmers, but it rarely affects the agricultural value of the land except in the extremely low wet places, where the soil has many of the characteristics of the Scott silty clay. The Holdrege loam includes a few small, scattered areas of well-defined Holdrege very fine sandy loam, which are not of sufficient size to indicate on the map.

The Holdrege loam occupies the table lands in the eastern and southeastern parts of the county, known as "the divides." The

topography in most places varies from level to gently rolling, but over part of the type erosion has made the land more or less hilly. Drainage is well established, although the watercourses are in the initial stage of development.

This is an important agricultural type. All of it is under cultivation. In its original state the soil was covered by a thick growth of the valuable grama, buffalo, and other short grasses. The western wheat grass often grows thick enough to be cut for hay in low places and on old fields, yielding one-half to 1 ton per acre. No trees originally grew on the type, but honey locust, black locust, elm, box elder, ash, and several other trees have been planted around many of the farmhouses.

Wheat and corn are the principal crops on this type, but barley, oats, millet, and sorghum are also important. The small grains and forage crops are better adapted to the soil than corn, and their acreage is increasing. They do exceptionally well in years of normal rainfall. If there is adequate precipitation before June 1 good yields of the small grains are assured. There are a few orchards of cherries, apples, peaches, pears, and plums. Gooseberries thrive, but strawberries and most other berry crops can not be produced successfully except where the land is irrigated. Cherries do exceptionally well, but apples are only moderately successful, and other tree fruits are even less well suited to the prevailing climatic conditions. A few farmers have small patches of alfalfa. This crop seems to succeed best where it is drilled in and cultivated. It thrives better in the low-lying positions where there is likely to be more moisture than elsewhere but these low places must not be too wet. Alfalfa is reported to be profitable if grown in a small way. Some difficulty is usually experienced in obtaining a good stand, though after the crop is once started it often does quite well for a long period. It frequently yields 1¼ to 2¼ tons per acre, in 1 or 2, and rarely 3, cuttings.

Winter wheat, the most profitable crop, yields 10 to 35 bushels per acre. The average yield of spring wheat is less than that of winter wheat. Corn yields 15 to 25 bushels, and occasionally as much as 40 or 50 bushels, per acre; barley 8 to 40 bushels or more, oats 15 to 45 bushels, sorghum 1½ to 7 tons of forage, averaging about 2¾ tons, and millet 1 to 2½ tons. Where grown for seed millet yields 10 to 35 bushels per acre. Potatoes are grown for home use and do well under favorable conditions. The better farmers obtain yields of 85 to 165 bushels per acre, and occasional yields are as much as 235 bushels.

Owing to its smooth topography and friable, silty character, this soil is very easily handled under a wide range of moisture conditions. Where the land is disked before listing for corn it withstands drought well, but it is often plowed rather than disked, as it is not subject

to drifting. Little barnyard manure is used, and the cultural methods are practically the same as on the other heavy upland types. The most careful farmers harrow the land after each day's plowing, in order to hold the moisture. The Holdrege loam is considered the best heavy soil of the upland. Land without improvements is valued at $35 to $40 an acre, and little is for sale. Improved farms sell for $50 to $75 an acre. Few sales have been made in recent years, and most of the type is in possession of resident owners.

The Holdrege loam is a strong, productive soil. Under proper cultural methods it will give good yields indefinitely, but provision should be made for keeping up the productiveness. A rotation should be followed which includes summer tillage, and an intertilled crop, like corn, should be grown between the crops of small grain. Although there is no immediate need for more organic matter, the organic content of the soil should not be allowed to decrease. The supply may be maintained by the use of barnyard manure or the plowing under of green vegetation. When a crop is to be seeded in the fall the soil should be frequently stirred until it is seeded, in order to store and conserve all available moisture. The surface should be broken after each soaking rain. The seed bed should always be firm when the seed is sown. The soil can be cultivated as frequently as necessary, since there is little danger of drifting, and it requires a deeper mulch than the sandy types. Plowing gives better results than disking, as it makes the soil looser and therefore more retentive, allows heat, air, and water to penetrate deeper, and also tends to free the surface of weeds. If the soil is dry and there is danger from drifting, it is best to leave the surface slightly rough.

In the following table are given the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Holdrege loam:

Mechanical analyses of Holdrege loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
372650	Soil	0.0	0.0	0.0	1.8	47.4	40.4	10.5
372651	Subsoil	.0	.0	.0	2.1	49.2	34.2	14.5
372652	Lower subsoil	.0	.0	.0	2.6	41.7	39.0	16.9

COLBY VERY FINE SANDY LOAM, ROLLING PHASE.

The Colby very fine sandy loam, rolling phase, consists of an ashy-gray or brownish-gray, calcareous, loamy very fine sand, underlain at 6 to 8 inches by a highly calcareous, pale yellowish-gray or light-buff, silty very fine sand. This has a smooth feel and an open,

friable structure, and grades downward into the unweathered parent loess.

The soil occurs on the smoother slopes from the valleys and plains to the high table-lands known as the East and South Divides, and also on the divide east of Stinking Water Creek. It is derived from the loess formation and is therefore confined to the southeastern and eastern parts of the county.

The topography is rolling to hilly, though not as rough as that of the Colby very fine sandy loam, broken phase. The rolling phase is cut by numerous intermittent streams which have deep, V-shaped valleys in their lower parts, and drainage is excessive, especially near the drainage ways and on the steep slopes.

This soil has the same native vegetation as the broken phase of the Colby very fine sandy loam, but the grass covering is thicker and it represents a better grade of pasture land. Only a small percentage of it is in cultivation. The same crops are grown as on the Holdrege very fine sandy loam, but the average yields are considerably less. The topography and soil conditions are not favorable for farming, and the soil should be used for grazing.

Land of this character is valued at $10 to $12 an acre. It is sold in connection with adjoining soils.

COLBY VERY FINE SANDY LOAM, BROKEN PHASE.

Areas of badly eroded stream slopes and bluffs of the divide in the eastern part of the county, occupied by the loess formation, are mapped as the Colby very fine sandy loam, broken phase. The type consists of a surface soil of gray, silty very fine sand, underlain at an average depth of less than 5 inches by a pale-yellow or light yellowish gray, silty very fine sand, which quickly grades into the unweathered loose, floury, loess material. Both soil and subsoil are highly calcareous. Lime carbonate, clay, and organic matter tend to bind the soil and check erosion to a marked extent.

The topography of this soil is rolling to rough and hilly, with numerous steep slopes and often precipitous bluffs. In places there is a close approach to true bad-land topography. All parts of the type are dissected by intermittent streams, which have deep V-shaped valleys in their lower courses.

The surface is too rough and easily eroded for farming. The only tillable areas are composed of small patches of other types too small to separate on the map. The land is used only for grazing.

Where erosion has been severe the ravines and buttes are almost bare, or covered only with a sparse growth of pasture grasses and shrubs. Much of its area, however, is covered with a good growth of excellent grasses, including grama grass, buffalo grass, and black-

root grass. Important among less well-known grasses are Prairie June grass (*Koeleria cristata*), a species of bunch grass; Dogtown grass (*Aristida longiseta*); and little bluestem (*Andropogon scoparius*). The other native vegetation consists chiefly of sagebrush and yucca. There is no timber. Loco weed occurs in places. The narrow, secluded bottoms of some of the numerous ravines and small hollows furnish native hay. The blackroot grass is a valuable species. It has an extensive, highly developed root system which enables it to bind the soil particles together, and it is thus instrumental in helping to prevent wash of the surface soil. The roots of this grass often mat the surface in places, and in eroded spots they can frequently be observed holding tenaciously to the soil. The blackroot grass is very nutritious and is relished by all kinds of stock. It is one of the earliest of the spring grasses.

The Colby very fine sandy loam, broken phase, is devoted exclusively to pasture. It is well adapted to stock raising in connection with the areas of more level prairie, as the draws and canyons afford protection for the cattle during the winter and the grass on the slopes furnishes pasturage during the greater part of the year. Twelve to twenty acres is considered sufficient for one horse or cow, but if the grass is supplemented by feed during the winter months only 7 to 10 acres is required for each animal.

This land sells for $6.50 to $8 or $10 an acre. Ranches which have good farm buildings, fences, and other improvements are valued at $12 to $25 an acre.

The continued use of this land depends upon the preservation of the native grasses. The owners realize this and guard against destructive fires and too close grazing.

VALENTINE LOAMY SAND.

The surface soil of the Valentine loamy sand is a brown to dark-brown loose, loamy sand 8 to 15 inches deep. The subsoil is a loose sand of about the same texture as the surface soil, brown in the upper part but changing to light brown or yellowish brown in the lower part. The sand grains are composed largely of quartz and feldspar.

Areas of this type lie in the basins and valleys of the sandhills, usually in the higher parts of these depressions where the surface is more uneven. It is best developed in the southwestern part of the county. The surface is level to undulating, broken by small ridges and knolls composed of sand brought down from the dunes. There is no run-off, the rainfall sinking into the porous soil.

Most of the type is used as pasture and hay land. The native vegetation consists of needle grass, bunch grass, sand grasses, and sagebrush. The surface is generally favorable for farming, and

the type is classed as a possible agricultural soil, but it has a low crop value owing to its open structure and its tendency to drift when cultivated. Small areas are tilled in depressions and valleys where the moisture conditions are likely to be most favorable. The principal crop is corn, but rye is frequently grown. Corn yields 10 to 15 bushels per acre, and occasionally more on new ground. Rye (which is about the only small grain that can be grown successfully) yields 8 to 12 bushels per acre. The type is capable of supporting 30 to 40 head of cattle per square mile. The land sells for $10 to $12 an acre.

In cultivating this type great care must be taken to keep the soil from drifting. It should be cultivated no more than is necessary to control the weeds. Most of the type should remain in pasture. When cultivated the soil is likely to deteriorate rapidly under the prevailing methods of farming. It is deficient in organic matter and also in lime.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Valentine loamy sand:

Mechanical analyses of Valentine loamy sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
372634	Soil	0.8	10.6	11.3	50.5	19.3	4.1	3.3
372635	Subsoil	.4	9.1	10.6	54.4	18.6	3.6	3.4

VALENTINE LOAMY FINE SAND.

The Valentine loamy fine sand consists of a brown to dark-brown, loose, loamy fine sand, 10 to 15 inches deep, underlain by a brown, loamy fine sand of moderately loose structure, which changes at a depth of 20 to 30 inches to a loose, light-brown or light yellowish brown fine sand. The surface soil contains considerable organic matter, but is deficient in lime. The sand grains consist of feldspar and quartz, the former giving the soil its distinctive color.

This soil is developed in the valleys and depressions of the sand-hills in the northeastern part of the county. It is everywhere associated with the sand dunes, and much of the soil material has been derived from that source by wind deposition. The type has a flat to gentle undulating surface, occasionally broken by low hills and ridges. It occupies irregular depressions and long, narrow valleys that evidently represent restricted stream channels. The rainfall sinks into the porous soil and is carried away through underground channels.

This type is intermediate in agricultural value between the Valentine loamy sand and fine sandy loam. Much of it can be successfully farmed, but the type is subject to drifting when cultivated and for this reason a large part of it is used as pasture and hay land. About 60 per cent of the type is under cultivation. In the low parts of certain valleys and depressions crops can often obtain considerable moisture through seepage. This soil does not retain as much moisture as the fine sandy loam, owing to its more open structure.

The native vegetation consists chiefly of bunch grass, various sand grasses, needle grass (a species of stipa), and sagebrush. Some grama grass also occurs in places. Hay yields from one-fourth to nearly 1 ton per acre, depending upon the rainfall. Corn is the principal cultivated crop, followed by wheat, millet, rye, sorghum, and potatoes. The soil seems better adapted to corn and rye than to other grains. There are a few patches of alfalfa on this type. Alfalfa is somewhat difficult to start, but good stands yield from three-fourths to 1¼ tons per acre. Corn usually yields 12 to 18 bushels per acre, rye 12 to 15 bushels, and potatoes 50 to 65 bushels. Yields are generally lighter than on the heavier soils.

In the cultivation of this type every means should be used to keep the soil from drifting and to increase the amount of organic matter.

VALENTINE SANDY LOAM.

The Valentine sandy loam, to a depth of 10 to 15 inches, is a dark-brown loamy sand or sandy loam containing a large quantity of organic matter. The soil has a grayish-brown appearance when thoroughly dry. The subsoil is a brown or dark-brown loamy sand or sandy loam of a rather open, friable structure, but having a sticky or heavy layer in its upper part which gives way to a light yellowish brown, loose sand in the lower part of the 3-foot section.

This soil occurs in the valleys and basins of the sandhills or along their borders, and is largely confined to the north-central, central, and southwestern parts of the county. It occupies low, gently undulating hills and ridges with intervening shallow depressions. The topography is favorable for the accumulation of moisture, but the type has good drainage, owing in part to the open structure of the subsoil and in part to the rolling surface.

The Valentine sandy loam is the most extensive sandy loam type of the uplands. It is a good agricultural soil, and practically all of it is under cultivation. The native vegetation includes sand grasses, needle grass, bunch grass, some grama and buffalo grass, sagebrush, and yucca. On old fields western wheat grass often grows in such abundance as to furnish one-fourth to one-half ton of hay per acre. Fair yields of corn, sorghum, and other crops are obtained in normal

years, and total crop failures rarely occur. As a rule, small grains, except rye, are not as successful as corn and sorghum. Millet, wheat, barley, and oats do not give nearly as good results as on the heavy soils. Corn yields 12 to 35 bushels, averaging 16 bushels, per acre; rye 8 to 20 bushels, wheat 8 to 15 bushels, millet one-half to 1 ton, and sorghum 1½ to 3 tons per acre. Oats yield moderately well in normal seasons. Potatoes in favorable years yield 75 to 125 bushels or more per acre. Alfalfa in the few small experimental patches yields three-fourths ton to 2¼ tons per acre. The crop appears to succeed under favorable conditions, but it is often difficult to secure a good stand. There are a few small experimental patches of Sudan grass on this soil.

The farming methods on this type are practically the same as on the other upland sandy loams. Weeds are not as troublesome as on the heavy lands, and the soil is stirred as little as possible, in order to prevent drifting. The more rolling areas are at times subject to damaging wind erosion, and require considerable care in cultivation. The loose, porous structure of the soil permits the rainfall to enter readily and makes it easy to keep the soil in condition to retain moisture. The type is naturally productive and it is only necessary to conserve the organic content and to prevent drifting to keep it so. The productiveness of some areas has decreased greatly through poor farming by tenants.

Land without improvements is valued at $20 to $25 an acre, and improved areas at $30 to $35.

VALENTINE FINE SANDY LOAM.

The surface soil of the Valentine fine sandy loam consists of a brown to dark-brown fine sandy loam rich in organic matter, containing sufficient clay to prevent excessive drifting and to cause a sticky structure. The soil at a depth of 10 to 16 inches is underlain by a dark-brown, moderately compact, friable light loam to heavy loam, which passes at 20 to 30 inches into a brown or yellowish-brown fine sand of rather open structure. The soil contains a large proportion of feldspar, which weathers rapidly, and much of the fine material in the type is derived from this source.

In its essential features this soil is uniform over its entire area. The loam layer of the upper subsoil is occasionally displaced by a heavy, silty very fine sandy loam, and sometimes the dark-brown color extends to a depth of 3 feet or more, especially in low-lying areas where the topography is flat or nearly flat.

The Valentine fine sandy loam occurs in the valleys and basinlike depressions in the sand-hills section of the county. It is always closely associated with the sand dunes, from which much of the ma-

terial has been derived. The type is found in irregular bodies varying greatly in size. The largest, about 3,200 acres in extent, occurs in a valley in the northeastern part of the county, 2½ miles south of Blanche School. Another typical one is located 1 mile west of Imperial.

The type occupies low, smooth ridges and hills with intervening shallow depressions. The topography is usually not as rolling as that of the Valentine sandy loam, and in places the surface is rather level. The type is thoroughly, but not excessively, drained. It lies well for the retention of moisture and practically all the rainfall is immediately absorbed. Its position has favored the accumulation of more organic matter than is found in the more sandy soils of this region.

This is an important agricultural type, all of it being under cultivation. Its texture is particularly suited to farming under the local climatic conditions. The original vegetation included a luxuriant growth of sand grass, bunch grass, needle grass, grama grass, buffalo grass, and a scattering growth of sagebrush and occasionally of yucca. The principal crops grown are corn and forage. Wheat, barley, and other small grains do fairly well under good cultural methods. Corn yields vary widely, ranging in different seasons from 12 to 40 bushels per acre. Winter wheat yields 9 to 25 bushels per acre, and averages 16 bushels. Spring wheat gives lower yields than winter wheat. Oats yield well in normal seasons, but on an average they are not as profitable as barley or wheat, owing to damage by lack of rain at heading time. Emmer yields 12 to 23 bushels, rye 12 to 22 bushels, and potatoes 65 to 150 bushels per acre. Barley gives fair yields. The yield of potatoes is satisfactory, but the crop is grown only for home use. Millet and sorghum are the important forage crops, the former yielding 1 to 1½ tons and the latter 2 to 5 tons per acre. Alfalfa is grown in a small way only. It yields 1¼ to 2½ tons per acre at each cutting.

This soil is less subject to drifting than the Valentine sandy loam, but nevertheless it is only cultivated sufficiently to destroy the weeds and work up a surface mulch. It is handled in about the same way as the other fine sandy loams of the uplands. Care is necessary to grow the small grains successfully.

Land of the Valentine fine sandy loam sells for $25 to $30 an acre. Little of it changes hands. Improved farms are valued at $35 to $50 an acre, depending upon the improvements, nearness to towns, and other conditions.

Some small areas of Valentine loam are included with this type. The soil to a depth of 10 to 12 inches is a brown to dark-brown, friable loam. The upper subsoil is a brown heavy loam or silt loam. Below 30 or 40 inches the lower subsoil is a light-brown or grayish-

brown silt loam or loam. This soil occupies a few small flattish depressions in the central upland part of the county, usually at the head of drainage ways. The largest area, about 160 acres in extent, is situated 3 miles northeast of Imperial. The loam type covers less than a thousand acres, and is of little importance. It is adapted to the same crops and has about the same agricultural value as the Dawes loam.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Valentine fine sandy loam:

Mechanical analyses of Valentine fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
372640	Soil	0.2	2.7	5.3	45.5	29.3	11.6	5.4
372641	Subsoil	.1	1.9	2.7	33.6	33.8	19.8	7.9
372642	Lower subsoil	.4	4.1	4.1	38.2	31.3	15.8	6.2

CANYON SANDY LOAM.

The soil of the Canyon sandy loam varies from brown loamy very fine sand to fine sandy loam. It has a grayish shade in some places where it contains considerable limestone material from the slopes above. The subsoil begins at 12 to 15 inches and consists of a grayish-brown or gray to almost white, loamy very fine sand or fine sand to fine sandy loam, sometimes containing a heavy, moderately compact layer. The lower subsoil is usually flourlike and loose, and frequently there is no textural difference between it and the soil. The surface soil is moderately rich in lime and the subsoil is highly calcareous, often being specked with gray or white lime particles. The subsoil and in many places the soil contain considerable waterworn gravel and limestone fragments derived from the Ogallala formation, which outcrops on the higher lying slopes.

This type varies widely, and there are no large uniform areas. It occurs along the lower slopes between the upland and the alluvial terraces of Spring Creek and Sand Creek, and on the slopes to some of the other streams. It has a hilly surface, and the slopes are subject to rapid erosion. In some places the calcareous rocks are exposed or have even been broken up and scattered over the surface.

Very little of this soil is cultivated. Corn and sorghum are the principal crops. The type supports a growth of native grasses including buffalo grass, grama grass, and western wheat grass, and is largely used for pasture.

As mapped, the Canyon sandy loam includes some areas of a coarser soil, which if more extensive would be mapped separately as a gravelly sandy loam. This soil consists of 6 to 15 inches of grayish-brown to brown loamy sand or sandy loam, underlain by the partly weathered, light-gray to almost white sandy and silty material of the Ogallala formation. The soil and subsoil material contain angular white limestone fragments and usually small, waterworn gravel, mainly of a pinkish color. The principal areas of this soil form strips on the slopes to the Frenchman Creek, Sand Creek, Spring Creek, Stinking Water Creek, and their tributaries. It also occupies isolated knolls and low ridges in the more level parts of the county. It has a rolling to hilly surface, often occupying steep, winding ridges and deep valley slopes cut across by numerous intermittent streams. Owing to the gravelly, porous structure, this soil is droughty and unsuited to agriculture. Much of it affords good grazing, as there is a fairly thick growth of grama, buffalo, blackroot, and other grasses. Blackroot grass produces a heavy, matted growth of roots, making a tough and durable sod which helps to prevent excessive wash. Bunch grass, several varieties of sand grass, yucca or "soapweed," and sagebrush are found on the sandier knolls and in other sandy areas. From 12 to 20 acres of this land are required to support one cow or steer.

Some areas of a lighter color, excessively stony soil are intermingled with the gravelly sandy loam. The soil is shallower and rockier than typical, and even less desirable.

SCOTT SILTY CLAY.

The Scott silty clay consists of 8 to 10 inches of dark-brown to almost black, compact silty clay, underlain by a dull-brown to nearly black, tough silty clay. Both the soil and the upper subsoil are sticky and plastic when wet and hard and brittle when dry. In a dry condition the materials have a pronounced slate or bluish-gray shade. The subsoil at about 30 inches becomes grayer in color and lighter in texture, and in most places contains layers or streaks of sandy material. The lower subsoil is mottled with yellow and rusty brown. Where its upper stratum is thick the subsoil in many places shows no appreciable change in color or texture to a depth of 3 feet or more. The upper subsoil and surface soil are so very compact as to be almost impervious. The type is locally known as "gumbo."

The Scott silty clay is quite uniform in texture, particularly in the large areas. The smaller areas sometimes have a silty clay loam surface soil, and near sandy soils there may be some sandy material on the surface.

This type occurs in the sinklike depressions or so-called lagoons, widely distributed over the upland, principally in the northwestern and central parts of the county. The areas range in size from 1 to 2 to about 30 acres, and many are too small to be shown on the map.

After heavy rains water may stand on the surface for a few days or even for weeks, and the type is of little agricultural value at present. A few of the better drained areas are devoted to corn and forage crops in favorable years, but the type can best be used for grazing and hay production, as it supports a thick growth of native grasses and weeds. In areas where water stands a large part of the year the vegetation consists of sedges, marsh grasses, and other water-loving plants. Smartweed is a characteristic growth. Western wheat grass flourishes where the ground is not too wet and is kept free from weeds. Weeds are difficult to eradicate on this type, and largely on this account the hay is of inferior quality and the yield rather poor, usually ranging from about one-fourth to three-fourths ton per acre.

Land of the Scott silty clay is sold with adjoining soil types, and is valued at $7 to $8 an acre.

The Scott silty clay could be farmed to the staple crops if adequate drainage were provided, but this would not be profitable at present on most of it. After drainage the soil would require special treatment, as it is too compact in its natural state. Barnyard manure and other forms of organic matter should be applied prior to cultivation, and light applications of lime might prove beneficial. Some farmers report that alfalfa can be grown if the land is drained and handled properly. It has been suggested that the land might possibly be drained by digging into the porous gravel beds, which underlie much of the type at no great distance below the surface.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Scott silty clay:

Mechanical analyses of Scott silty clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
372631	Soil	0.0	0.8	0.6	7.4	27.0	28.1	36.3
372632	Subsoil	.4	2.0	1.3	13.9	28.6	23.7	30.2
372633	Lower subsoil	.4	1.3	.7	8.0	26.0	31.0	32.8

DAWES SANDY LOAM.

The Dawes sandy loam is a dark-brown loamy sand to sandy loam, underlain at 10 to 18 inches by a light brown to brown, slightly compact layer from 5 to 15 inches thick, ranging in texture from a heavy sandy loam to a light loam. The subsoil at a depth of 20 to 30 inches

grades into a gray, and finally almost white, material which varies in texture from very fine sandy loam or loam to silty and fine sandy clay. This lower stratum is strongly calcareous and in most places of chalklike texture, though in a few places it is fine sand or sand.

The type varies considerably in depth, even within single fields. Occasionally the calcareous, gray lower subsoil lies near the surface, as in the other members of the series. The heavy or sticky layer in the subsoil is practically everywhere present, but it varies greatly in thickness within short distances.

The Dawes sandy loam is typically developed on low, gently rolling hills and ridges and in the basinlike or valleylike depressions of the sand-hills, occupying irregular shaped areas which range in size from 20 to 1,500 acres or more. Areas are most numerous and most typical in the southwestern part of the county, where they form relatively narrow strips with a northwest-southeast trend. The three largest areas lie in the extreme southwestern part of the county, near Best, Earl School, and Valley School, respectively. Some areas exist on the level table lands where there is no suggestion of a valley or depression, but such areas are always closely associated with sand dunes.

The Dawes sandy loam is considered a fairly good type for dry farming, and moderate yields are obtained under proper cultural methods. About 80 per cent of the type is under cultivation, and it is of considerable local importance. The most profitable crops are corn and sorghum. The type is better adapted to corn than to such small grains as wheat, oats, and barley, but potatoes, rye, and certain vegetables do well. Corn has proved profitable, but wheat does not do so well on account of the drifting of the sand. Oats are not nearly as profitable as corn, and they do not withstand drought as well as the other small grains. In favorable years corn yields 15 to 25 or even 35 bushels per acre, rye 12 to 15 bushels, and emmer 12 to 25 bushels, potatoes 65 to 85 bushels, sorghum 1½ to 2 or even 4 tons, millet one-fourth to three-fourths ton. There are a few good patches of alfalfa, especially in the southwestern part of the county, where the water table in the valleys is reported to be at a depth of only 10 to 25 feet. Alfalfa yields 1 or 2 and sometimes 3 cuttings a season, averaging 1½ to 2 tons per acre. Yields vary widely from year to year, but there are fewer crop failures on the better areas of this type than on the heavy upland soils.

The Dawes sandy loam has a texture well suited to cultivation under the prevailing climatic conditions. Its loose, open structure permits the rainfall to enter and makes it easy to keep the soil in condition to retain moisture. The type withstands drought reasonably well, though not so well as the Dawes and Valentine fine sandy

loams. Deep plowing is not necessary, as the soil often needs to be compacted rather than loosened, especially for small grains. The surface is apt to drift badly unless it is left rough and the rows run at right angles to the prevailing winds. If the weeds are destroyed there is generally sufficient shifting of the surface material to form a mulch, so that frequent cultivation is not as necessary as on the heavy soils. The productiveness of rolling areas of this type could easily be destroyed through careless farming methods.

Land of the Dawes sandy loam sells for $20 to $25 an acre without improvements, and for $30 to $35 an acre where improved.

Some areas of loamy sand are included with this type, consisting of a brown or dark-brown, loamy fine to medium sand. In all respects, except texture, this soil does not differ from the sandy loam type. It covers less than 1,000 acres. The largest and most typical area is situated 3 miles north of Imperial.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Dawes sandy loam:

Mechanical analyses of Dawes sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
372618.....	Soil.....	0.2	3.2	6.1	50.1	27.2	8.4	4.8
372619.....	Subsoil.....	.2	4.1	5.2	41.3	30.4	10.6	8.2
372620.....	Lower subsoil...	.0	1.5	1.8	14.8	30.4	31.2	20.2

DAWES FINE SANDY LOAM.

The soil of the Dawes fine sandy loam is a dark-brown, very fine sandy loam to fine sandy loam, containing sufficient clay to become slightly sticky when wet. The subsoil begins at 8 to 15 inches and consists of a brown, friable moderately compact light loam to heavy loam, underlain at 20 to 30 inches by gray, strongly calcareous material, which ranges in texture from a very fine sand to a loam. This lower subsoil is chalkylike when dry, and in that state it has a yellowish-brown tinge on fractured surfaces.

This soil contains a large amount of organic matter, especially in low-lying areas. Here the dark color may extend to more than the average depth, and the upper subsoil may be almost black. The type often remains quite uniform in color, texture, and structure over large areas, but occasionally the highly calcareous, gray lower subsoil material approaches close to the surface, as in other members of the Dawes series.

The Dawes fine sandy loam occurs in irregular bodies in low-lying areas or valleylike depressions associated with the sand hills or

on flat table-lands or divides. A large and typical area occurs in the northeastern part of the county, 1 mile west of Blanche Church, and other large areas are mapped 2 miles southwest of Champion.

The type has a level to gently rolling surface. It occupies low hills and ridges, as well as depressions. The type, however, is well drained, even in the depressed areas, owing to the loose structure of the soil and the moderately open structure of the subsoil.

This is a good agricultural type, on account of the reasonable certainty of crop yields and the ease with which it can be handled. Probably 95 per cent of it is under cultivation. The leading crops are corn, wheat, barley, millet, and sorghum. Oats, emmer, rye, kafir, potatoes, and alfalfa are grown to some extent. The soil seems well adapted to corn and forage crops, and wheat, barley, millet, sorghum, and rye also do well. Yields are intermediate between those obtained on the Dawes sandy loam and the Valentine fine sandy loam. Corn ordinarily yields from 12 to 25 bushels per acre; wheat, 8 to 15 bushels; barley, 10 to 40 bushels; emmer, 12 to 40 bushels; rye, 12 to 15 bushels; potatoes, 65 to 125 bushels; millet, 1 to 2 tons of hay; sorghum, 2 to 5 tons; and kafir, about 2½ tons. Oats in some years do very well, but they often fail to head properly. They sometimes yield 22 to 30 bushels per acre. Alfalfa, which is grown in a small way, gives one or two and occasionally three cuttings, each cutting yielding 1 to 1½ tons per acre.

Farming methods on this soil are about the same as on the other upland fine sandy loams. There is less danger of drifting than on the sandy loams and loamy sands, and the soil can be worked under a wide range of moisture conditions. Little attention is paid to crop rotation, and in many cases corn has been grown continuously for 10 or 15 years or more. On some farms yields have gradually decreased through overcropping and careless farming methods.

Land of this type is valued at $20 to $30 an acre where unimproved. Farms with improvements are held at about $35 an acre.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Dawes fine sandy loam:

Mechanical analyses of Dawes fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
372615	Soil	0.2	1.9	1.5	19.0	59.0	12.3	6.2
372616	Subsoil	.1	1.5	1.0	14.0	53.1	22.7	7.6
372617	Lower subsoil	.1	1.4	1.0	8.6	60.4	20.5	8.2

DAWES LOAM.

The Dawes loam to a depth of 6 to 10 inches is a mellow, friable, brown to dark-brown loam, usually the latter, which is the color distinguishing the Dawes soils from the Rosebud soils, which generally are of a lighter shade of brown. The surface soil is relatively high in organic matter. In places it contains a small admixture of fine rounded quartz and feldspar gravel, which usually has been brought to the surface by burrowing animals. The upper subsoil consists of a moderately compact, friable, dark-brown to almost black silt loam to silty clay loam, grading at 20 to 30 inches into a light-gray to almost white, highly calcareous fine sandy and silty material. In many places, especially in depressions which have been influenced by wash from the surrounding slopes, the material in this lower horizon is a silty and fine sandy loam or clay, in which case it is chalklike when dry. The lower subsoil usually contains considerable fine gravel, and sometimes there is also a small quantity in the upper subsoil.

The Dawes loam is quite uniform over large areas. The thickness of the heavy layer in the upper subsoil may vary within short distances, but the average depth to the white calcareous structure is much greater than in the Rosebud loam. The upper subsoil is generally quite heavy and compact as compared with that of the Rosebud type. In the deeper depressions, where the soil and upper subsoil are dark colored, the latter is often tough and compact, in contrast to its typically friable and moderately compact structure with little or no tendency toward a hardpan.

In some places the soil varies from typical in having a silt loam texture and compact structure. This heavier soil usually occurs in small areas ranging in size from 40 to 160 acres, but a tract of about 750 acres is situated about one-half mile southwest of Lamar. A typical area lies 4 miles north of Lamar.

The Dawes loam is distributed over the higher parts of the upland plains or tablelands and sometimes in the sandhill basins, in areas ranging in size from a few acres up to 4 or 5 square miles. The largest area lies near Imperial, in the central part of the county. Another large and typical area is mapped 4 miles southeast of Champion, near the Champion Valley Lutheran Church, in T. 5 N., R. 39 W. A typical area occupying a sandhill basin occurs in the northwestern part of T. 8 N., R. 38 W. Numerous areas are encountered in the northwestern part of the county in what is known as the Lamar country.

The Dawes loam occupies flat to gently undulating situations where the drainage ways are in their initial stage of development. The nearly level surface favors the retention of the rainfall, giving the

soil a slight advantage over the members of the Rosebud series. The smooth surface also is favorable for an extensive system of farming.

The type is well adapted to agriculture under the prevailing climatic conditions. Practically all of it is under cultivation. The soil is better adapted to small grain and forage crops than to corn. Wheat, barley, millet, and sorghum do exceptionally well. Corn is still the leading crop, but the tendency is to produce less corn and more small grains and forage. Fair yields are obtained in seasons of normal rainfall, corn yielding 14 to 35 bushels per acre, winter wheat 10 to 30 bushels, spring wheat somewhat less than winter wheat, barley 15 to 40 or 50 bushels, and millet 1 to 2¼ tons of hay or 25 to 40 bushels of seed. Oats do well but are sometimes injured by drought and warm winds at heading time. Yields range from 10 to 40 bushels, averaging about 22 bushels, per acre. Sorghum and kafir produce heavy yields, but kafir does not mature seed in this climate. Sorghum yields from 2 or 3 tons to occasionally 6 or 7 tons per acre, but the average is about 2½ tons per acre and 20 to 25 bushels of seed. Kafir produces about the same amount of forage as sorghum. Emmer is grown to some extent, giving slightly lower yields than barley. Potatoes and other vegetables do well when supplied with sufficient moisture. Potatoes generally yield 75 to 125 bushels per acre, and in some years as much as 225 bushels has been obtained. Alfalfa is grown on a few experimental patches. It affords one and occasionally two or three cuttings a season, with an average yield per cutting of 1 to 1¾ tons per acre. There is a difference of opinion as to the profitableness of this crop. The areas of deeper soil seem to grow alfalfa successfully in normal seasons, but it will probably not pay to grow alfalfa on a large scale. The farming methods on this type are practically the same as on the other heavier soils.

Land of the Dawes loam sells at $30 to $35 an acre. Improved farms are valued at $40 to $50 or more an acre, depending upon the improvements and the nearness to towns and lines of transportation.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Dawes loam:

Mechanical analyses of Dawes loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
372621	Soil	0.2	1.8	1.6	12.1	41.2	34.5	8.4
372622	Subsoil	.2	1.2	1.0	10.6	33.4	35.8	18.2
372623	Lower subsoil	.6	1.6	1.2	11.9	41.0	30.2	13.6

TRIPP SANDY LOAM.

The Tripp sandy loam to a depth of 8 to 10 inches consists of a brown sandy loam, containing, in many places, small quantities of fine rounded gravel. The upper subsoil is a brown to dark-brown, friable loam to heavy loam, usually carrying a little fine pinkish and brownish feldspar and quartz gravel. At 30 to 36 inches this grades into a brownish-gray or gray, and finally into a lighter gray to almost white, stratified material consisting of sand, silt, and fine rounded gravel rather loosely cemented with lime carbonate. Though hard and chalklike when dry, the material is readily pulverized between the fingers. Harder layers of this material are abundant in the substratum.

The essential features of the Tripp sandy loam are fairly uniform over large areas. The gravel content is somewhat variable, being much larger on slopes to streams, where the light-gray lower subsoil material lies nearer the surface. The slopes to the first bottoms of Frenchman Creek near Champion are very gravelly.

The Tripp sandy loam occurs on terraces or second bottoms along Frenchman Creek and its tributaries. One of the largest areas is mapped on the high terrace in and near the town of Champion. The type has a level to gently undulating topography, but is well drained, owing to the open, gravelly nature of the lower subsoil.

The surface soil has a large content of organic matter, especially where it has been irrigated for a long period. This with the considerable clay content tends to prevent drifting.

This is a good agricultural soil, and it is all under cultivation. While heavy enough to clod if plowed wet, the clods break down readily and a good seed bed is easily prepared. Most of the type is irrigated and gives excellent yields of corn, wheat, alfalfa, and sorghum. Barley, millet, oats, kafir, potatoes, and emmer are grown to some extent. Corn does not seem to benefit by irrigation as much as some of the other grain crops. Corn yields 30 to 40 bushels per acre, and winter wheat 35 to 50 bushels. Spring wheat gives lower yields than winter wheat, largely on account of damage due to the drifting of the sand in the spring. Alfalfa is an important and profitable crop. It gives three and sometimes four cuttings in a season, yielding 3 to 5½ tons per acre per season. Under irrigation sorghum yields 3 to 8 tons of forage per acre. The average yield of seed is about 20 bushels per acre. Kafir gives equally good forage yields. Millet also does well under irrigation, yielding 1½ to 2½ tons per acre. Barley often yields 35 to 40 bushels per acre. Potatoes are profitable on irrigated areas. This crop does best when grown after alfalfa, frequently yielding 200 bushels per acre. Oats yield 40 to 60 bushels per acre, but this

crop seems to be less profitable than some of the other grains. Without irrigation the yield ranges from 75 to 100 bushels. Yields of all other crops on unirrigated land are much below the figures given above. Sweet clover has been grown successfully on this soil. Almost all the common vegetables can be produced successfully under irrigation.

Irrigated land of the Tripp sandy loam is valued at about $100 an acre, and nonirrigated land at $35 to $40 an acre.

Yields on this soil have decreased slightly in recent years, but the best farmers are now rotating crops and using other means for increasing its productiveness. The following rotation is used by some farmers: Corn, wheat, and alfalfa, followed by potatoes for 2 years.

Some areas of loamy sand are included with the Tripp sandy loam on the map, being distinguished by gravel symbols. They consist of a brown loamy sand, frequently containing fine gravel, underlain at 10 to 15 inches by a brown sand which carries a large percentage of gravel, especially in the lower subsoil. The substratum consists of gray stratified sands, fine waterworn gravel, and silt usually rather loosely cemented with carbonate of lime, though some of the layers are hard and compact and are held quite firmly together. Grayish calcareous material is encountered at a depth of 30 to 40 inches. The total area of this loamy sand soil is only about 1,000 acres. It occurs in a few scattered areas on the high terraces along Frenchman Creek. The largest area, about 320 acres, is situated east of McGuires Slough in T. 6 N., R. 40 W. The type has a level to slightly undulating surface, but drainage is excessive owing to the loose subsoil. Most of this soil is in pasture. It is droughty, and only with exceptionally favorable circumstances are the yields sufficiently large to justify its cultivation.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Tripp sandy loam:

Mechanical analyses of Tripp sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
372680	Soil	1.1	12.0	12.1	34.3	14.6	13.9	11.9
372681	Subsoil	1.5	10.1	9.6	30.3	17.7	19.2	11.7
372682	Lower subsoil	1.3	9.1	7.5	22.4	23.7	30.2	6.0

TRIPP VERY FINE SANDY LOAM.

The surface soil of the Tripp very fine sandy loam is a brown to grayish-brown, loamy very fine sand or very fine sandy loam 10 to 15 inches deep. The surface soil is usually only moderately calcareous,

but the lime content gradually increases with depth. The subsoil consists of a slightly lighter colored, loamy, very fine silty sand, grading at a depth of 20 to 30 inches into a gray, loose, strongly calcareous, silty very fine sand. This has a smooth feel and in many places a yellowish color. The substratum generally is a highly calcareous, light-gray or pale yellowish gray, silty very fine sand, but in some places it is composed of coarser stratified material of more open structure. There is little difference in texture between the soil and subsoil, except that the latter probably contains more silt and is slightly more compact in its upper part, and is also more calcareous, the soil having only a small content of lime.

The Tripp very fine sandy loam occupies terraces or benches, lying 20 to 60 feet above the streams, along Frenchman Creek, Spring Creek, Stinking Water Creek, and their tributaries. The alluvial deposits have been greatly modified in many places by colluvial wash brought down during torrential rains by numerous intermittent streams. The level portions of the type seem to consist largely of weathered surface material of the old terrace deposits, but in the sloping areas the soil is mostly composed of colluvial wash. There is little difference in the physical properties of the different deposits. All parts of the type have been more or less influenced by the deposition of wind-blown silts and sands. The surface varies from level to sloping, and is favorable for irrigation.

This is the most extensive of the terrace soils. The greater part of it is in cultivation, and a small proportion is irrigated. The untilled areas are used for grazing. The native vegetation includes blue grama grass (*Bouteloua oligostachya*), buffalo grass, a species of salt grass, needle grass, bunch grasses, and occasionally a species of sagebrush. This soil is not so valuable as the Tripp loam for grazing, owing to the smaller proportion of buffalo and grama and other nutritious grasses in the natural growths. It is well adapted to general farming. Almost all the crops of this region are produced, including corn, wheat, oats, barley, rye, emmer, millet, sorghum, alfalfa, and potatoes. Alfalfa is profitable where the land can be irrigated, and it also does well on the low-lying, more nearly level areas that receive seepage waters or are partly subirrigated by water escaping from the streams. The crop here yields 1½ to 3¼ tons per acre per season, but under dry-farming methods the yields vary widely. Corn is grown extensively on new ground or after alfalfa. The crop yields 20 to 40 bushels per acre, wheat 8 to 25 bushels, millet 1 to 1¾ tons, barley 12 to 35 bushels, and sorghum 2 to 3 tons of forage. Potatoes are a profitable crop, but are produced only for home use. They often yield 85 to 135 bushels per acre, and occasionally as much as 200 bushels. Wheat and barley seem to be the best small-grain crops for this type.

This land sells for $25 to $40 an acre. Improved farms bring $50 to $60 or more an acre, depending upon the location, topographic position, improvements, and the possibility of irrigation development.

The Tripp very fine sandy loam is a fairly productive type, and it is remarkably retentive of moisture considering its structure. The soil readily works up into a good tilth, but drifts unless carefully handled. Yields have decreased greatly within recent years on some farms, largely owing to overcropping and to failure to maintain the supply of organic matter. Applications of manure would prove beneficial. Sugar beets have been profitably produced on this soil in Kimball County, and in other parts of western Nebraska.

TRIPP LOAM.

The surface soil of the Tripp loam consists of 8 to 10 inches of brown loam, containing in some places, especially along streams, some coarse sand and small pebbles. The upper subsoil is a brown, friable but moderately compact, heavy loam to silt loam, grading at 15 to 20 inches into a light-brown sandy, gravelly, and silty material of variable texture and rather open structure. The extreme lower subsoil, below 30 inches, may change to a gray, strongly calcareous, silty substance, which is hard, brittle, and chalklike when dry, which grades into a substratum composed of stratified sand, gravel, and silt partly cemented with lime carbonate. Near the stream channels more or less fine gravel is present in the subsoil, and a coarse gravelly loam subsoil occurs in places.

The Tripp loam lies on the terraces, 10 to 40 feet above the channels, along Frenchman Creek, Sand Creek, and several smaller streams. It represents old alluvium brought down by the streams and now lying mainly above overflow. The surface is level to slightly undulating. The run-off is apt to be excessive near the drainage ways, and in places the underdrainage also is excessive. Approximately 20 to 25 per cent of the type is under cultivation, the remainder being in pasture. The native grasses make a good growth and include grama grass, buffalo grass, and some western wheat grass.

On account of the loose, porous nature of the lower subsoil the type is droughty, but where it is irrigated or when the rainfall is sufficient good yields of corn, alfalfa, wheat, sorghum, potatoes, and other staple crops are often obtained. In favorable seasons corn yields 15 to 35 bushels per acre, millet 1 to 2 tons, and sorghum 2 to 3½ tons or more. Corn and sorghum seem to be the most profitable crops. Unimproved land of this type is valued at $25 to $30 an acre, and is sold in connection with adjoining upland types.

Included with this type are some areas of a more silty soil. It consists of 10 to 12 inches of brown, friable silt loam with a subsoil of dark gray or dark-brownish gray heavy silt loam to silty clay loam, grading at 20 to 30 inches into a gray material of variable texture, but usually coarser than the upper subsoil. The substratum has a gray-streaked appearance and consists of stratified fine sand and silt, with a relatively small quantity of coarse sand and fine rounded gravel. Gray alkali spots appear in places on the surface of this type. The surface soil is usually calcareous and the subsoil and substratum everywhere so. This siltier soil occurs on the alluvial terraces or second bottoms along the larger streams, principally Stinking Water Creek. The surface is almost flat but the drainage is fairly good, as the soil lies 15 to 30 feet above the normal water level. The greater part of this land is under cultivation. Alfalfa is the most profitable crop, but small grains also do well. Other important crops are corn, wheat, barley, millet, and sorghum. Wheat is more successful than on the Tripp very fine sandy loam. The soil is productive and under proper farming methods should give good yields indefinitely. It is friable and forms a mellow seed bed if handled under the proper moisture conditions, but the surface sometimes cracks when dry.

In a few small areas along Frenchman Creek and Spring Creek, lying only 3 to 15 feet above the channel and subject to occasional overflows, the soil is a dark-brown to grayish-brown calcareous loam, containing some pebbles. The subsoil below an average depth of about 30 inches consists of a gray silty, sandy, and often gravelly material stained with iron rust. The substratum is composed of light-gray stratified sand, gravel, and silt partly cemented with lime carbonate. The surface is flat, but good underdrainage is afforded by the porous, gravelly lower subsoil, and corn, alfalfa, and other crops can be grown in most places. The soil is productive and practically all of it is in cultivation. Alfalfa is the most profitable crop, yielding 2½ to 3½ tons per acre per season with the aid of natural irrigation. Areas suited to alfalfa would probably sell for $50 or more an acre.

LAUREL FINE SANDY LOAM.

The surface soil of the Laurel fine sandy loam, which is 10 to 15 inches deep, consists of a light-brown to light grayish brown fine sandy loam. The upper subsoil is a light-gray, friable, calcareous loam, often with a yellowish tinge and frequently stained with granular particles of iron oxide. At 20 to 30 inches it grades into a lighter colored fine sandy material. A substratum of fine sand to very fine sand and silt extends downward for several feet, but beds of coarser material are common in the lower substratum.

Strata of fine sand may occur throughout the 3-foot section. In some places the heavy subsurface layer is lacking. The entire 3-foot section has a high lime content.

The Laurel fine sandy loam is quite uniform in color, but often varies in texture, particularly near streams. The soil when wet may appear dark gray, especially in poorly drained areas where much organic matter has accumulated. Occasionally the surface soil is a loam, and in patches it is a silty very fine sandy loam. The subsoil varies more than the surface soil, which may be uniform over large areas. The lower subsoil practically always has a slightly mottled appearance, due to yellowish or brownish iron stains, and where it is exposed on the stream banks has a somewhat streaked appearance, caused by the presence of white, lime carbonate and other soluble salts. Deposits of alkali sometimes accumulate on the surface, as on the sides of irrigated channels.

The Laurel fine sandy loam occupies the greater part of the first-bottom lands along the lower Frenchman Creek. It is subject to occasional overflow and to the deposition of additional sediment by the streams. The topography is level to gently undulating and in places the soil is poorly drained, but generally the drainage is sufficient to allow the production of alfalfa and other crops. The surface of the flood plain stands 2½ to 15 feet above the normal level of the streams.

This is the most important first-bottom soil in the county, and most of it is under cultivation, the remainder being in hay and pasture land. The wild grasses include salt grass (*Distichlis spicata*), Lyme grass (*Elymus virginicus*), *Sorghastrum avenacum*, switch grass (*Panicum virgatum*), scattered patches of bluestem, western wheat grass, and other grasses. Several species of sedge and rushes grow in the wettest areas near streams. The chief tree growth is cottonwood, but elm, black locust, ash, willow, and box elder also grow along the streams.

The most important and most profitable crop on this soil is alfalfa. Corn is grown extensively but does not seem to do as well as on the Holdrege loam and some of the other upland soils. Sorghum, kafir, millet, barley, wheat, oats, and potatoes are secondary crops. The type is best adapted to alfalfa, hay, and other forage crops. It supports a much better grass growth than the upland types, and grasses flourish even in the driest years, yielding three-fourths ton to 2 tons per acre.

Alfalfa does exceptionally well owing to natural subirrigation. It appears to do best where the water table lies 5 or 6 feet below the surface, but where the subsoil is too wet the plants soon die out. The crop affords 3 and occasionally 4 cuttings a season, yielding a total of 2¼ to 3½ tons per acre and sometimes 4 or 5 tons, de-

pending on the irrigation. One cutting of hay is made in case seed is harvested. Corn yields range from 15 to 50 bushels per acre, averaging about 25 bushels on unirrigated land. Corn does best on new ground or following alfalfa. Potatoes in favorable season average 135 bushels per acre. Sorghum and millet are successful crops, the former yielding 2½ to 4½ tons of forage per acre. Barley in some years has averaged 35 bushels per acre, wheat 40 bushels, and oats 45 bushels, but these yields are very exceptional. Oats do not as a rule succeed as well as the other small grains.

Land of this type that is particularly adapted to alfalfa, but now growing other crops, sells for $40 to $50 an acre. Improved land in alfalfa is valued at $75 to $100 an acre, and desirable tracts near Wauneta at $125 an acre.

The Laurel fine sandy loam is a good agricultural type. As alfalfa and hay are dependable crops, the type is well suited to general farming and dairying. It is usually included in farms that embrace upland soils used for pasture, and the hay and corn produced are practically all fed to stock. A rotation is sometimes followed which consists of alfalfa, corn for 2 years, then barley, sorghum, or winter wheat. The type will retain its productiveness indefinitely under good agricultural methods. Weeds make a heavy growth on this soil and are hard to eradicate.

Some areas of fine sand are mapped with the Laurel fine sandy loam, consisting of a light-brown to grayish-brown, fine sand to very fine sand, underlain at 10 to 15 inches by pale yellowish gray or light-gray, silty, loose fine sand. Both soil and subsoil are highly calcareous. The typical substratum underlies the subsoil. These areas of fine sand occur in the first bottoms of Frenchman Creek east of Wauneta. They are subject to occasional overflows and have nearly flat to gently undulating surface, but are sufficiently well drained for the production of grain crops and alfalfa. This soil is subirrigated, as it lies only 3½ to 15 feet above the normal level of the stream, and it is a desirable agricultural type.

A darker colored variation is included with the Laurel fine sandy loam as mapped. The surface soil is a brown, or dark grayish brown fine sandy loam high in organic matter, underlain at 10 to 15 inches by a dark-gray to dark brownish gray loamy fine sand or very fine sandy loam. At a depth of 30 to 40 inches this grades into gray, stratified sand, silt, and fine gravel partly cemented with carbonate of lime. The 3-foot section is high in lime, and alkali spots occasionally occur on the surface. The soil contains enough clay to be slightly sticky, but owing to its high content of organic matter it readily forms a mellow seed bed. This type of soil is best developed along the upper Frenchman Creek, where it represents a relatively recent deposit of alluvium. The surface is almost flat, and the land close

to the stream is rather poorly drained. A large percentage of this soil is under cultivation. There is a scattered growth of cottonwood and willow along the stream banks. The native grasses are about the same as on the typical Laurel fine sandy loam. The principal cultivated crops are alfalfa, corn, and sorghum, followed by wheat, barley, millet, oats, and potatoes. Yields are identical with those obtained on the typical Laurel fine sandy loam.

A third variation included with the Laurel fine sandy loam consists of a darker and coarser soil. To a depth of 8 to 12 inches it is a brown to dark-brown loamy sand carrying a large quantity of coarse sand and small pebbles. The soil has a high content of lime and is rich in organic matter. It is underlain by a highly calcareous, gray loamy sand to heavy sandy loam. Coarse sand and gravel layers frequently occur in the subsoil, and the substratum consists of light-gray, stratified gravel, sand, and silt in which the coarse material predominates. It has a high percentage of lime, which imparts a streaked appearance. Black peaty or mucky layers often occur in the lower subsoil and substratum. The composition of this soil varies greatly, especially near streams, where there is an admixture of much coarse material such as small limestone pebbles, coarse sand, and feldspar and quartz gravel. Here the upper subsoil may range from a loose sand to a loam, but usually the subsoil is of about the same texture as the surface soil. The areas of this darker sandy loam variation occur in the narrow first bottoms of the upper Frenchman Creek and some of its tributaries, usually 300 to 500 feet wide. The surface is flat and the soil close to the stream is often poorly drained. The soil is subject to overflow, as it lies only 2 to 12 feet above the normal level of the streams. Some of this land is farmed to alfalfa, corn, and other crops, but most of it is used for pasture and hay production.

LAUREL LOAM, POORLY DRAINED PHASE.

The Laurel loam, poorly drained phase, is quite variable in both texture and color. The surface soil is usually a grayish-brown highly calcareous loam, rich in organic matter. It may extend to a depth of 15 inches or more, but is often only a few inches deep. The subsoil is a gray or drab, strongly calcareous loam, mottled with yellowish and brownish stains of iron oxide and containing sandy layers. Black peaty layers frequently occur in the subsoil, but it is seldom entirely black, as it generally contains more or less intermixed grayish material. The substratum consists of gray, highly calcareous, stratified sand, gravel, and silt. Whitish alkali patches frequently occur on the surface. The variation in this soil is especially great near streams, as each overflow is likely to change its characteristics through removal or deposition. In some areas the soil is a sandy loam rather than a loam.

The Laurel loam, poorly drained phase, is of alluvial origin and occurs in the first bottoms of Spring Creek, lower Sand Creek, Stinking Water Creek, Frenchman Creek, and their tributary branches and sloughs. It has a flat surface and is poorly drained. This soil in its present marshy condition is only adapted to use as hay and pasture land. The hay is for the most part coarse and not relished by stock. The yield is 1 to 1¾ tons per acre. The native vegetation includes a variety of water-loving plants, such as various reed grasses, cat-tails, flags, and rushes. A so-called "three-cornered" grass, a species of rush, is very abundant. Western wheat grass grows in the best drained places. The principal tree growth is cottonwood and willow, which thrive in certain localities near streams.

Most of this land is valued at $10 or $12 an acre. The better areas bring $30 or more an acre, depending upon the location, improvements, and other local conditions. This land is generally sold in conjunction with better surrounding soils.

A silt loam variation is included with the Laurel loam, poorly drained phase. It occurs in wet first bottoms along streams, and artificial drainage is necessary before the land can be successfully cultivated. The principal areas occur along Stinking Water Creek, Frenchman Creek, and Spring Creek.

DUNESAND.

The term Dunesand is applied to the soil occupying the extensive sand-hill areas. The soil to a depth of 8 to 16 inches is a brown, incoherent, fine to coarse sand in which the fine and medium grades of sand predominate. It contains varying quantities of organic matter, but not enough to prevent drifting when the grass covering is removed. The subsoil is similar to the soil except for its lighter color, which is due to the smaller content of organic matter. The subsoil contains some silt and clay, but seldom enough to form a sticky or distinctly heavier material, and in the true sand-hill area the loose sand usually extends to great depths. The sand grains are chiefly composed of quartz and feldspar, the latter being brownish or pinkish and imparting to the soil its typical color. Viewed at a distance the sand dunes have a brownish-gray appearance, especially when the surface is dry.

There is little variation in the Dunesand from place to place. In some areas the soil contains more silt, clay, and organic matter than typical, doubtless owing to the fact that it has remained undisturbed for a long period of time and the effects of weathering have been greater. These loamier areas have a thicker grass covering than most of the type, and therefore a greater grazing value.

Dunesand occupies about one-fourth the area of the county It occupies the greater part of the upland in the northeastern and south-

western parts, and is also well distributed throughout the central part. The type does not occur on the high plains in the northwestern part of the county or on the higher portions of the tablelands or divides in the southeastern part.

Drainage ways are absent or poorly developed in these areas. All the rainfall is immediately absorbed and there is little or no run-off, even on the steepest slopes. Wind action has been the controlling factor in forming the rather monotonous surface features, which consist of sharply rolling ridges and dunes ranging in height from 10 or 20 to 110 feet or more. In the rougher places small hummocks of wind-lodged sand and so-called "blow-outs" are numerous. Between the ridges and in many small basins there are areas of agricultural soil which vary in size from a few acres to several square miles. The valleys have a southeasterly trend, roughly parallel to the general drainage system.

The destruction of the native sod in the areas of Dunesand is followed by damaging wind erosion, but nevertheless a few patches here and there are in cultivation. Corn is usually grown. The yield is poor except on the more loamy areas, which give fair yields the first year or two after breaking.

The Dunesand is without trees or large shrubs. The native vegetation includes a large number of grasses, of which long-leafed reed grass (*Calamovilfa longifolia*), *redfieldis*, dogtown grass (*Aristida longiseta*), little bluestem (*Andropogon scoparius*), beard grass, and needle grass (a species of stipa) are most common. Bunch grasses occur abundantly over all parts of the type. Grama and buffalo grasses are found in certain localities, but as a rule they make only a scattered growth. The most conspicuous vegetation in the sand hills proper consists of artemesia, a species of sagebrush, and soap weed (*Yucca glauca*), which occur very abundantly over the entire type. In some places the grasses of the sand dunes are cut for hay. The yields are usually light, ranging from one-fifth to one-half ton or more per acre. With the crop of hay, the Dunesand is capable of maintaining 32 to 40 head of cattle or horses to the square mile. There is usually good pasturage for eight or nine months of the year, and where the range feed is supplemented by 60 to 90 days of winter feeding from the farm only 7 to 12 acres is required for each head of stock.

Areas of Dunesand generally sell for $5 to $10 an acre, but well-located ranches having good farm buildings, fences, and other improvements are valued at $12.50 or more an acre, depending upon local conditions.

The use of this land depends on the preservation of the native grasses. The surface is generally well sodded, and it is the opinion of most cattlemen that the grass has materially improved during

recent years. This is largely due to the control of prairie fires, which formerly swept over much of the type during late fall and early spring. In addition, new grasses have made their appearance in certain localities. The soil of the Dunesand is incoherent, and loses more than it gains in stability under continued cultivation. No attempt should be made to cultivate the dunes proper.

SUMMARY.

Chase County is situated in the southwestern part of Nebraska, bordering the State of Colorado. It comprises an area of 899 square miles, or 575,360 acres. The county lies within the Great Plains region. Its surface varies from flat or slightly undulating to rolling and hilly. The average elevation is about 3,200 feet above sea level, and the prevailing slope is eastward.

The county is drained by Frenchman Creek and its tributaries. The larger streams have cut deep valleys in their lower courses, and there are some water power and irrigation developments along Frenchman Creek.

The 1910 census gives the population of the county as 3,613, or an average of 4.02 persons per square mile. The greater part of the population is native born. Imperial, the county seat, is situated near the center of the county. Wauneta, Lamar, Champion, and Enders are other important towns.

Transportation facilities are afforded by a branch of the Chicago, Burlington & Quincy Railroad, which joins the main line at McCook. All the public highways are of earth, but they are in good condition the greater part of the year.

Chase County has good market facilities. Omaha, Denver, Kansas City, Lincoln, and other good outside markets are easily accessible.

The climate of this region is semiarid and the growing season is relatively short. The mean annual rainfall is 20.79 inches, three-fourths of which comes during the growing season. There are wide extremes of heat and cold, but the climate is healthful, and not unpleasant. High winds may occur at any time of the year, but tornadoes are practically unknown.

The early agriculture consisted entirely of stock raising on the open range. Farming began in the early eighties and has gradually increased in importance, until at the present time the value of all crops produced slightly exceeds the value of all live-stock products. The agriculture consists of an extensive type of grain farming combined with stock raising and with some intensive cultivation under irrigation.

The grain crops include corn, wheat, barley, emmer, rye, and oats, ranking in the order named. Corn occupies a larger acreage than all the other grain crops combined. Wheat occupies about one-half

as large an acreage as corn. Sorghum, millet, and alfalfa are the principal forage crops. Alfalfa is grown extensively on the subirrigated and artificially irrigated bottom lands and terraces. Potatoes and vegetables are produced in a small way for home use. Orchard fruits, except cherries and possibly plums, do not succeed. Bush fruits and berries in general are not profitable without irrigation, but gooseberries and currants often give good results. Nutritious hay and pasture grasses flourish everywhere.

Stock raising is a profitable industry. The animals are generally free from all kinds of malignant diseases. Hogs do exceptionally well. Cattle and horses are the chief sources of income from stock raising. There are no exclusive dairy farms, but many farmers keep 10 to 12 cows, and a large quantity of dairy products is sold each year. Sheep raising has proved unprofitable in most cases. Practically every farmer raises poultry in a small way.

The best farmers attempt to follow the natural adaptation of soils to crops in planting. The prevailing methods of agriculture are generally applicable to dry-farming conditions, except that no definite crop rotation is followed and most of the farm manure is wasted. Most of the farms have the necessary equipment.

Farm labor is rather scarce at times, and most of the work is done by the farmer and his family. Good wages are paid for farm labor. In 1910 there were 609 farms in the county, with an average size of 695.3 acres. The share system is followed in renting farms. Land values range from $6 to $100 an acre. The ordinary selling price of good farm land ranges from $20 to $50 an acre.

The soils of Chase County may be grouped into two general classes—residual soils and transported soils. The residual soils are derived through weathering from the underlying bedrock, while the transported soils are derived from wind-blown and alluvial deposits. Nine soil series, embracing 22 soil types, are recognized in Chase County.

The Rosebud series is quite extensive and is represented by four types. The Rosebud soils are shallow and droughty, but in favorable seasons the fine sandy loam, loam, and silt loam produce fair yields of the staple crops. The loam and silt loam seem adapted to wheat, other small grains, and forage crops. The Rosebud loam is the most extensive agricultural type in the county, but it is used chiefly for pasture.

The Dawes sandy loam, fine sandy loam, and loam are good agricultural types of the upland. They are deeper and more productive than the Rosebud soils. The loam and the heavier areas of the fine sandy loam are good soils for wheat, other small grains, and forage crops.

The Valentine series is represented by four types. The fine sandy loam is an excellent soil for dry farming. Practically all of the Valentine fine sandy loam and sandy loam and most of the loamy sand are under cultivation.

The Holdrege loam is a deep, productive soil. It is generally considered the best heavy upland soil in the county for general farming, and is especially suited to small grain. The very fine sandy loam also is a good soil for farming.

The rolling phase and the broken phase of the Colby very fine sandy loam have a rough, hilly topography and are used for grazing.

The Scott silty clay occurs in slightly depressed areas and is poorly drained. It is used as hay and pasture land.

The Tripp series includes the sandy loam, very fine sandy loam, and loam. These soils are productive and well suited to the production of hay grasses and alfalfa. They are irrigated in some places and in other areas have natural subirrigation.

The Laurel fine sandy loam is the most important first-bottom soil in the county. It is naturally subirrigated and is also irrigated artificially to a small extent. The type is used chiefly for growing alfalfa and for wild-hay production. It is a productive and desirable soil. The Laurel loam, poorly drained phase, is subject to frequent overflows.

Dunesand is a wind-laid upland type, occupying rolling or hilly areas of dunes and intervening valleys. It covers about one-fourth of the county. This land is used for pasture.

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[PUBLIC RESOLUTION—No. 9.]

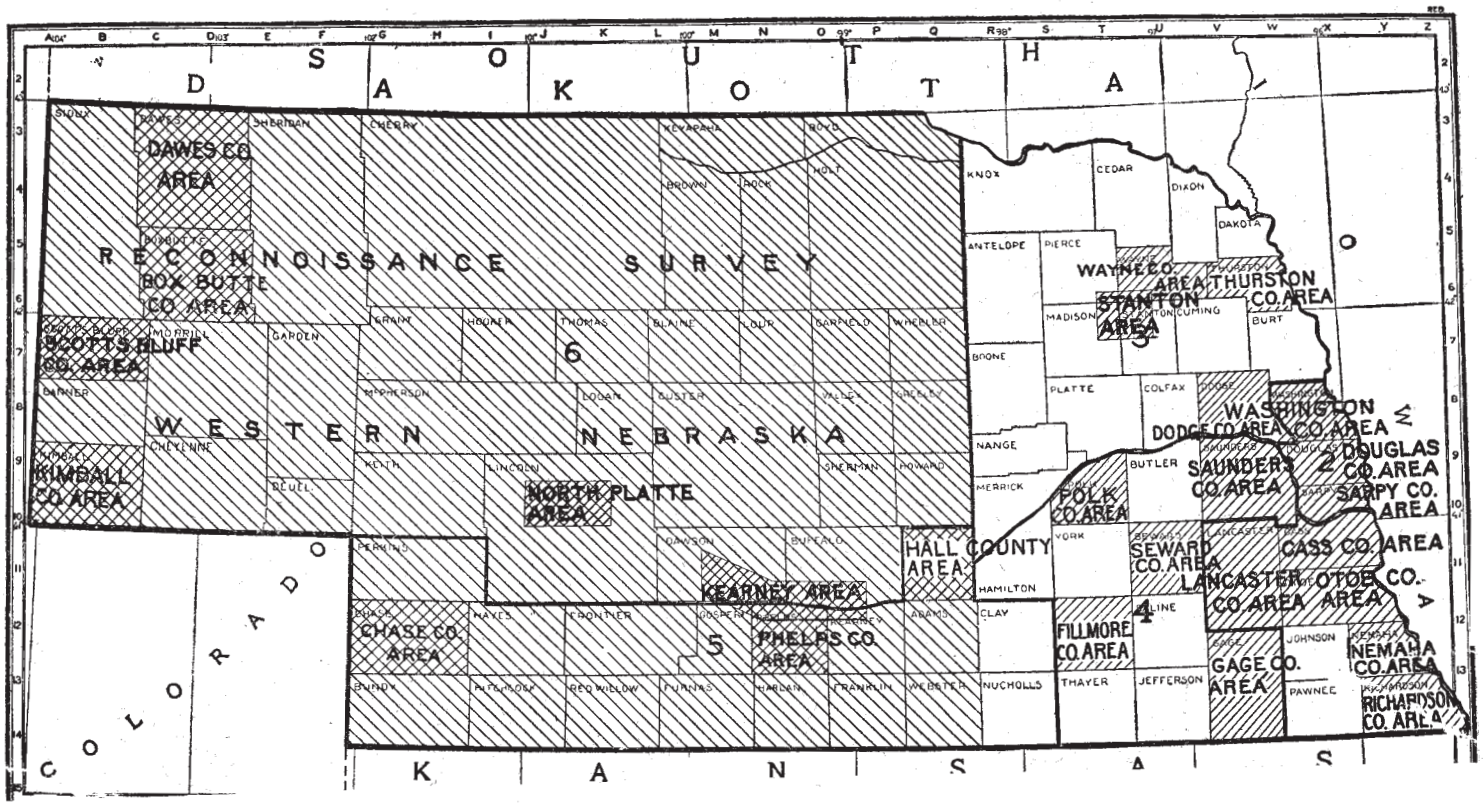
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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.]


SOUTH DAKOTA
RECONNOISSANCE SURVEY
WESTERN NEBRASKA
DAWES CO AREA
BOX BUTTE CO AREA
SCOTTS BLUFF CO. AREA
KIMBALL CO AREA
NORTH PLATTE AREA
KEARNEY AREA
CHASE CO AREA
PHELPS CO AREA
HALL COUNTY AREA
WAYNE CO. AREA
THURSTON CO. AREA
STANTON AREA
WASHINGTON CO. AREA
DODGE CO. AREA
DOUGLAS CO. AREA
SAUNDERS CO. AREA
SARPY CO. AREA
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