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 DAWES COUNTY, NEBRASKA.

BY

R. R. BURN, IN CHARGE, L. VINCENT DAVIS, AND J. M. SNYDER, OF THE U. S. DEPARTMENT OF AGRICULTURE, AND F. A. HAYES AND THOMAS E. KOKJER, OF THE NEBRASKA SOIL SURVEY.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1915.]

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1917.

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LETTER OF TRANSMITTAL

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., November 6, 1916.

SIR: In the extension of the soil survey in the State of Nebraska during the field season of 1915 a survey was undertaken in Dawes County. This work was done in cooperation with the State of Nebraska, and the selection of the area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this work and to request their publication as advance sheets of Field Operations of the Bureau of Soils for 1915, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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SOIL SURVEY OF DAWES COUNTY, NEBRASKA.

By R. R. BURN, In Charge, L. VINCENT DAVIS, and J. M. SNYDER, of the U. S. Department of Agriculture, and F. A. HAYS and THOMAS E. KOKJER, of the Nebraska Soil Survey—Area Inspected by THOMAS D. RICE.

DESCRIPTION OF THE AREA.

Dawes County lies in the northwestern part of Nebraska, adjoining the State of South Dakota. It is bordered by Sheridan County on the east, Box Butte County on the south, and Sioux County on the west. Dawes County is 39 miles long north and south and 36 miles wide. It has an area of 1,402 square miles, or 897,280 acres.

Physiographically the county includes portions of two main divisions. The southern part lies within the High Plains, the northern part in a lowland belt to which no name has ever been applied, but which may be designated as the Oelrichs lowland, from the town of that name located within this belt in South Dakota a few miles north of Dawes County.

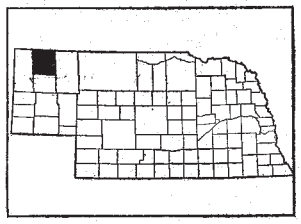

FIG. 1.—Sketch map showing location of the Dawes County area, Nebraska.

That part of the High Plains lying within the county is known in Nebraska geography as the Dawes Table, and occupies the southern third of the county. It consists of a high plateau lying at an elevation ranging from 4,000 to 4,500 feet above sea level. It is smooth, with the exception of the slight dissection to which it has been subjected, sloping gently southward from its crest, which lies within a very few miles of its extreme northern boundary. Along the extreme southern border of the county the Dawes Table is dissected to a depth of about 400 feet by the Nebraska River, the belt dissected having a maximum width of about 8 miles. The main valley is a few hundred feet wide, and the tributaries are all small, few of them more than narrow ravines. The dissection near the river is rather complete, but the slopes are smooth and somewhat rounded.

North of the crest of the table, known locally as Pine Ridge, the plateau drops steeply to the level of the White River Basin, the name used locally for the southern part of the Oelrichs lowland. This northern steep slope or escarpment of the plateau attains a

total drop of about 900 feet in a distance ranging from 1 mile to 5 or 6 miles. It is especially steep when compared with the gentle southward slope of the plateau. It is cut into a series of narrow ridges and narrower ravines, making a very rough surface, striking in its roughness because of the prevailing smoothness of the country north and south of it. It is marked on the soil map by the Rough stony land and on the landscape both by its prominence as a topographic feature and its cover, though rather sparse, of pine timber. The trees ordinarily found in the river bottoms grow somewhat more vigorously in these ravines than elsewhere.

The escarpment slope is steepest near the top and near the bottom flattens out gradually to the low, smooth White River Valley at its foot. This is merely a low part of the Oelrichs lowlands, developed by the action of White River on soft shales and clays. The valley lies near the foot of the escarpment and trends northeastward, parallel to the escarpment, from the county line west of Crawford. In the vicinity of Chadron the river turns northward, while the escarpment continues slightly northeastward to the county line. The lowland from Chadron eastward is higher and more rolling than farther west, but still contrasts strongly with the escarpment belt south of it.

The Oelrichs lowland north of the lowland just described consists of a rolling plain developed on soft shales and clays with occasional beds of indurated rock of various kinds. Over the northwestern part of the county the topography is rather uniformly rolling. In the northeastern part the relief is somewhat more pronounced, owing to the occurrence of occasional resistant beds of rock. North of the extension of the White River lowland east of Chadron there is a low hilly belt extending from White River eastward to the county line. Along the northern border north of this hilly belt the relief is less pronounced. All of this region lies at a lower elevation than that of the Dawes Table.

The Niobrara River drains about 450 square miles of the county on the south and the White River drains all the remainder, except about 35 square miles in the northwest corner, which drains north into the Cheyenne River. The White River rises in Sioux County, about 30 miles west of the Dawes County line, and flows in a northeasterly direction, crossing into South Dakota about 2 miles from the eastern county line. The valley is approximately 45 miles long, but the length of the stream is much greater because of its meandering course. White River has a fall of about 700 feet within the county, averaging about 15½ feet per mile. Water power is developed at Crawford for a flour mill. The flood plain lies 100 to 150 feet below the general level of the bordering uplands. The channel of the river is 15 to 20 feet wide, and in general is rather deeply intrenched, but the first-bottom land is subject to overflow and in seasons of exces-

sive precipitation much damage is done to crops. In dry seasons and during late summer the flow decreases, but the river never goes entirely dry. Numerous tributaries flow southeasterly into the White River, the most important of which are Big Cottonwood, Little Cottonwood, Rush, and Lone Tree Creeks. These streams have carved out narrow valleys and in general are bordered by narrow strips of bottom land. They are cutting rapidly near their sources, and much slower in their lower courses; but the White River and its tributaries are eroding to a greater or less extent all along their courses. Numerous tributaries, of which the most important are Beaver, Bordeaux, Chadron, Dead Horse, Indian, and Ash Creeks, enter the White River from the south, flowing almost due north from their sources in the Pine Ridge watershed. Here they have deep channels, which are being rapidly intrenched. Along most of these tributaries, terraces varying in width from one-eighth to one-half mile extend quite continuously for distances of 3 to 8 miles upstream from their junction with the White River. These tributary streams are almost all fed by springs and very seldom dry up.

The source of the Niobrara River is in Wyoming. It enters Dawes County from the south near Marsland, flows northeast for about 3 miles, and thence eastward nearly parallel with the county line. Its valley in Dawes County is about 27 miles long, and it has a fall of about 350 feet, averaging about 13 feet to the mile. The current is more sluggish than that of the White River, although the stream is not so deep. The flood plain lies 100 to 150 feet lower than the upland, 2 or 3 miles away. The valley bottom ranges from one-fourth to nearly three-fourths mile in width. The material of the flood plain is sandy, owing to the nature of the bordering upland from which it is derived. The larger tributaries of the Niobrara River enter it from the north. Cottonwood, Pebble, and Pepper Creeks are the most important affluents. Below the table-lands they flow in deep canyons, and they are bordered by strips of bottom land only in their lower courses, where the gradients are much reduced. Since these streams are not fed by springs they are generally dry during much of the summer period.

The two main stream systems have developed such a network of tributaries that drainage is good over the whole county, except a small part of the Dawes Table. Here some depressions occur which have no natural outlets, but their total area is small. The remainder of the county has been thoroughly dissected and in some areas, including notably Pine Ridge, erosion has been severe. In the sandiest areas of the eroded table-lands drainage is largely accomplished underground, and there is a marked absence of streams. The spring-fed streams rising in Pine Ridge and flowing northward into the White River are clear and the water is pure enough to be used for

drinking purposes. These streams also afford excellent watering places for stock. The water supply for Chadron is taken from Chadron Creek at a point about 7 miles south of the town. Water in the area of Pierre clay is obtained from ponds made by damming small streams, or from water holes in larger ones. These sources of water are made use of principally because the ground water is not of good quality.

Dawes County was formed from a part of Sioux County in 1885. Settlement had begun a few years before, and by 1886 nearly all the land had been filed upon under the public-land laws. The lowlands along the White River and Bordeaux Creek were first taken up and later settlement spread over the entire county. The early settlers were of many nationalities, a large percentage being American born.

In 1910 the total population of the county was 8,254. Approximately 89 per cent of the population consists of native white persons and 9 per cent of foreign born. The principal foreign nationalities represented are German, Irish, English, and Swedish. The rural population, including the residents of all the towns except Chadron, constitutes 67.4 per cent of the total and averages four persons to the square mile. The most densely populated areas are in the immediate vicinity of Chadron and Crawford, in the White River Valley, on the flat north of Crawford, and on the Dawes Table. The area of Pierre clay soil and the country between the Dawes Table and the Niobrara Valley are very sparsely settled.

Chadron, the county seat and principal town, is situated about 10 miles northeast of the center of the county. It had a population in 1910 of 2,687. This town is a division point on the Chicago & North Western Railroad, and the shops operated here furnish employment for quite a large number of men. Crawford is situated at the junction of the Chicago, Burlington & Quincy Railroad and the Chicago & North Western Railroad, about 4 miles from the western county line. This town is noted for its horse markets. It owes its growth partly to the establishment of a military reservation near by and partly to the development of the surrounding farming community. Marsland, Whitney, Wayside, and Belmont are other towns in the county, named in order of importance. Fort Robinson lies near the western border of the county, on the Chicago & North Western Railroad.

The Chicago & North Western Railroad between Omaha, Nebr., and Lander, Wyo., crosses the county east and west. A branch runs northwest from Dakota Junction to Deadwood and the Black Hills. The main line of the Chicago, Burlington & Quincy Railroad between Omaha and Denver on the south and Billings, Mont., on the north, crosses the western part of the county, passing through Marsland and Crawford.

Marketing facilities in the northeastern, northwestern, south-central, and southeastern parts of the county are poor. Farmers in the south-central and southwestern parts market at Hemingford, in Box Butte County, and those living in the southeastern part at Hay Springs, in Sheridan County. Chadron and Crawford furnish local markets for dairy products. A creamery is operated at Chadron, creating a good demand for cream. Each of these towns has a mill and an elevator. There are also elevators in Marsland and Whitney. Practically all the live stock sold is shipped to the Omaha markets.

Wagon roads are maintained along section lines where possible, but in many places in the rougher sections of the county it is necessary to make wide detours to avoid steep hills and bluffs. Well-kept highways are maintained between the towns, but some of the less important roads receive very little care. The county is well supplied with rural mail delivery routes, and rural telephone lines are fairly well distributed.

CLIMATE.

The following table, compiled from the records of the Weather Bureau station at Fort Robinson, gives the normal monthly, seasonal, and annual temperature and precipitation:

Normal monthly, seasonal, and annual temperature and precipitation at Fort Robinson.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1897).	Total amount for the wettest year (1892).
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December	28.3	68	−28	0.68	1.30	0.50
January	23.1	74	−28	.68	1.90	1.56
February	23.1	72	−37	.55	T.	.19
Winter	24.8	74	−37	1.91	3.20	2.25
March	33.5	89	−25	1.20	.50	.56
April	46.4	89	3	1.70	.40	3.93
May	55.2	96	7	2.73	.65	5.02
Spring	45.0	96	−25	5.63	1.55	9.51
June	65.0	104	32	2.97	1.49	11.91
July	71.1	106	35	2.12	3.60	1.64
August	70.3	103	31	1.58	T.	1.94
Summer	68.8	106	31	6.67	5.09	15.49
September	61.0	100	9	1.03	T.	.28
October	48.4	94	6	1.29	T.	4.74
November	35.4	81	−11	.38	.65	.07
Fall	48.3	100	−11	2.70	.65	5.09
Year	46.7	106	−37	16.91	10.49	32.34

About 72 per cent of the annual rainfall of 16.91 inches normally occurs during the months from April to September, inclusive. About 48 per cent occurs in May, June, and July, with a maximum in June. The summer rainfall is variable. In the year of lowest precipitation on record only 6.14 inches of rain fell during the growing season, and the total rainfall was only 10.49 inches. In the wettest year on record the total precipitation amounted to 32.34 inches, of which 24.72 inches fell during the growing season. The summer precipitation generally occurs in thunderstorms, and hail sometimes does serious damage to crops over local areas. The average annual snowfall is a little less than 2 feet. Snow seldom covers the ground during the entire winter.

The mean annual temperature is 46.7° F. January and February are the coldest months, with a mean temperature of 23.1° F., and July is the warmest, with a mean temperature of 71.1° F. The lowest temperature on record is −37° F., recorded in February, and the highest is 106° F., in July.

The average date of the last killing frost in the spring is May 13, and that of the first in the fall September 21. The average growing season is thus 130 days in length. Its shortness makes it necessary to grow quick-maturing crops. The earliest recorded killing frost in the fall occurred on September 2, and the latest in the spring on June 9.

The prevailing winds in winter are from the northwest, and during the summer months from the south and southwest. Tornadoes are unknown. During the period from 1909 to 1911, inclusive, there were on the average 210 to 220 clear days and 145 to 155 cloudy or partly cloudy days a year.

While the rainfall is not always sufficient for the production of as good yields of grain as are obtained in eastern counties of the State, the farmers have adopted methods whereby fairly good returns can be relied upon even in the driest years. The rainfall is usually sufficient to insure a crop of small grain and hay in favorably situated areas. On the upland alfalfa generally gives one crop of hay and a later seed crop. The season is too short and the altitude too high to grow slow-maturing varieties of corn, even if the rainfall were sufficient. This disadvantage has been overcome to some extent by the substitution of varieties which are hardier and earlier maturing, though possibly less productive.

AGRICULTURE.

The first settlers to make use of the agricultural resources of Dawes County were cattlemen. During the period from 1877 to 1884 agriculture was confined to the grazing of cattle on the free

open range, where a variety of nutritious grasses furnished good summer and fair winter grazing. Winter losses were very heavy at times, but usually the profits on the animals that survived were large. Grain farming began to replace open-range ranching about 1884, when settlers began to take up the alluvial lands along Bordeaux Creek and White River. A little later homeseekers from the vicinity of Sidney, to the south, settled upon the table and park lands. At that time the nearest railroad points were Sidney to the south and Valentine to the east. By the end of 1886 settlement had spread to all parts of the county. A large percentage of the tillable land was brought under cultivation, and it is probable that there was as much land in cultivation before 1890 as there is at the present time. Corn, oats, and potatoes were grown for home use, but wheat early became the money crop.

As in other parts of the Great Plains, the waves of settlement have advanced and receded. During periods following years of good crops immigration has been rapid, while subsequent periods of drought have caused abandonment of large areas of land. After the first tide of rapid settlement, a series of dry years, beginning in 1887, resulted in a gradual decrease in the population that continued through the early nineties. There have since been other fluctuations in population. The early population was larger than that enumerated as late as 1910, although it is probably exceeded at the present time. The droughts, although severe, would probably not have checked agricultural development so seriously if the present farming methods had been used at that time. The farmers did not understand the best methods of conserving soil moisture by cultivation, varieties of crops suited to the region had not been introduced, and a system of stock raising in connection with grain farming had not been 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 few men, whose holdings were utilized for grazing under a system of combined stock ranching and grain farming. With the return of settlers the large tracts were gradually broken up, but a large proportion of the county, including the Rough broken land of Pine Ridge and the Pierre clay land in the northern part, is still used for stock raising in connection with hay and grain farming. Resettlement of the county was hastened by the passage of the Kincaid Act, which increased the size of the homestead available under the public-land laws to 640 acres, and made it profitable to take up land chiefly valuable for pasture. Within a short time the remaining public land was brought into private ownership.

At the present time the smooth land of the White River Valley is largely held in comparatively small farms devoted to grain production, general farming, and, to a small extent, dairying. The remainder of the area is utilized by stock farmers and ranchers, many of whom cultivate only sufficient lands to produce grain and hay for feed.

The most extensively grown crop, according to the report of the Nebraska State Board of Agriculture, is corn, which occupied 16,532 acres in 1914. In 1910 wheat and oats both ranked above corn in acreage, but the latter crop has been increasing. A few farmers raise more corn than they require and sell the surplus in the community. Corn is used for feeding hogs, cattle, and horses. The demand is greater than the supply, and there is a large annual importation from the corn belt.

Wheat ranks second in importance among the grain crops. In 1909 there were 12,863 acres devoted to this crop and in 1914, 10,653 acres. The average yield in each of these years was between 12½ and 13 bushels per acre. There are two flour mills in the county, but the greater part of the crop is shipped to eastern markets. The quality of the grain is generally very good.

Oats rank third in acreage. About 10,000 acres annually are devoted tc this crop. The production is practically all used within the county for feeding stock.

Rye is an important crop in local areas, mainly on the table-land and park lands. The 1910 census reports only 919 acres in rye, but in 1914, according to the report of the Nebraska State Board of Agriculture, this crop occupied 3,703 acres, with an average yield of 19.4 bushels per acre. The average in 1915 is apparently very close to that of wheat. Part of the crop is used by local mills, but the greater part is shipped out of the county.

According to the 1910 census, about 50,000 acres are devoted to hay production. Of this total, about 39,000 acres are in wild grasses. The feeding value of the western wheat grass which grows in the Pierre clay region is very good, and the hay always brings a premium on the market. The other grasses cut are the bluestem and grama. Alfalfa is the principal cultivated hay crop, occupying over 9,000 acres in 1909. Much of the hay produced is fed to stock, but a large tonnage is shipped to both eastern and western markets and to the Black Hills.

Irish potatoes are an important product in certain sections of the county, especially on the eroded table-lands in the vicinity of Belmont and Marsland, where the sandy soil is very well suited to the crop. About 2,500 acres were devoted to potatoes in 1909. Yields as high as 200 bushels per acre are frequently obtained. The produc-

tion is sold mostly to eastern buyers, who come into the county and contract with the farmers at the time of harvest.

Barley and spelt are at present relatively unimportant crops, but they are gaining in favor on account of their seemingly greater resistance to drought. Very little barley or spelt is marketed.

Fruits, including apples, cherries, and plums, are grown to a small extent. Few orchards receive proper care. Strawberries do well, but are not produced commercially.

Nearly every farm has as much pasture land as cultivated land, and most farms have more. In the region occupied by the Pierre clay, and in the area lying south of the Dawes Table, nearly all of the land is used for grazing.

Live-stock raising is the most important industry in Dawes County. The value of all live-stock products in 1910 exceeded the value of all crops combined. Cattle and horses are the chief sources of revenue. The census reports 14,472 head of cattle sold or slaughtered in 1909, and 1,292 horses sold. Nearly all the cattle are shipped to eastern markets in the fall as 2-year-old or 3-year-old feeders. The horses are sold to buyers who come into the county, Crawford being the principal horse market. The grade Hereford is the type of beef cattle most generally raised, although there are many Shorthorn grades. There are a few purebred Hereford herds, which have a good influence on the stock of the county. The type of horse has been improved from the western bronco, and heavy draft animals are kept in many parts of the county. The best type of horse is raised on the table-land farms and in the vicinity of Crawford.

Dairying is not yet well developed, but there are a few strictly dairy farms adjacent to the larger towns. On nearly every farm a few cows are kept for dairy purposes, the products being marketed in the form of cream or butter. Silos are rapidly coming into use as a means of utilizing the corn, which otherwise would be unprofitable in dry seasons. The pit silo is the type most generally used. The chief types of dairy cows kept are grade Holstein and dual-purpose Shorthorn. There are a few purebred Holstein cows in the county.

The raising of hogs promises to become a very important industry, as alfalfa is very successful and pasturage on this crop is sufficient to maintain hogs, with a comparatively low grain ration, until they can be shipped as feeders. Some hogs are fattened for market. The high altitude, healthful climate, and isolation have prevented losses from disease, and a few farmers in the county have been remarkably successful in hog raising. Over 4,500 head were marketed in 1909.

Sheep are raised on a few farms. The census reports the sale of over 8,000 head in 1909. Some sheep are brought in from the range in the fall and wintered.

The value of poultry and eggs produced in 1909 was $57,779. About one-half of the production was sold. On practically every farm chickens are kept in greater or less number.

The farmers realize that the soils of the table-lands, the park lands of Pine Ridge, the light-textured types of the White River Valley, and the terrace soils of the White River and its tributaries from the south are well suited to the production of alfalfa, corn, wheat, oats, rye, and barley. Alfalfa does especially well on the terrace soils. The park lands of Pine Ridge and the light table-land soils are known to produce yields of excellent potatoes. Owing to the low productive capacity of the heavy Pierre clay soil and the difficulty encountered in working it, the areas where this type predominates are used for grazing and hay production. Large tracts are leased by the ranchers. No farming is done in the rough areas of Pine Ridge. This land is devoted to grazing or is in timber, and profits are possible only where large tracts are worked. The sandy, shifting nature of the soils on the eroded southern part of Dawes Table makes grain farming unprofitable here, and the land is devoted to grazing.

Corn is planted by means of listing on old corn or stubble land, or by plowing and checking on land having a heavy subsoil. The crop is cultivated one to three times. About one-fourth of the acreage planted is cut over for fodder and silage, and the remainder is husked. The larger part of the wheat is spring sown, but winter wheat is steadily gaining in popularity. In either case wheat is sown on stubble or corn ground and double-disked in, although this method does not result in as good a seed bed or insure as good a stand as plowing the ground and drilling in the seed. Rye is generally sown broadcast in the fall on old stubble ground and is covered by double-disking in the same manner as wheat. Oats and barley are in all cases sown broadcast in the spring on old stubble or corn ground, and covered by disking. Wheat and rye harvesting begin about July 20. Barley, spelt, and oats mature somewhat later, depending on the variety sown.

The farm equipment in use includes plows, disks, harrows, cultivators, mowing machines, rakes, hay stackers, and binders. Thrashing machines travel from farm to farm after the harvesting of the grain. Most of the thrashing is done from the shock. The type of draft horses and mules used is fairly good. A few farmers have tractors for plowing and breaking. The farm buildings, as a rule, are only fairly good. The barns are in general better than the dwellings. Fences are usually kept in good condition.

No definite system of crop rotation is practiced. In general corn is planted for a number of years, followed by oats or barley, and this by wheat or rye. No grasses are introduced in the rotation for soil-enriching purposes, but alfalfa is extensively grown for hay and

seed. No commercial fertilizers are used on account of the freshness of the soil and the cheapness of land. Only a small proportion of the manure produced is utilized.

Farm labor is rather difficult to obtain. Of the 781 farms in the county, 366 reported an expenditure for labor in 1909, averaging $292.78 each. Where employed by the year laborers receive $25 to $35 a month, with board. Day hands during harvest season receive $1.50 to $2.50 a day.

The size of farms in Dawes County ranges from a few acres to several sections. Most of the farms are between 300 and 1,500 acres in size, and the average size for the county is 897.8 acres.

According to the 1910 census, 84 per cent of the farms are operated by owners, as compared with 85.6 per cent in 1900, and 95 per cent in 1890. According to the report of the Nebraska State Board of Agriculture, only 77 per cent were operated by owners in 1914, and the proportion apparently is steadily decreasing. The cash and share rental systems are about evenly divided in favor. Share rent ranges from one-fourth to one-third of the crop. Cash rent ranges from 50 cents to $4 an acre, depending on the location and value of the land.

On account of the fact that only a comparatively small total acreage of land has changed hands for cash, it is difficult to determine land values accurately. The valuations given, which vary with the topography and situation, are based on estimates of the county agricultural agent, reliable real estate dealers, and farmers. Land on the Dawes Table is valued at $20 to $35 an acre, and on the eroded slopes of the table at $7 to $15 an acre. The rough, broken land of Pine Ridge is held at $5 to $10 an acre and the park land at about the same valuation as farms on Dawes Table. The upland south of the White River is valued at $10 to $25 an acre, depending largely on the soil texture, the lighter types being the more valuable. Land in the Pierre clay area is valued at $3 to $15 an acre, the price depending on the water supply, location, and improvements. The alluvial terrace land of the White River and its tributaries is valued at $25 to $60 an acre, depending on the location and improvements. The bottom land along the White River is valued at $25 to $30 an acre. A comparatively small area of upland north and east of Crawford compares in value very favorably with the alluvial terraces.

Irrigation is carried on quite generally along the Niobrara and White Rivers and their tributaries. 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. In some years, as in the summer of 1915, there is sufficient rainfall to make irrigation unnecessary. A large project for irrigation along the White River was inaugurated near Crawford about 20 years ago, with a capital of $150,000. This was expended, but obstacles were encountered which

prevented the completion of the project and the results obtained were of little importance. The small private ditches, however, have proved very successful. Alfalfa is the main crop grown under irrigation, although some wild-hay land is irrigated. Practically all the terrace and first-bottom land along the White River and the first-bottom soils along the Niobrara River are irrigable.

SOILS.

The soils of Dawes County are grouped into two general classes, residual soils, formed through disintegration and decomposition of the underlying bedrock, and transported soils of alluvial or colluvial origin.

The oldest rock beds are the Niobrara and Pierre formations of Cretaceous age. The Niobrara formation, mostly a chalk rock exposed in the northeastern part of the county, has not given rise to extensive soil areas. The Pierre formation outcrops very generally over the greater part of the area of the county north of the White River, where it has been pushed up along the southern border of the Black Hills uplift. It consists of dark to slate-colored shale which weathers into heavy clay soils of rather uniform character.

Lying irregularly or unconformably upon the Pierre shale are the Tertiary beds. As grouped by geologists they consist of the Chadron and the Brule formations of the unconsolidated White River beds, and the Gering and Arikaree formations of the Loup Fork beds. The Chadron is exposed in thin remnants in the northwestern part of the county where its weathered product, mixed with the underlying Pierre shale material, forms a clay loam soil. South of White River it underlies the Brule clay formation in thin beds and weathers into a sandy soil. The Brule clay formation is exposed between the White River and Pine Ridge. It consists of a pale-pink silt to clay, with a high percentage of fine sand, and weathers into a heavy silty to sandy soil. The Gering formation consists of a loosely bound sandstone. It outcrops along lower Pine Ridge, where it weathers into sandy soil. The Arikaree formation consists of gray sandstones with occasional harder layers of impure limestones. It outcrops on Dawes Table and Pine Ridge and over considerable areas bordering the table. The soil weathering from this formation consists of silty to sandy loams.

The Dawes Table, where a capping of Arikaree sandstone has resisted the general down-wearing of the surface that has taken place over this whole region, represents the remnant of an ancient plain. Erosion of this plain has exposed the lower lying formations, each of which gives rise to a different soil type. The first stage was the erosion and removal of the harder materials, followed by cutting down into the softer layers. This was accomplished during the

period of the Black Hills uplift. The second stage was a period of sluggish flow and deposition, during which time the present material of the alluvial terraces was deposited. The present stage is one of erosion over the entire area. During all the stages, the White and Niobrara River Valleys have been constantly widening by the action of tributaries.

The stages of development of the Niobrara River Valley are not so clearly defined as those of the White River Valley. The first stage, however, was the same in both cases, namely, the removal of the top layer of Arikaree material. In the case of the Niobrara Valley the process of erosion was not influenced by the Black Hills uplift and the softer layers have not been reached. A period of deposition took place, but the stream has not built up a system of high terraces. It is at present eroding the surrounding upland and the low terraces.

The removal of the Arikaree and Gering formations has exposed the underlying Brule and Chadron formations. North of White River the Arikaree and Brule material and most of the Chadron have been removed by erosion, leaving the Pierre exposed.

Small areas of alluvial land occur along the streams throughout the county. These include terrace, colluvial, and first-bottom soils, formed by the reworking of Arikaree, Gering, Brule, Chadron, and Pierre materials.

The extensive exposures of the Arikaree formation where drainage is well established have weathered into a distinct group of soils known as the Rosebud series. The parent rock consists of loosely consolidated, fine-grained, calcareous sandstones. The resulting soils in this county are fine sandy loams and silt loams, having brown to grayish-brown surface soils. The subsoils are of a lighter color and have a high lime content. The proportion of white calcareous material, which is finely divided and floury, increases to a depth of 3 feet or more. These soils are easily eroded and in hilly sections white bare spots are a feature of the landscape. In Dawes County the Rosebud fine sandy loam, very fine sandy loam, and silt loam are mapped.

The soils of the Pierre series occur in the northern part of Dawes County, where the drab or slate-colored shales of the Pierre shale formation are exposed to weathering. The soils weathered from these shales have a characteristic color that may be described as olive brown. The subsoil is usually similar in color to the surface soil, but where the soil covering over the shale is shallow it may have a dark-drab or slaty color. The lighter textured soils of this series have been modified by the overlying Chadron formation and have a lighter color. A characteristic feature of the heavy soils of the Pierre series is their extremely sticky nature, which gives them the local name of

"gumbo" wherever they occur. The topography consists of a succession of rounded hills and ridges, with narrow intervening valleys. In this survey the Pierre loam, silt loam, silty clay loam, clay loam, and clay types are encountered.

The surface soils of the Dunlap series are brown to dark brown in color. The subsoils consist of brown to dark-brown, heavy, compact silty clay loams. The series occupies the flat tops of the high tables representing remnants of the original High Plains, and the topography varies from almost level to undulating. The soils are derived from the fine-grained, calcareous sandstones of the Arikaree formation, by weathering under conditions of restricted drainage. The soils of the series differ from those of the Rosebud in their heavy, compact subsoils and more nearly level topography. The silt loam type is the only member of the Dunlap series encountered in Dawes County.

In the soils of the Dawes series the 3-foot section shows three distinct strata. The surface soil has a brown color not unlike that of the corresponding types of the Rosebud series. The upper subsoil, beginning at a depth of 8 to 12 inches and having a thickness of 6 to 12 inches, is a brown or dark-brown, heavy, compact silt loam to silty clay loam. The lower subsoil is a light-yellow or almost white, calcareous silt loam, resembling the lower subsoil of the Rosebud series. The Dawes soils occur in the White River Valley and have a topography ranging from gently to sharply rolling. They are mainly residual in origin, being derived by weathering from several light-colored silty and fine sandy formations, including the Brule and Chadron and in places the Arikaree. The surface soils have been modified by wind-blown and colluvial materials. In this county the Dawes very fine sandy loam and silt loam types are mapped.

The Epping series includes types with light-brown to grayish-brown surface soils and light-buff to flesh-colored, silty or silty clay subsoils, usually somewhat heavier than the surface layer. The material throughout the 3-foot section is highly calcareous. The topography ranges from gently rolling to almost level. The soils are residual from the Brule clay formation. The material erodes badly and incipient bad-land areas are a feature of the landscape. In Dawes County the Epping series is represented by the silt loam and silty clay loam types.

The surface soils of the types correlated with the Tripp series are brown to dark brown. The subsoils are light brown to grayish brown. Both surface soil and subsoil have a high lime content. The series is alluvial in origin, being developed on high terraces above the reach of overflows. The material consists of sediments brought down from exposures of the Arikaree and the Brule formations.

The topography is almost level, but drainage is good. In Dawes County the Tripp very fine sandy loam and silt loam types, each with a colluvial phase, occur.

The soils of the Orman series occur on terraces within or bordering outcrops of Pierre shale and consist largely of reworked Pierre clay. The surface soils are brown and the subsoils brown or yellowish brown, but both have the slaty or olive-brown tinge characteristic of the Pierre soils. The substratum, occurring at any depth from 3 to 10 inches, consists of Pierre shale. The topography is flat to undulating. The soils, like those of the Pierre series, are sticky when wet and bake hard when dry. The Orman silt loam and silty clay loam are mapped in Dawes County.

The Laurel series includes light-brown to gray surface soils and yellowish-brown to light-gray subsoils. The types of this series occur in first-bottom situations subject to overflows. The material is composed of sediments derived from the Brule, Arikaree, and other light-colored formations. This series is characterized by a high lime content in both surface soil and subsoil. The Laurel fine sandy loam, very fine sandy loam, and silty clay loam types are mapped in Dawes County.

In addition to the 20 types grouped in the 8 series recognized, two types of miscellaneous material are mapped. Rough broken land includes areas of dissected land too rough to permit of cultivation. The type mapped as Badlands includes areas where swiftly flowing waters have eroded the land into a peculiar sharply dissected topography and the greater part of the surface is bare of vegetation.

In the following pages of this report the various soils and miscellaneous types encountered in Dawes County are described in detail and their relation to agriculture discussed. The distribution of the various soils is shown on the map accompanying this report, and the table below states the actual and proportionate extent of each:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Pierre clay	180,032	20.1	Pierre silty clay loam	11,520	1.3
Rosebud very fine sandy loam	175,040	19.5	Tripp silt loam	4,672	1.1
Dawes silt loam	85,504	9.5	Colluvial phase	5,376	
Rosebud fine sandy loam	83,136	9.3	Orman silty clay loam	8,704	1.0
Rough broken land	80,128	8.9	Laurel fine sandy loam	8,576	.9
Rosebud silt loam	78,848	8.8	Badlands	8,384	.9
Dunlap silt loam	60,416	6.7	Pierre silt loam	5,120	.6
Dawes very fine sandy loam	25,024	2.8	Epping silty clay loam	4,352	.5
Tripp very fine sandy loam	18,752	2.5	Epping silt loam	2,944	.3
Colluvial phase	3,712		Orman silt loam	2,880	.3
Pierre clay loam	15,488	1.7	Pierre loam	1,408	.2
Laurel silty clay loam	14,144	1.6			
Laurel very fine sandy loam	13,120	1.5	Total	897,280	

ROSEBUD FINE SANDY LOAM.

The surface soil of the Rosebud fine sandy loam is a gray to brown, loose fine sandy loam, averaging in depth about 12 inches. It is underlain by a lighter colored fine sandy loam, generally a little more compact than the surface soil. The loose structure, however, often continues to a depth of 36 inches, although the subsoil at a depth of about 24 inches sometimes becomes a silt or a very fine sandy loam. The subsoil is always light in color, varying from pale yellow to light gray. The organic-matter content of the type is comparatively low. Rock fragments are encountered in the lower part of the 3-foot section, although they are less common than in the other types of this series. The surface soil, being loose and incoherent, has been modified to a considerable extent by wind action. Small areas of almost typical Dunesand, not extensive enough to separate, are included with this type as mapped.

In places on slopes the loose sand has been washed or blown away and the calcareous material of the underlying Arikaree formation is exposed, giving rise to the white spots on the hillsides which are a characteristic feature of the landscape in areas of this type.

The Rosebud fine sandy loam occurs mainly in the southern part of the county along the slopes to the Niobrara Valley. It generally lies on a lower level than the other types of the series. The topography is in general gently rolling to rolling, but in places the areas extend over rather gentle slopes near the Niobrara River. Only a short distance back from the stream, however, the topography is rolling. The drainage is everywhere very good. On account of the open structure of the subsoil much of the drainage is underground, and where this is the case, as on gentle slopes, fewer small streams are developed, so that the topography is smoother.

This type is quite extensive, but it is not of much agricultural importance, owing to its comparative remoteness from railroads and its tendency to blow badly when plowed. About 95 per cent of its total area is used for grazing. Wild hay is harvested in the valleys and yields about one-third ton per acre. Corn is grown in small patches in well-protected areas. It produces about 10 to 20 bushels per acre. This yield is not profitable, but the crop is useful for feed. Potatoes are apparently fairly well adapted to this soil, yielding about 70 bushels per acre. They are grown mainly near Marsland. Excellent grasses grow on this soil, the principal varieties being sand grass and grama.

Cattle and horses are pastured on this type. Grade Hereford is the principal type of cattle, but there are some grade Shorthorns. About 8 acres of land are required to support each head of stock where the pasturage is supplemented by feeding hay during stormy

periods. The cattle are usually shipped in the fall, when two or three years old.

This soil is easily worked on account of its loose nature. No fertilizers are used and no crop rotation is practiced. It is questionable whether a more intensive type of agriculture would be profitable. Under improved market conditions, the raising of potatoes might become an important industry. The land is valued at $8 to $10 an acre.

ROSEBUD VERY FINE SANDY LOAM.

The surface soil of the Rosebud very fine sandy loam is a grayish-brown to dark-brown very fine sandy loam 10 to 14 inches deep. It is underlain by a grayish-brown very fine sandy loam subsoil, which in many places changes to a fine sandy loam at a depth of 24 inches. The subsoil sometimes contains more silt than the surface soil, which tends to give it a compact structure. Light-colored rock fragments are often encountered in the lower part of the 3-foot section. Small areas having a heavy loam subsoil are included with this type as mapped, occurring where the topography is nearly flat.

This type is extensively developed over the slopes of the Dawes Table, and is the predominating type over several townships in the southwestern part of the county, both north and south of Pine Ridge. Along the southern slopes of the Dawes Table it occurs mainly in long, narrow strips with intervening similarly outlined areas of the fine sandy loam and silt loam of the series. Along the northern slope it continues as an irregular strip at the foot of the bluffs of Pine Ridge to the eastern county line.

The Rosebud very fine sandy loam is derived mainly from the Arikaree formation, and to a less extent from the Gering. The areas derived from the Gering formation occur on the rolling slopes at the foot of Pine Ridge. Bedrock occurs at varying depths and outcrops very generally along the canyons. The topography of this type is quite rolling. The streams are for the most part deeply intrenched and bordered by steep slopes. All the land is thoroughly dissected and the drainage is good.

This soil is one of the most important in the county. Approximately 30 per cent of the land is farmed, and the percentage is rapidly increasing, especially in the so-called parks. The most important crops are corn, alfalfa, wheat, and potatoes. Wheat, rye, and potatoes constitute the cash crops, the grain produced being marketed at mills or elevators in the towns. Corn and oats are practically all fed upon the farm where grown, and a large quantity of corn is annually shipped in for feed. As is the case in general throughout the county live stock constitutes the principal source of farm income. A large part of the type is used for pasture, although

the general practice is to farm this soil and the silt loam, and to use the sandy soils for pasturage, where they all occur on the same farm. Hogs are raised on practically every farm in small numbers. Cattle are kept on the range, and some farmers fatten cattle during the winter, but most of the stock is shipped in the fall after coming off the summer pasture. Hereford and Shorthorn are the principal beef types. Dairying is not carried on extensively, but practically every farm has some dairy products to sell.

Wheat and rye are harvested in July and August. The grain is usually marketed from the thrashing machine. Potatoes are harvested in October and are sold to eastern buyers who contract for the crop. The semihumid climate gives a dry, mealy potato which it is difficult to produce in the more humid regions. Potato growing, however, is a relatively unimportant industry. Corn yields on an average about 15 bushels per acre. Wheat and rye yield 12 to 15 bushels and oats about 25 bushels. Potatoes average about 80 bushels an acre, and yields of 200 bushels are frequently obtained.

The soil is friable and easy to till. Corn is usually surface planted, as it gets an earlier start in this case than where listed. It is usually not given more than two cultivations. The small grains are usually disked in, after being sown broadcast on old stubble or corn ground. No commercial fertilizers are used on this soil and practically no manure is applied.

The value of land of this type of soil depends largely on the location. Land nearest town probably would bring as much as $35 an acre, but that south of the table is not valued at more than $15 to $20 an acre.

Alfalfa does well on this type and is a profitable crop, not only for feed, but also for the seed usually obtained, which is sold. Much more alfalfa could be grown on this soil than is now produced. Potatoes produce well, but market conditions are not favorable and it is doubtful whether more extensive production would be profitable at present. Better methods of seeding small grain, the more extensive substitution of fall wheat for spring wheat, and better cultivation of corn have all proved profitable wherever tried. The failure to utilize the manure which accumulates represents a considerable waste.

A variation in the type deserves special mention. It occurs in the vicinity of Crawford, on the gentle slopes stretching from the bluffs of Pine Ridge, and constitutes the greater part of the Rosebud very fine sandy loam in the semicircle south of Crawford formed by a bend in Pine Ridge. This soil is a brown very fine sandy loam, with little change in color or texture to a depth of 24 to 30 inches. Below this depth the material is light brown in color and slightly heavier in texture, being in some places a whitish sticky sandy loam and in others a silty loam, as is typical of the Rosebud soils. The soil of this

variation occupies gently rolling slopes. In places there is an almost level topography, suggestive of a terrace. The more level areas occur on the lower slopes, while the land near the bluffs is more rolling. In the higher situations the material is wholly residual, but on the lower slopes the greater depth of the surface soil doubtless consists of colluvial and wind-blown materials. This is one of the best soils in the county. It is mellow and easily tilled, and is very retentive of moisture. Corn and small grains are grown very successfully and alfalfa yields well on the lower lying areas.

ROSEBUD SILT LOAM.

The surface soil of the Rosebud silt loam, to an average depth of about 10 inches, consists of a silt loam containing varying proportions of fine sand and very fine sand. The material is usually brown in color, but ranges from light brown or grayish brown to rather dark brown, the shade depending upon the content of organic matter. The darker soil occurs on the more nearly level areas, where conditions have favored the accumulation of organic material. The upper subsoil is a light-brown silt loam, passing into yellow or grayish-yellow, almost pure silt. At a depth of about 30 inches a white, floury, calcareous silt is usually encountered. The unweathered Arikaree sandstone occurs below the 3-foot level and in the more rolling areas it outcrops in places, giving rise to characteristic white spots on the hillsides.

The type is characterized by a high percentage of soluble salts, but no dangerous accumulation has taken place in the surface layer. There is a moderate lime content in the surface soil. The proportion increases rapidly in the subsoil, and the white material of the lower subsoil is largely composed of lime.

The typical Rosebud silt loam has been derived, by weathering, from the calcareous sandstone of the Arikaree formation. The weathered products of other formations have been included in places. In the northeastern part of the county the type is mapped over exposures of the Niobrara formation, and in the White River Valley the soil has been modified by materials from the Chadron and Brule formations. The Rosebud silt loam is extensively developed on the southern slopes of the Dawes Table, where numerous areas occupy stream divides extending in a northwest-southeast direction. On the north slope of Dawes Table this soil occupies the so-called park areas of Pine Ridge, and it occurs in numerous small bodies in the White River Valley. The topography ranges from gently sloping to rolling along the streams. In the parks the type generally occupies broad, nearly flat divides. The slope and the porous nature of the subsoil insure drainage.

This type is not extensive. Probably about 35 per cent of its area is under cultivation. Wheat, corn, oats, alfalfa, and potatoes are the most important crops grown. The agricultural methods followed and the crop yields are practically the same as in the case of the Rosebud very fine sandy loam. Wheat probably gives a little better yield and for that reason it is the most important crop.

The soil is a little heavier in texture and more compact than that of the very fine sandy loam, and is consequently slightly harder to cultivate. It contains, however, sufficient sand to make the soil break up well when plowed. It is said that this type holds water better than the sandier soil and for this reason it is more valuable. The land is valued at about $25 an acre.

PIERRE LOAM.

The surface soil of the Pierre loam, to an average depth of 8 inches, is a grayish-brown or brown loam. The coarser material consists largely of silt and very fine sand. The subsoil is a grayish-brown or olive-brown clay loam or clay.

This type occupies small, isolated areas in the northwestern part of the county. It occurs where thin layers of the Chadron formation overlie the Pierre shale. The surface soil is derived either entirely from the Chadron formation or from the Pierre shale with a considerable admixture of Chadron material. The upper stratum of the Pierre loam contains beds of quartz gravel and agate fragments, and over small areas these occur in great abundance.

The Pierre loam usually occupies a position slightly above the level of the surrounding country, where the Pierre shale has been protected from erosion to some extent by the Chadron formation. The land is rolling and in places sharply eroded. Drainage is everywhere good.

None of the type is under cultivation, but the greater part is used for grazing. The soil would have a slightly higher valuation than the Pierre clay if it were conveniently situated for farming. The selling price at present is that commanded by pasture land, about $4 to $6 an acre.

PIERRE SILT LOAM.

The surface soil of the Pierre silt loam is a brown or grayish-brown, rather heavy silt loam, having an average depth of about 10 inches. Below this depth there is an abrupt change into a brown or olive-brown, compact silty clay loam or clay. This subsoil material in some places continues to a depth of more than 3 feet, while elsewhere it grades into a yellowish-brown, more friable silty clay loam at any depth below 24 inches.

The Pierre silt loam occurs in the deeper part of the valley of White River, extending southward up some of the tributary valleys.

Near the areas of Pierre clay it consists of the weathered product of the Pierre shale, modified by thin overlying beds of the newer, sandier formations. Farther back from the Pierre shale outcrop the characteristics of the material of that formation are less noticeable, and it is probable that the type in the more southerly areas is derived entirely from heavy members of the Brule clay formation.

Only a small proportion of the type is cultivated, the greater part being used as pasture and hay land. Wheat and corn are grown. The yields are slightly below the average for the region. The land is well situated in regard to roads and markets.

The selling price of land of the Pierre silt loam varies from $10 to $15 an acre.

PIERRE SILTY CLAY LOAM.

The Pierre silty clay loam consists of a light-brown or olive-brown silty clay loam, 8 to 10 inches deep, underlain by a very compact, yellowish-brown or olive-brown material ranging in texture from silty clay loam to stiff clay, and extending to a depth of 20 inches. The lower subsoil, from the depth of 20 inches to the bottom of the 3-foot section, is slightly more friable than the upper subsoil. The surface soil, particularly near the areas of Pierre clay, differs from the surface soil of that type only in its more silty texture. It has the same sticky character when wet and bakes hard and cracks upon drying in much the same fashion. There is a gradual increase in the silt and fine sand content of the type away from the Pierre clay, where the soil is modified by larger proportions of sandier materials of other formations. In some of the areas farthest away from the White River the soil is probably derived entirely from heavier beds of the Brule clay formation.

The type occurs along the White River Valley. Areas extend for several miles up some of the deeper tributaries. The topography is for the most part rolling, the contour being very similar to that of the vast areas of Pierre clay to the north. Drainage is invariably good.

The Pierre silty clay loam is not extensive and the type is of little agricultural importance. It is used principally for grazing. Cattle for fall shipment are pastured on it in the late summer. The land has a value for farming somewhat higher than that of the Pierre clay. The selling price approximates $10 an acre.

PIERRE CLAY LOAM.

The surface soil of the Pierre clay loam, extending to a depth of 8 to 15 inches, consists of a brown clay loam. The silt and very fine sand that make up the greater part of the coarser material give the soil a more loamy and friable structure than that of the Pierre

clay, but the proportion is not sufficient entirely to destroy the sticky, tenacious character of the soil when wet. The subsoil is a brown or olive-brown clay, not unlike the subsoil of the Pierre clay. It is very sticky when wet and bakes hard upon drying. Below 20 inches the subsoil when dry is more friable, but it is still very compact and assumes a polish where rubbed with the soil auger. There is a wide variation in depth, color, and texture of both surface soil and subsoil.

The Pierre clay loam occurs principally in the northwestern and northeastern parts of the county. It usually occupies hills or table-like buttes standing above the general level of the surrounding country. This position is attributable to the resistance offered to erosion by beds of the Chadron formation, which is left locally as a cap, protecting the underlying softer Pierre shales. The greater part of this type is derived from two formations. The surface soil has weathered from the Chadron formation, which breaks down into a silty or sandy soil, while the subsoil has weathered wholly or in part from the Pierre shale. The depth and texture of the soil depends upon the thickness of the Chadron material and the thoroughness with which weathering has taken place.

The type is unimportant agriculturally, and is used only for grazing. Much of the land is covered with rock fragments and does not support a good stand of grass. Land values average about $3 to $5 an acre.

PIERRE CLAY.

The surface soil of the Pierre clay, which has a depth of 10 to 15 inches, is a light-brown to olive-brown heavy, sticky clay. The subsoil is a drab, olive-brown or slaty-colored heavy clay. In many places there is little difference in color between surface soil and subsoil. Below a depth of 30 inches the subsoil is mottled dark gray and drab, with occasional iron stains. Frequently the slaty-colored shale from which the soil is derived is encountered within the 3-foot section. The sand of this type is mostly of the finer grades. There is a large percentage of silt in both surface soil and subsoil, but the content of this material is not noticeable, on account of the sticky character of the clay. Its tenacity when wet is one of the most constant properties of the type, whatever variations may occur in the color or texture, and has given rise to the local name of "gumbo," applied to the heavy soils of the Pierre series.

The Pierre clay is the most extensive soil in the county, and it covers larger uniform areas than any other type. It occupies almost the entire area north of White River and Big Cottonwood Creek. A large area lies between Big Cottonwood and Little Cottonwood Creeks and several smaller bodies occur in the deeper valleys to the

south of the White River Valley, in the northeastern part of the county.

The entire area of the Pierre clay is dissected into a succession of characteristic rounded hills and ridges, with narrow intervening valleys. Surface drainage is good.

Only a small percentage of the land is cultivated, the remainder being used for pasturage and wild-hay production. Corn and wheat are the principal crops grown. On account of the droughty nature of the soil the yields are ordinarily low. Wheat yields on an average about 10 bushels per acre and corn 12 to 15 bushels. Much better yields are obtained in favorable seasons. The yield of wild hay averages about one-half ton per acre on the hills and about 1 ton in the valleys. Haying begins about August 10 and continues until the occurrence of frost. The hay has a reputation for high feeding value. The soil is particularly well adapted to the western wheat grass (*Agropyron tenerum* Vasq.) and in good seasons or in well-watered valleys this very valuable hay crop gives large yields. It is stated that work animals keep in good condition upon this hay without grain.

The Pierre clay is naturally a strong soil, but its sticky nature when wet makes it less desirable than the soils of lighter texture. If plowed when too wet the soil upon drying bakes into hard clods that are difficult to pulverize. If allowed to get dry the soil becomes too hard to break. Unless a surface mulch is worked up at the proper time after rains, moisture is lost very rapidly and crops quickly suffer. If plowing is done at the proper time the soil breaks up into small granules and a mulch is worked up that is very retentive of moisture. On account of the care required in the use of this soil and its droughty nature under ordinary cultivation, it is not likely that it will be extensively cultivated until the more tractable soils have been taken up.

Land values on the Pierre clay depend largely on the location and water supply. The well water is of very poor quality, and the water used is obtained mainly from the damming up of small streams or from water holes in the larger ones. Much of this land lies 20 miles or more from a town. Its value ranges from $3 to $15 an acre.

DUNLAP SILT LOAM.

The surface soil of the Dunlap silt loam, extending to a depth of 12 to 15 inches, is a dark-brown, friable silt loam. Usually the soil is a typical silt loam, but in places it contains a relatively large proportion of fine and very fine sand. The upper subsoil passes quickly from a heavy silt loam into a brown or dark-brown silty clay loam, and at a depth of 16 to 22 inches grades into a stiff, compact,

almost impervious silty clay loam or clay locally known as hardpan. The subsoil may continue heavy in texture to a depth of more than 3 feet, or it may become more friable below a depth of 30 inches. Occasionally fragments of the Arikaree sandstone, from which the type is derived, occur in the lower subsoil. The surface soil and the heavy layer of the subsoil are only moderately calcareous, but where the heavier subsoil is friable and approaches the bedrock there is a high lime content.

The Dunlap silt loam covers an area of many square miles on the Dawes Table in the southeastern part of the county. The type occurs mainly in one continuous body, but its outline on the south is very ragged. The Dawes Table is a remnant of the original High Plains, into which streams are rapidly extending their valleys. The original plateau has been almost cut across by streams, and it now occurs on divides which narrow toward the southeast. The area as a whole is wedge-shaped, the large end extending toward the center of the county, and the smaller end tapering toward the southeast. Several small outlying remnants of the type occur between the higher part of the Dawes Table and the Niobrara River.

The Dunlap silt loam occupies the top of a plateau, which appears level from a distance, but is in detail undulating, and tilted slightly toward the southeast. Local drainage has not been thoroughly established, but the porous nature of the lower substratum and the gentle slope are sufficient to dispose of the low rainfall except in a few small depressions, where the subsoil is very heavy.

The Dunlap silt loam has been derived from the light-colored sandstones and clays of the Arikaree formation by undisturbed weathering under conditions of poor drainage. This process has resulted in the concentration of clay in the subsoil and in the removal of a large part of the lime content from the surface soil and upper subsoil.

About 40 per cent of this type is under cultivation. Wheat, rye, corn, alfalfa, oats, and potatoes are the principal crops. Wheat yields on an average about 12 bushels per acre. It is usually sown broadcast in the spring and disked in. Fall wheat is increasing in popularity, as yields have been good. The acreage of rye is almost equal to that of wheat. Rye is usually sown on stubble ground and disked in. The yield is about 12 bushels per acre. Corn gives an average yield of about 15 bushels per acre. It is usually surface planted, on account of the heavy nature of the subsoil. Corn is cultivated two or three times. About 20 per cent of the corn planted is cut for fodder; the remainder is husked in the fall. Alfalfa usually is cut twice, yielding about 1½ tons of hay per acre. A seed crop of about 1½ bushels per acre can usually be obtained if a second cutting

of hay is not made. The seed is sold to local dealers and distributed to various parts of the United States. In growing alfalfa the common practice is to plow the ground in the spring, harrow and pack the seed bed, and sow the seed in the latter part of May. No crop is obtained until the following year.

This soil is friable and quite easily tilled. It is not hard to keep in good condition if proper attention is given to cultivation. No definite system of crop rotation is followed, although a good rotation is more nearly approached than on any other type, and the farm manure produced is more economically used. The land is held at $25 to $30 an acre, the price depending largely on the improvements.

Hog raising could well be carried on more extensively on this type. Alfalfa yields well and enough corn can be grown to feed the stock while foraging on the alfalfa pasturage. It is doubtful whether it would be profitable to grow enough corn to fatten all the hogs that could be raised on the farm. The substitution of fall wheat for the spring varieties has been successful in all cases. The main drawback to this change is the necessity for plowing in the fall, when the ground is dry.

DAWES VERY FINE SANDY LOAM.

The surface soil of the Dawes very fine sandy loam consists of a brown, friable very fine sandy loam, 8 to 12 inches deep. The upper subsoil, above the depth of 16 inches, is a more compact, light-brown very fine sandy loam or silt loam. The upper subsoil ranges in structure from only slightly heavier than the surface soil to a very compact hardpan. The lower subsoil, extending from the 20-inch to the 36-inch level, is a light-yellow or light-gray very fine sandy loam, similar to the lower subsoil of the sandy Rosebud types. The surface soil is only moderately calcareous, but the lime content increases with depth, being very high in the lower subsoil. The type in nearly all its occurrences is made up of the three layers, but the heavy intermediate layer in places is very thin or loosely consolidated. There is also considerable variation in the thickness of the three strata.

The Dawes very fine sandy loam occurs in the lower valley of White River, mainly between Crawford and Chadron. A few isolated areas are scattered over the southern slope of the valley almost to the foot of the bluffs. The type occurs mainly over rolling ridges and slopes. The smoother areas are usually encountered near the White River, but sharply dissected patches may occur in any part of the type. The drainage is invariably good.

Probably 35 per cent of the total area of the Dawes very fine sandy loam is under cultivation. The principal crops are alfalfa, corn,

and wheat. The wheat and part of the alfalfa are sold for cash, while the corn is practically all fed to stock on the farm. Oats and spelt are grown to some extent for feed. Potatoes are not an important crop. The rolling land is in general used for pasture. Few farms are operated on this type alone, most of them including areas of the Dawes silt loam and alluvial soils. Grade Hereford and Shorthorn cattle are raised. Milk and butter are produced on nearly every farm to supply home needs, and on some farms there is a surplus for sale.

Alfalfa yields about 1 ton per acre at a cutting, and two cuttings are generally harvested. Where the crop is irrigated three good cuttings are possible. If a seed crop is desired, only one cutting of hay is made. The seed is harvested in September, yielding from 1½ to 4 bushels per acre. Wheat yields 12 to 15 bushels per acre. Spring wheat predominates, but fall wheat is increasing in acreage steadily. Corn yields average 15 to 20 bushels per acre.

This soil is friable and easy to handle. Listing and checking of corn are about evenly divided in favor. A considerable acreage is fall plowed when the season is not too dry. Wheat is usually sown broadcast and double disked into old stubble or corn ground, but a few of the best farmers plow the ground and drill the seed in. No definite crop rotation is followed on this type, and no fertilizer, except a small proportion of the farm manure produced, is applied to the crops.

The flat land of this type northeast of Crawford is valued at $25 to $35 an acre. The more rolling land, used mostly for pasture, is held at $10 to $15 an acre.

As corn and alfalfa both produce well on this soil, it would apparently be profitable to fatten more stock instead of shipping feeders. More hogs also could be raised, as they need little grain to supplement alfalfa pasturage.

DAWES SILT LOAM.

A 3-foot profile of the Dawes silt loam shows the three layers characteristic of the series. The surface soil to an average depth of 8 inches is a brown to rather dark brown silt loam. The upper subsoil, which has a thickness of 6 to 12 inches, is a brown to dark-gray, heavy, compact silty clay loam. The lower subsoil is a yellowish-brown, buff-colored or almost white, heavy silt loam, similar to the lower subsoil of the Rosebud silt loam. There is considerable variation in the type in texture, color, and relative thickness of the different layers. The soil is lighter colored and often heavier in texture on slopes than in the smoother areas. In places the lower subsoil is a very fine sandy loam.

The Dawes silt loam is mainly residual in origin, being derived by weathering from several light-colored silty and fine sandy formations, including the Brule and Chadron and in places the Arikaree and Gering. The greater part of the surface soil material is doubtless derived from the Brule formation, modified by wind-blown and colluvial material from the other formations. The lower subsoil is nearly everywhere derived solely from the Brule clay formation.

This type occurs mainly in the White River Basin, between Pine Ridge and the alluvial lands of White River. Other areas occur north of this stream, near Crawford. In places the surface is that of a gently rolling plain, as between Crawford and Whitney. In other places the type has been deeply eroded, giving rise to a steeply rolling topography. The slope is always sufficient for adequate drainage.

This type is the third most extensive in the county. Approximately 15 per cent of the land is under cultivation, the remainder being used for pasture or wild-hay production. Wheat, corn, alfalfa, oats, rye, barley, and spelt are the principal crops, named in the order of relative importance. Wheat and rye are grown for sale, while the corn, oats, and other small grain produced, and most of the alfalfa crop, is fed to stock on the farm. The live-stock industry consists of the raising of cattle to be sold at the age of 2 or 3 years. Some cattle are fattened for market. A few hogs are raised on every farm. Dairying is not carried on extensively, except on a few farms which supply the demand of towns.

Corn on this type yields about 12 bushels per acre, wheat and rye 10 bushels, oats and barley about 20 bushels, and alfalfa 1 to 2 tons of hay. The pasture land is about equally divided for summer and winter use. About 10 acres of land are necessary to support each head of stock, and in winter hay is required to supplement the pasturage.

Over the greater part of the area of this type the soil is easily tilled. Where the surface soil has been partly removed by erosion, so that the heavy layer lies close to the surface, the land is best adapted to use as pasture. In the smooth areas the soil is friable and easily farmed. Fertilizers are not used extensively on this soil, and only a small percentage of the farm manure produced is applied to the land. No crop-rotation system is followed.

Land values depend largely on the location and topography. The most isolated, rough land is not valued at more than $8 to $10 an acre, while the flat land is held at $25 to $30 an acre. Land values in general range between the two extremes.

The success encountered with alfalfa on this type indicates that the more extensive growing of this legume would be profitable. There is generally a good market for the hay and the seed is always salable.

EPPING SILT LOAM.

The surface soil of the Epping silt loam is a gray to light-brown, rather heavy silt loam, 8 to 10 inches deep. The upper subsoil is a lighter colored, heavy silt loam. Below 24 inches the subsoil is usually lighter in texture, in places passing into the pink silty material of the Brule clay, from which the type is derived. In the level areas the soil has a thin covering of light-colored silt that gives a whitish appearance to the surface layer. The type is not uniform over large areas, the depth and character of the surface soil varying with the topography and the progress of erosion. Dissection has been rapid; the stream banks are bare of vegetation and incipient Badlands are a feature of the landscape. The topography is for the most part rolling, but small flats bare of plant growth occur in the region of the Badlands.

This type is developed in several areas in the western part of the county, northwest of Crawford. It has a low agricultural value. Little of the land is cultivated, the greater part being used for grazing. The grass growth on much of the type is sparse even in favorable seasons. The selling price of the land ranges from $3 to $5 an acre.

EPPING SILTY CLAY LOAM.

The surface soil of the Epping silty clay loam consists of a gray, light-gray or light-brown, heavy silty clay loam, 8 inches deep, underlain by a gray, very sticky clay which extends to a depth of 16 inches. Below this the texture gradually becomes lighter, until at the depth of 3 feet the material is often a heavy silt loam. Both surface soil and subsoil are strongly impregnated with alkali. The surface, particularly in the deeper basins, is often covered with a thin crust of light-colored silt, which gives the land a whitish appearance.

The type is not extensive. It occurs in several isolated areas northwest of Crawford and in small developments over exposures of the Brule clay, from which it has been derived through weathering. It usually occupies long flats and basins within or near the areas of Badlands, although in some places the topography is gently rolling. The flats and basins are level to undulating, and drainage is poorly established. None of the land is under cultivation. It is used only for hay production and for pasture. It is not valuable for either of these purposes and much of the surface is bare. On the average about 20 acres of this land are required to pasture a steer. The selling price is $3 to $5 an acre.

TRIPP VERY FINE SANDY LOAM.

The surface soil of the Tripp very fine sandy loam is a grayish-brown to brown very fine sandy loam, ranging in depth from 12 to

24 inches. The subsoil is a grayish-brown to yellowish-brown, loose very fine sandy loam, usually lighter textured than the surface soil, in some places being an almost pure very fine sand. In some places, however, there is little change in texture to a depth of 3 feet. When dry the surface soil presents an ashy-gray appearance. Occasionally there are layers of dark material in the subsoil. In all cases where observations were possible it was noted that a sandy substratum extended to a depth of at least several feet below the 3-foot section. One small area where the subsoil is moderately heavy is included with this type as mapped.

The Tripp very fine sandy loam occurs on the high alluvial terraces bordering the White River on each side and along most of its tributaries to the south. The soil material has weathered from a mixture of sediments brought down from the Arikaree, Gering, and Brule clay formations. The topography is flat, or, where erosion has affected it, gently rolling. The drainage is everywhere good. The soil is open structured and readily absorptive, and the texture is favorable to the retention of moisture.

Although this type is not very extensive, it is important on account of its productiveness and adaptability to irrigation. Approximately 65 per cent of it is under cultivation, a proportion higher than that of any other type.

Alfalfa is by far the most important crop, with corn and wheat ranking next. Oats, barley, and potatoes are other crops. The farms on this type usually include some upland. This is used for pasture, while the feed grown on the Tripp soils is used to subsist the stock or for fattening during the winter months. Hogs are raised quite extensively. They are pastured on alfalfa during the summer and by fall are ready to be sent to the Omaha markets as feeders, weighing 100 to 125 pounds. Shorthorn and Hereford cattle are raised. Dairying is carried on a little more extensively than on most of the upland soils.

Alfalfa under irrigation yields about 3 tons per acre per season. In some cases a seed crop is harvested in September, in such cases only one cutting of hay being obtained. Yields of seed range from 2 to 4 bushels an acre. The seed is sold to local dealers and distributed to various parts of the United States. Corn yields about 15 to 20 bushels per acre. Corn is grown for feeding to stock on the farm. About 25 per cent of the corn planted is cut for use as silage or fodder. Wheat yields about 10 to 12 bushels per acre. The crop is marketed at near-by elevators and mills.

Land of the Tripp very fine sandy loam varies somewhat in value with the location and acreage under irrigation. Valuations range from $30 to $60 an acre.

Some of the farmers on this type have met with success in raising hogs on alfalfa, and it is probable that much more of this kind of feeding could profitably be done.

Tripp very fine sandy loam, colluvial phase.—The surface soil of the colluvial phase of the Tripp very fine sandy loam is a brown to dark-brown very fine sandy loam 16 to 20 inches deep. The subsoil is a light-brown very fine sandy loam. The phase differs from the typical soil in lacking the characteristic light-colored and loose, open structured subsoil. Its topography is gently sloping, while that of the typical soil is flat. The phase occurs along streams flowing out from the Pine Ridge watershed and is derived mostly from reworked Arikaree materials. In places it merges into the lower terrace system of the streams, but more often it is entirely separate. It occurs also at the base of the Pine Ridge area where soil material from the Gering formation has been washed out in the form of alluvial fans. In agricultural value and importance the colluvial phase ranks close to the typical Tripp very fine sandy loam.

TRIPP SILT LOAM.

The surface soil of the Tripp silt loam is a brown to light-brown friable silt loam 10 to 14 inches deep. It is underlain by a layer of slightly heavier silt loam varying from 3 to 8 inches in thickness. This layer in some areas is entirely lacking. The subsoil consists of a light-gray to yellowish-brown silt loam, but generally becomes lighter in texture with depth. Small areas of silt loam terrace soil having a heavy subsoil are included with this type, as mapped, where the areas are too inextensive to be separated as the Orman silt loam. The lower subsoil in the typical areas frequently consists of very fine sandy loam. The layers of silt and sand extend to depths of several feet below the surface. The subsoil of this type is more compact than that of the Tripp very fine sandy loam.

The Tripp silt loam occurs on the high alluvial terraces of White River and its tributaries from the south. It is derived from reworked sediment washed from the Arikaree, Gering, and Brule clay formations. The surface is almost flat, but the drainage is fairly good.

This soil is not so extensive as the very fine sandy loam type. About 50 per cent of the land is under cultivation. Alfalfa is the most important crop, followed by corn, wheat, oats, and barley. Wheat growing is more important on this type than on the very fine sandy loam, the crop being more successful on the heavier soil. The corn grown is all consumed by stock on the farm.

Alfalfa yields are slightly lower than on the sandier type, since the first crop does not get so early a start. Wheat yields about 12

bushels per acre, corn 15 to 20 bushels, and oats and barley about the same as on the very fine sandy loam type.

Alfalfa and wheat are seeded and harvested under the same methods as on the very fine sandy loam. Corn is more generally surface planted. The crop is cultivated two or three times. About 25 per cent of the corn planted is cut for use as silage or fodder.

Land of the typical Tripp silt loam averages in price $25 to $50 an acre, the price varying with the location and the extent of irrigation development.

Tripp silt loam, colluvial phase.—The surface soil of the colluvial phase of the Tripp silt loam consists of a brown to dark-brown, friable silt loam 12 to 16 inches deep. This is underlain by a light-brown, somewhat heavier silt loam containing darker colored layers. This phase differs from the typical Tripp silt loam in the heavier texture and structure of its subsoil and in its sloping topography. It is made up of sediments from the Arikaree formation, the material having been washed down and deposited by streams as colluvial fans or as a covering on hillsides along the valleys of streams emerging from the areas of Rosebud soils. Some of the areas gradually merge with the lower terraces of the streams, while others on the colluvial fans at the foot of the bluffs are entirely separated from the terraces. In agricultural value this phase is but little inferior to the typical silt loam, but the greater part of its area is not so conveniently situated with respect to roads and markets. The same crops are grown on the phase as on the typical soil.

ORMAN SILT LOAM.

The surface soil of the Orman silt loam, extending to a depth of 8 to 10 inches, is a brown or grayish-brown, rather heavy silt loam. Often it has the olive-brown tinge characteristic of the Pierre clay. The subsoil is a heavy silt loam or silty clay loam, having a brown, slaty or olive-brown color. In places the lower subsoil varies from typical, consisting of a light-gray, floury, silty material. More rarely the Pierre formation in position is encountered at depths of less than 3 feet, but it usually lies at depths of 5 to 10 feet below the surface.

The Orman silt loam occurs extensively on the high terraces along Big Cottonwood Creek. Drainage is fairly good and the type lies above the reach of overflows.

This soil consists of reworked Pierre clay material brought down as sediments and deposited as a rather thin covering over terraces.

The soil is more friable and easily worked than the heavy Pierre types of the upland, and it adds greatly to the value of farms in which areas of it are included. About 25 per cent of the type is

under cultivation. Alfalfa and corn are the principal cultivated crops. Alfalfa yields 2½ to 4 tons to the acre, the yield depending upon the extent of irrigation. The soil is not especially adapted to corn and the yield is about 15 bushels per acre. A large part of the type is used as wild-hay land. About 1 ton of hay is produced per acre and the quality is of the best on account of the large proportion of western wheat grass included. The selling value of this land ranges from $15 to $20 an acre.

ORMAN SILTY CLAY LOAM.

The surface soil of the Orman silty clay loam, extending to an average depth of 10 inches, consists of a brown or dark grayish brown silty clay loam. In places the soil has the slaty or olive-brown color characteristic of soils derived directly from the Pierre shale, and like those types, it is sticky when wet and cracks at the surface upon drying. The subsoil is a brown, olive-brown or slate-colored, heavy, compact silty clay loam or clay. In places the lower subsoil is a light-gray silt loam. In color and structure the type resembles so closely the associated Pierre clay that it is difficult to separate the two types. The Pierre shale underlies this type and is often encountered just below the 3-foot section.

The Orman silty clay loam occurs principally on the high terraces north and northwest of Whitney. It is alluvial in origin and represents sediments brought down from the Pierre clay areas. The topography is nearly flat, and drainage is not good, particularly on the lower parts of the terrace. Although this soil here is not overflowed, the rainfall and the run-off from the hills are retained in depressions on the surface, and the heavy, impervious subsoil prevents the removal of the water by percolation.

Not more than 10 per cent of the type is under cultivation. The remainder is used as pasture and wild-hay land. Corn, wheat, and alfalfa are grown on the cultivated areas. Corn yields 12 to 15 bushels per acre, wheat 8 to 10 bushels, and alfalfa 1 to 2 tons of hay. Yields vary widely with the rainfall. A good quality of wild hay, consisting largely of western wheat grass, is cut, yields ranging from one-half to 1 ton per acre.

This soil is difficult to handle. It is sticky when wet and hard when dry, resembling in this respect the Pierre clay. The selling price of the land ranges from $10 to $20 an acre.

LAUREL FINE SANDY LOAM.

The surface soil of the Laurel fine sandy loam is a light-brown to gray, loose fine sandy loam, about 10 inches deep. It is underlain by a light yellowish gray fine sandy loam that grades into a

fine sand at a depth of about 24 inches. The sand becomes coarser with depth, and in the lower part of the 3-foot section the material usually consists of a loose sand with intervening layers of finer sand and silt. The color of the lower surface soil is usually light gray. The content of organic matter in this type is usually deficient. The soil shifts considerably before the wind, and the surface is influenced by wind action where exposed. The type is underlain by sand and small gravel for a depth of several feet.

The soil in the first bottoms along most of the streams flowing into the Niobrara River from the north is included with this type. It differs from the typical Laurel fine sandy loam in that the subsoil is not so sandy and incoherent.

The Laurel fine sandy loam is mapped almost continuously along the Niobrara River. The type occupies the first bottoms and very low terraces along the stream. The surface is nearly flat, and the land close to the stream is rather poorly drained and subject to overflow. High water rarely, if ever, reaches the outer banks.

This type is not extensive, and it is not important agriculturally. The soil is too loose to be safely plowed, on account of its tendency to blow before the wind. Wild hay is the most important crop. Yields range from 1 to 2 tons per acre, depending largely on the extent of irrigation. Alfalfa has been seeded in places and has proved a successful crop. Only a small acreage of corn is grown. The land is valued at $15 to $25 an acre.

LAUREL VERY FINE SANDY LOAM.

The surface soil of the Laurel very fine sandy loam is a grayish-brown to brown very fine sandy loam, ranging from 8 to 12 inches in depth. This is underlain by a yellowish-brown to gray, loose very fine sandy loam, which continues to the bottom of the 3-foot section, interspersed with layers of very fine sand. Frequently the surface soil is underlain by a subsurface layer of slightly heavier very fine sandy loam from 4 to 10 inches thick. A substratum of fine to very fine sand extends downward for several feet. Both surface soil and subsoil are highly calcareous.

The Laurel very fine sandy loam occupies the greater part of the first-bottom land along White River and some of its tributaries. Several narrow, winding areas also occur along the Niobrara River and a few of its tributary streams. The soil is subject to frequent overflows and to the deposition of additional sediment by the streams. The topography is nearly flat and in places the soil is poorly drained. In other areas the drainage is sufficient for the production of grain crops.

The soil does not cover a large total area, but it is the most important first-bottom soil in the county. About 20 per cent of the type is

under cultivation, the remainder being in wild-hay and pasture land. The most important crop is alfalfa. Corn is grown to a small extent and the small grains are grown inextensively. Elm, ash, cottonwood, and box elder constitute the tree growth along the streams. The timber is used principally for fence posts and firewood, though some ash is used for lumber.

Dairying is comparatively well developed on this type, on account of the productiveness of the pasture land, which supports a much better grass growth than the upland types.

Alfalfa yields about 4 tons of hay per acre, in three cuttings. Only a small quantity of seed is harvested. Corn yields about 15 bushels per acre. Wild hay averages 1 to 2 tons per acre. Part of the hay produced is fed; the remainder is baled for shipment.

This land is valued at $20 to $35 an acre, the price depending on the location and drainage.

LAUREL SILTY CLAY LOAM.

The surface soil of the Laurel silty clay loam is a gray or grayish-brown silty clay loam, 10 to 15 inches deep. The subsoil is lighter in texture, grading through a silt loam and sometimes becoming a very fine sandy loam at a depth of 22 to 30 inches. It is gray, yellowish gray or grayish brown in color. In places a very fine sandy loam directly underlies the surface soil and a heavy silt loam is developed in the lower part of the 3-foot section. In other places the subsoil in the upper part is a heavy silt loam and lighter material is not reached above the lower part of the 3-foot section. Usually a substratum of sand, several feet in thickness, occurs below the 3-foot section. Both surface soil and subsoil are highly calcareous.

There is included with this type, as mapped, the bottom land along the streams in the Pierre clay area. The surface soil here is typical in both texture and color, but the subsoil, although a little lighter in texture than the surface soil, is not as light as the subsoil in the areas along the White River. Usually it consists of a heavy silt loam. It is of nearly the same color as the typical subsoil.

The Laurel silty clay loam is mapped in several areas in the first bottoms along the White River and its tributaries. The land is subject to inundation during periods of high water. The surface is flat, but drainage over most of the type is fairly good.

The original material giving rise to this soil consists of sediments brought down from several light-colored formations of heavy texture, modified to some extent by wash from areas of Pierre clay.

About 25 per cent of the type is under cultivation, the remainder being used as pasture land. The principal crops are alfalfa and wild hay. Corn is grown on a small acreage. Alfalfa yields about 2 to 4 tons of hay per acre per season, depending on the irriga-

tion given. Only one cutting of hay is made where seed is harvested. Wild hay yields 1½ to 2 tons per acre. The type is usually included in farms that embrace upland pasture soils, and the hay and corn produced are practically all fed to stock. Cottonwood is the principal tree growth on this soil along the streams.

This soil is rather heavy, but alfalfa does well after a stand is obtained. The land is valued at $15 to $20 an acre.

Small areas of a silt loam variation are included with the Laurel silty clay loam as mapped. The soil here, to a depth of about 10 inches, consists of a light-gray to dark-gray or brownish-gray silt loam. The upper subsoil, to a depth of 18 inches, is a gray or yellowish-gray silt loam, lighter in color than the surface soil. Below this the subsoil to a depth of several feet consists of a yellowish-brown to light grayish brown very fine sandy loam.

Both surface soil and subsoil contain a large percentage of lime. The soil of this variation occurs along White River and its tributaries, principally in narrow bottoms along the small creeks that flow northward from the sandy areas. It occupies a slightly higher position than the other types of the series, but the land is subject to occasional overflows. Alfalfa is the most important crop. It yields 3 to 5 tons per acre. The yield of wild hay ranges from 1 to 2 tons per acre. Much of the hay, both wild and cultivated, is baled and shipped out of the county. Corn is grown to a small extent in some of the better drained areas. The greater part of this land is used as pasture for beef and dairy cattle.

ROUGH BROKEN LAND.

The type mapped as Rough broken land includes the extensive sharply rolling areas which are topographically unsuited to farming. It occurs principally along the sharply dissected escarpment of the Dawes Table and includes the eroded remnant of the High Plains known as Pine Ridge. Where erosion has been severe the surface of the ravines and buttes is almost bare, and there are extensive exposures of sandstone, but the slopes are generally covered with a sparse growth of excellent pasture grasses and shrubs. Over a large part of the southern slopes there is a good growth of pine trees. Originally much of the pine growth was valuable timber, but the greater part of this has now been removed.

At the present time these areas are used only as pasture and timber land. The surface is too rough and easily eroded and the soil too droughty for profitable cultivation. The only tillable areas included are small patches of other types too small to separate on the map.

The Rough broken land is valued only for pasture and sells at $5 to $10 an acre.

BADLANDS.

Badlands is a term applied to certain areas occurring throughout the western part of the Great Plains, where a peculiar form of topography has been developed. On hillsides and along ravines swiftly flowing waters have carried away the silty soils and have cut into the underlying silty slopes, leaving a large part of the surface roughly dissected and bare of vegetation. The large content of soluble salts in the freshly exposed shales has further prevented the growth of vegetation.

In Dawes County the areas of Badlands are small. They usually occur on hillsides. The bare spots alternate with low grass-covered tables and lobes that have escaped erosion between the dissected strips. The prevailing type of soil where erosion has been active is a light-colored, in places pink or almost white, compact silty clay loam or silty clay. The largest developments of the type occur north and northwest of Crawford, near the western boundary of the county. The land is of low agricultural value. It is not cultivated and furnishes only pasturage of low grade.

SUMMARY.

Dawes County lies in the northwestern part of Nebraska, in the physiographic division known as the High Plains. The topography varies from flat in the alluvial table-lands to the very steeply rolling in the Pine Ridge areas. The elevation of the county ranges between 3,000 and 4,800 feet above sea level. Practically all the area is tributary to the White and Niobrara Rivers, and drainage is generally well established.

Dawes County in 1910 had a population of 8,254. Less than half the people live outside the towns. Parts of the county have good transportation facilities. Public roads are well maintained over most of the county, and telephones and rural-mail delivery service reach nearly all sections. Omaha is the principal market for the live-stock products. Towns within the county furnish local markets.

The climate is subhumid and the growing season is short.

The agriculture consists mainly of stock raising, with the production of hay and some grain for feed. The land is comparatively new and no crop-rotation system is followed. A large percentage of the farm manure produced is wasted. Land ranges in value from $3 to $50 an acre, depending on the location, topography, improvements, and soil texture.

The upland soils of Dawes County are residual in origin. The exposure and weathering of different formations of the High Plains have given rise to soils of the Rosebud, Pierre, Dunlap, Dawes, and

Epping series. Wash from these upland soils has produced alluvial soils of the Tripp, Orman, and Laurel series. Miscellaneous types include Rough broken land and Badlands.

The Rosebud soils are quite extensive. The very fine sandy loam and silt loam are important types agriculturally, but the fine sandy loam is used almost entirely for grazing.

The soils of the Pierre series are heavy in texture and are farmed to only a small extent. The clay is the most extensive type in the county.

The Dunlap silt loam is largely under cultivation. This soil is well suited to alfalfa.

The Dawes very fine sandy loam and silt loam are important agricultural soils.

The Epping silt loam and silty clay loam are used almost exclusively as hay or pasture land. The grass growth on these soils is sparse.

A larger proportion of the Tripp very fine sandy loam is under cultivation than of any other type. The silt loam is also farmed extensively. A colluvial phase of each of these types similar to the typical soil in agricultural value is mapped.

The Orman silt loam and silty clay loam are farmed to only a small extent. The silty clay loam is difficult to handle.

The Laurel fine sandy loam is a loose soil, subject to drifting. It is used mainly as wild-hay land. The very fine sandy loam is the most important first-bottom soil in the county. Dairying is well developed on this type. The silty clay loam is used for the production of alfalfa and wild hay.

Rough broken land includes areas of rough, dissected topography, used only as pasture and timber land.

Badlands includes areas eroded by stream action into a peculiar form of topography. It is valued at present only for the scant pasturage afforded.

The Dawes and Rosebud soils are well suited to the production of alfalfa, corn, wheat, oats, rye, barley, and potatoes. Potatoes are especially well adapted to the Rosebud soils. Alfalfa reaches its best development on the Tripp soils, but does well on nearly all the types of the county. A well-balanced system of stock raising, with increased production of alfalfa and corn, should result in marked progress in the agricultural development of the county.

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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.]

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