SOIL SURVEY OF PERKINS COUNTY, NEBRASKA.

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DESCRIPTION OF THE AREA.

Perkins County is situated in southwestern Nebraska, adjoining the northeastern corner of Colorado. Grant, the county seat, is 295 miles by rail west of Lincoln. The county is rectangular in outline, its approximate dimensions being 42 miles east and west and 21 miles north and south. It has an area of 886 square miles, or 567,040 acres.

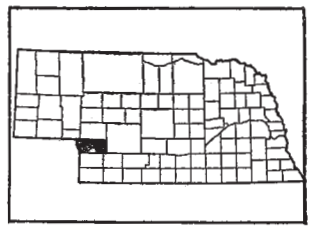

FIG. 31.—Sketch map showing location of the Perkins County area, Nebraska.

Perkins County lies in the Great Plains region, on the eastern edge of the High Plains. Topographically, it is a part of a broad local plain or plateau, designated the Perkins Table by the State survey.

The original surface was a broad constructional plain whose materials were brought down from the elevated region to the west in late Tertiary times and deposited as sediments. The surface, which originally was relatively smooth, has been lowered by wind and water erosion and altered in a small way by deposition of transported materials. There are a few intermittent stream valleys and low hills and numerous shallow depressions, but in general the landscape has no marked relief. The highest hills are remnants of the old plain. They are capped with hard rock and thus have escaped effacement. The shallow basins are without drainage outlets; consequently run-off gathers at their lowest point and escapes either by evaporation or slow percolation through the soil and subsoil. They vary greatly in size, but most of them contain less than 8 acres. They lie only a few feet below the surrounding land and appear to represent depressions in the original plain which have probably been made deeper by wind action. There are numerous developments of local sand-dune topography everywhere, except in the western and northwestern parts of the county. The extreme northwestern corner is very slightly modified by drainage ways. The southeastern part is somewhat more dissected and rolling.

The sand hills, representing outlying areas of the extensive sand-hill region of north-central Nebraska, are most extensively developed in the south-central part of the county. The surface is composed of rounded, rolling, and choppy hills and irregular ridges capped in places by drifting sand and pitted by blow-outs. These features have

a general northwest-southeast trend. Their monotony is mitigated in places by more or less level basins and depressions.

The southeastern part of the county slopes southeastward. It is traversed by numerous drainage ways. Here the topography in general is moderately rolling to rolling, with many gentle slopes, and the divides usually consist of smooth, rounded hills and ridges. A small area adjacent to Stinking Water Creek at the southern county line and about 3 square miles of land in the extreme southeastern corner are capped with loess. These areas are dissected by typical loess canyons, but, owing to their total small extent, the loess topography is developed only in miniature; it is characterized by small gullied drainage ways and by small landslides, which produce a succession of projections known as cat steps.

The stream deposits have a small total area and occur as narrow bands adjacent to the larger drainage ways. Those along Stinking Water Creek include both lower or first bottoms and small higher terraces. In many places, especially in the upper courses of the valleys, the terraces are very old or have suffered modification by wind-blown materials, so that their boundaries can be followed only in a general way and the separation of the soils from the true upland types is more or less arbitrary.

Perkins County has an average elevation of about 3,400 feet above sea level. The general slope is eastward. According to the records of the Chicago, Burlington & Quincy Railroad, the altitude at Venango is 3,591 feet, at Brandon 3,513 feet, at Grant 3,408 feet, at Madrid 3,297 feet, and at Elsie 3,385 feet.

In general, the county is without extensive well-established drainage. The extreme northwestern corner is tapped by small headwater drainage ways leading into the South Platte River. The broad, level plains are traversed by a few very shallow, intermittent draws which either lead southward into Chase County and the tributaries of Frenchman Creek or are lost in the sand-hill areas. Much of the precipitation of the eastern quarter of the county escapes into headwater drainage of Stinking Water, Blackwood, and Redwillow Creeks. The channels are obscure in places, but reappear at lower levels. They are bordered by strips of alluvial lands varying from a quarter of a mile to a mile in width. All drainage is intermittent.

Where drainage is not established the rainfall is trapped in small basins which dot the plains and escapes by evaporation and slow seepage. In the sand-hill areas and associated sandy soils the precipitation is quickly absorbed by the loose, porous materials and there are no drainage ways.

Water is obtained from wells 100 to 325 feet deep on the uplands, the shallower wells being in the south-central part of the county. In the valley lands the wells are shallower. The quality of the water everywhere is excellent, and apparently the supply is inexhaustible. The water-bearing horizon lies at the base of the Ogallala formation, while the alluvial sands bear the underflow of valley lands.

Perkins County was organized from a part of Keith County in 1887. The earliest settlers came to the county in 1884, but the first permanent settlement was not made until the following year. Most of the native population of the first settlement came from Illinois, Indiana, Ohio, Michigan, and Iowa, but the later settlers are chiefly from eastern Nebraska. Among the people of foreign extraction Ger-

mans probably predominate, particularly among the farmers, but they are not colonized as in some parts of eastern Nebraska. In 1920 the county had a population of 3,967, all of which is classed as rural.

Grant, the county seat and principal town, 4 miles west of the center of the county, had a population of 585 in 1920. It has a flour mill and two elevators. Venango, in the southwestern corner, with a population of 285, has 2 elevators and receives patronage from eastern Colorado. Madrid, Elsie, and Grainton are small towns lying east of Grant. Grant and Venango have public waterworks and lighting systems. All towns have two grain elevators, implement stores, lumber yards, and other business enterprises. An elevator is located at Brandon, a siding lying between Grant and Venango.

Transportation facilities are good throughout the greater part of the county. The Holdrege-Curtis-Sterling branch of the Chicago, Burlington & Quincy Railroad crosses the central part in a general east-west direction. Toward the west the road bends slightly southwest. It maintains an intermediate distance between the main line of the Union Pacific Railroad on the north and the Culbertson-Imperial branch of the Burlington on the south. No point in the county is more than 10 or 12 miles from a shipping point. The branch line connects with the Chicago-Denver main line at Holdrege and the Alliance-Denver branch at Sterling.

All the roads are of earth construction. Most of them follow section lines, except a few in the sand hills and in rough parts of the county, which detour to avoid unfavorable topography. A state highway traverses the county from Grant eastward parallel to the railroad to Elsie, where it swings toward Hayes Center in Hayes County. It is in good condition for both wagon and automobile traffic. The main roads between towns and a few local roads are in fair condition, but the less important receive very little attention. The greater number are mere trails only recently confined to section and land lines. Owing to the favorable plains topography over the county in general, relatively few culverts and bridges are necessary and road improvement is not very expensive.

Perkins County has several rural mail routes and all important points are reached by telephone lines. It has a fairly good rural school system and good graded and high schools in the towns. The county high school is housed in a modern two-story structure at Grant.

The principal local markets are Elsie, Grainton, Grant, Madrid, and Venango. Some products are handled at Ogallala, Brule, and Big Springs in adjoining counties to the north and northwest. Wheat is delivered to local elevators in all the towns or loaded at Brandon siding. There is local demand for much of the farm produce. Dairy products and eggs are sold at all towns. The outside markets for livestock and other agricultural products are chiefly Denver, Lincoln, Kansas City, Omaha, and St. Joseph.

CLIMATE.

The climate of Perkins County, like that of all the eastern margin of the High Plains, is characterized by wide extremes of temperature and rainfall. The climatic conditions, however, are favorable to the

production of certain grain and forage crops, and to combined grain farming and stock ranching.

The following table, compiled from the records of the Weather Bureau stations at Grant and Madrid, gives the normal monthly seasonal, and annual temperature and precipitation:

Normal monthly, seasonal, and annual temperature and precipitation at Grant and Madrid.[1]

[Elevation at Grant 3,405 feet; at Madrid, 3,294 feet.]

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1915).
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	27.0	72	−33	0.60	0.40	0.62
January	24.7	70	−30	.31	.20	.21
February	25.9	79	−37	.67	.10	.82
Winter	25.9	79	−37	1.58	.70	1.65
March	36.2	101	−13	.98	.58	1.54
April	47.6	98	6	1.90	.65	6.63
May	59.8	99	12	2.71	1.99	6.70
Spring	47.9	101	−13	5.59	3.22	14.87
June	70.7	105	32	3.61	1.55	5.08
July	75.7	109	38	2.46	.40	8.82
August	73.8	109	30	2.18	1.67	4.62
Summer	73.4	109	30	8.25	3.62	18.52
September	63.6	107	20	1.23	1.78	1.16
October	49.5	93	2	1.05	.02	1.85
November	36.0	85	−17	.37	.13	.05
Fall	49.7	107	−17	2.65	1.93	3.06
Year	49.2	109	−37	18.07	9.47	38.10

[1] The Weather Bureau station was located part of the time at Grant and part of the time at Madrid.

The temperatures in Perkins County are marked by wide variations. The winters are long and cold, with low temperatures occurring as cold waves and blizzards, initiated by high winds and often continuing for several days. In early days these storms were very destructive to livestock, but such losses are now prevented by providing shelter.

The distribution of rainfall is vital, as the precipitation consists mainly of local showers, is extremely variable, and is near the minimum required for profitable agriculture. Local showers by chance visit restricted areas repeatedly, while adjacent localities are passed by. It is not uncommon for rains to fall as a series of light showers and evaporate without supplying water for the crops, and other rains are torrential in character, with a high proportional run-off. Hail occasionally does damage over local areas and is one of the hazards of farming in this region.

The mean annual rainfall at the Perkins County stations is 18.07 inches. Precipitation varies greatly from year to year, however. In

the wettest year on record the total precipitation was 38.10 inches and in the driest year 9.47 inches. Nearly 80 per cent of the average annual rainfall occurs during the growing season, from April to September, inclusive, and 63 per cent of it occurs in May, June, July, and August. It is generally heaviest in June and gradually decreases to November, rises slightly in December, then falls again in January, the driest month. The rainfall of May and June is fairly well distributed, but in July, August, and September the distribution is not so favorable, and long droughts may occur during these months. The snowfall is comparatively light, but adds some moisture where the surface is favorable for retaining it.

The average date of the first killing frost in fall is September 26 and of the last in spring May 7. This leaves an average growing season of about 142 days free from frost. The date of the earliest killing frost on record in the fall is August 25 and of the latest in spring is May 27. The season is ordinarily long enough to mature the common farm crops, especially early maturing varieties. But late planting, improper seed selection, and inadequate seed-bed preparation, all of which are more or less controllable, tend to hinder favorable germination, growth, and maturity, and consequently invite failure. The grazing season ordinarily opens late in April and continues into November. Under prevailing climatic conditions native grasses cure naturally and furnish some sustenance during the winter.

Evaporation tends to prevent the accumulation and retention of soil moisture for crops. This is effected by four agencies—temperature, wind, sunshine, and low humidity. The prevailing wind is from the northwest, but during the summer months winds from the south and southwest are common. High winds are frequent, but tornadoes are of rare occurrence. The winds are valued as a source of power for pumping, but they accelerate evaporation from soil and plants, particularly when strong and hot. The humidity is low and tends to permit excessive evaporation, while the high temperatures of summer and almost continuous sunshine combine to reduce moisture.

As most of the tillable land is inherently fertile, the climate is the controlling factor in production. The relatively low rainfall results in smaller yields than those of eastern Nebraska, but with good methods farming has yielded fair average returns. The disadvantages of altitude and a short growing season may be met by the use of hardier and earlier, though possibly less productive, varieties of crop plants. The rainfall is usually sufficient to insure a crop of small grain and hay in favorably situated areas. Owing to the short growing season corn sometimes fails to mature.

AGRICULTURE.

While the development of Perkins County runs parallel to that of other counties of western Nebraska and has had similar fluctuations of prosperity and depression, its early history, owing to geographic conditions, is unique. Early agriculture of other western counties was confined to grazing cattle on the open range, cattlemen being the first settlers to make use of these resources. The large range supported a variety of nutritious grasses and supplied good summer pasturage. Climatic conditions favored the curing of the

grass on the range, so that it furnished fair sustenance throughout the winter. While vegetation throughout Perkins County was luxuriant and nutritive, there was a lack of adequate and readily accessible water for stock. The county has no streams of continuously running water and well water lay at depths at that time prohibitive. The few water holes where water accumulated immediately following heavy rains, and perhaps stood for some time, were by their very nature limited in capacity and durability. Until the extension of railroad facilities, cattle were run on the Stinking Water, Frenchman, and other creeks to the south and driven across the once famous trails of Perkins County to the main line of the Union Pacific Railroad at Ogallala. The water holes furnished sufficient water en route.

The first real settlement in Perkins County occurred in 1885. Immigration was stimulated by the low price of land and rapid development followed, so that by 1889 settlement was nearly complete. Spring wheat and corn were the principal crops. The Federal census of 1890 reported 25,703 acres in corn in 1889, 12,147 acres in wheat, 6,981 acres in oats, and 3,779 acres in hay. Following this tide of rapid settlement there came a series of dry years, culminating in the disastrous droughts of 1893 and 1894, which caused a marked decrease in population, and the outflow continued to 1895 and 1896. It is probable that the agricultural development would not have been as seriously arrested had the present dry-farming methods been understood at that time. The general financial depression of the entire country had also brought low prices for all farm products. Later the conservation of soil moisture by cultivation, adoption of proper crop varieties and tillage methods, and combined stock and grain farming largely overcame adverse climatic conditions and development was renewed.

Ranching began in 1898 and 1899. None but grades were included in herds of Shorthorn, Hereford, and Angus. In 1900 the value of animals sold and slaughtered was reported by the census as $133,294. Nearly every farmer kept a few cows, and for many the sale of milk served as the principal source of income. A creamery was established at Grant in 1900 and was operated until 1905. Milk was hauled to the station and separated and the skim milk returned to the owner.

The Kincaid Act, which increased the homestead to 640 acres, served to bring in additional settlers and to improve general farming conditions. The act made it possible to acquire land adapted only to grazing, and a profitable system of combined farming and stock raising became firmly established by 1910. Crop production was often confined to forage crops and necessary home products, but always in connection with dairying. The sale of milk, butter, and eggs served to supply many with daily living expenses.

The increased demands for grain, the favorable markets, and the greater perfection of motor machinery led to the inauguration of "big" farming in 1915 and 1916. This type of operation has been steadily promoted, and a large part of the smooth, level land is being farmed with the assistance of tractors and other power machinery.

The following table, giving the acreage and production of the principal crops of the county, as reported by the censuses of 1890, 1900, 1910, and 1920, shows the general progress of agriculture during the last 30 years:

Acreage and production of principal crops in 1889, 1899, 1909, and 1919.

Crop.	1889		1899		1909		1919	
	Acres.	*Bushels.*	*Acres.*	*Bushels.*	*Acres.*	*Bushels.*	*Acres.*	*Bushels.*
Corn	25,703	285,822	12,729	140,330	27,026	499,759	39,132	640,960
Oats	6,981	87,097	221	1,990	2,876	66,659	3,102	76,030
Wheat	12,147	110,331	5,950	17,810	9,291	137,407	54,297	828,981
Rye	2,173	16,485	602	2,200	203	2,957	7,182	66,670
Barley	225	2,599	95	300	296	4,931	1,920	31,115
Emmer					5,843	114,748	1,136	17,558
Potatoes	1,164	58,605	216	7,998	649	39,198	168	4,405
		Tons.		*Tons.*		*Tons.*		*Tons.*
Hay, all kinds	3,779	4,425						
Tame			1,643	1,441	2,363	3,222	4,821	5,987
Wild			6,647	5,413	18,238	11,499	10,191	5,549
Alfalfa[1]			10	22	477	714	2,533	3,146
Coarse forage			503	608	1,989	3,630	7,468	12,246

[1] Alfalfa is also included in the item "tame hay."

About 62 per cent of the area of Perkins County in 1920 was included in a total of 585 farms. The general type of agriculture consists of combined stock and grain farming, with production of some dairy products; but some farms are devoted entirely to grain production.

Dry farming is the basis of agricultural prosperity of the county. On the sandier soils, which are better able to check run-off and retain available moisture, this system is of less importance, but it requires special emphasis where available moisture becomes the limiting factor in crop production.

The greater part of the county is used for grazing, especially in the sandier regions. Only about one-fourth of the total area was under cultivation in 1920, and over 80 per cent of the cultivated land was devoted to corn and wheat. Oats, barley, rye, sorghum, millet, and alfalfa are the most important of the other cultivated crops.

In the last few years wheat has ranked first among the grain crops. It is the principal cash crop. Winter wheat is now grown almost exclusively; less than 5 per cent of the crop being spring wheat. The yields are largely dependent on climatic conditions and therefore vary from year to year. The average for the county is estimated at 8 to 10 bushels per acre. The highest average yield, 21.6 bushels, was reported in 1916, following the year of heavy rainfall in 1915. In 1913 the acreage of winter wheat was less than that of spring wheat, which indicates the leading position the crop has assumed.

Most of the wheat is grown on the heavier loam and silt loam soils, and at present there is a tendency to increase the acreage by cropping the heavier textured soils, which are better suited to wheat than corn. There are large acreages on many sandy soils, but there is danger of damage from drifting during the strong fall and spring winds. During favorable years wheat gives best results in this region on a deep, mellow soil, but in unfavorable years there may be a complete failure. Winter wheat is preferred to spring wheat, as it is more likely to ripen before the dry weather and hot winds of summer occur. The crop may be bound and threshed from the shock, headed and threshed from the stack, or harvested with the combine, which cuts and threshes at the same time and returns the straw to the ground. A part of the crop is used locally and by the flour mill at Grant, but the greater proportion is shipped to outside markets. The

average quality of the grain is good. Turkey is the principal variety grown, but Kanred occupies an acreage estimated at about 5 per cent of the total. Macaroni is the leading spring wheat.

Summer tillage is practiced by many farmers to offset the unfavorable moisture conditions. Neglect in eradication and control of Russian thistles, sunflowers, and other weeds which infest the fields will defeat the advantages sought, however, as all vegetation depletes the soil moisture.

Corn ranks second among the grain crops. The State census reports an average yield of 24 bushels per acre in 1920. The average of the county over a series of years, however, is variously estimated at 8, 10, and 12 bushels. Droughts and warm dry winds cause frequent damage. Owing to the high altitude, the shortness of the growing season, and cool nights at critical periods, the kernels are sometimes soft and immature. The early settlers had only partial success in growing corn, but hardier, fairly early, acclimated varieties have been introduced and are giving better results. These new varieties have smaller stalks and ears than those varieties grown in eastern Nebraska, but they are more likely to mature. The seed is generally saved from year to year, but little attention is given to the finer points of seed selection. Some farmers claim to have grown corn on the same field for years without appreciable decrease in yield. As a rule, however, the crop does best in systematic rotations. The corn is fed to cattle, hogs, and horses and is in demand by all stockmen. Some farmers produce more corn than they need and sell the surplus. When the demand is greater than the supply, some corn may be shipped in from the Corn Belt. The ears are husked from the standing stalk, or the crop is cut for fodder, if many of the ears have failed to mature. Only one silo is reported in the county in 1920. Corn is grown on every soil in the county, the yields varying largely with moisture conditions, but the crop seems to be better adapted in the long run to the sandier soils.

Oats, barley, rye, and sorghum have held nearly equally important places in the last three or four years, varying in order of importance from year to year. In 1920 oats had the largest acreage. The average yields have ranged from 8 to 32 bushels per acre, with the highest yield in 1920. In general the crop is less profitable than other grains, but it is valuable in rotations and is needed to feed farm stock, especially horses. The crop frequently suffers damage from hot summer winds and droughts at heading time, and is subject to attack by grasshoppers. Oats may follow corn, but the crop is seldom grown in successive years on the same land. It does better on the heavier soils in favorable seasons, but in drier years the heads do not fill well and may be valuable only as forage. It is usually cut with a binder and threshed from the shock, and most of it is fed to horses.

Rye and barley had nearly equal acreages in 1920, while in 1919 rye occupied a considerably larger acreage. The average yield in 1920 was 13 bushels per acre. The crop is grown for the grain, for hay, and for pasture and generally produces fair yields. It is sown on both the heavier and lighter soils, as it is adapted to a wide range of soils and is quite drought resistant. Rye makes an excellent early feed for cattle before the native grasses are fit to use, and furnishes nutritious pasturage in late fall.

Barley occupies a variable acreage from year to year. The highest average yield in recent years was in 1915, a year of heavy rainfall, when the average yield reached 35 bushels per acre. The crop appears to be more hardy than oats, but suffers damage by grasshoppers, which clip the heads.

Sorghum is an important forage crop. In 1920 it occupied 4,426 acres and produced an average yield of 3 tons per acre. It is considered a very satisfactory annual forage crop and is profitable on nearly every soil type, but does best on a sandy loam. The crop is remarkably resistant to drought and alkali, but appears to have a bad effect on the succeeding crops. It is thought by some that this is due largely to the poor physical condition in which the soil is left, as the crop draws heavily on soil moisture, and it is said that the temporary injury to the soil may be overcome by disking the field as soon as the crop is removed, a practice which loosens the ground and makes it more favorable to absorb fall rains and melting winter snows. The grain should be fairly mature when cut for fodder, and if the heads only are removed they should be fully ripe. The crop may be pastured, fed as fodder or hay, as silage, or as a soiling crop, and the grain fed to all kinds of stock. Sorghum compares favorably with corn in feeding value. Chemical analyses indicate that the grain and fodder are about equal to corn, but are slightly less digestible. The crop makes excellent roughage for wintering stock and for feeding in addition to grain for fattening. It furnishes fair pasturage, but there is some danger of poisoning from stunted plants which, after a period of warm, dry weather, sometimes store up prussic acid in the leaves in sufficient quantity to cause death to cattle. Normal growth, however, seldom contains injurious amounts, and in curing for hay the acid disappears.

The acreage of wild hay has been very materially reduced since 1909. The hay is cut on all types of land and the yields vary widely, with the average yield about 1 ton per acre. It is a valuable stock feed and holds a high rank among the hay and forage crops. Many of the individual areas cut for hay are small, but one or more are included in nearly every farm. The crop consists of a number of native grasses, principally stipa, or needle grass, wheat grass, sand reed grass, bunch grass (little bluestem), big bluestem, Indian grass, and small amounts of buffalo and grama grass. The native grasses produce good yields where not injured by fires, overgrazing, and other abuses. The greater part of the crop is fed locally to work stock and cattle during the winter.

The tame hay crop consists mainly of millet and alfalfa. Millet occupied 3,877 acres in 1920 and averaged 1.8 tons per acre, as reported by the Nebraska Department of Agriculture. Although millet can be grown on all soil types, it does best on the soils of heavier texture during favorable seasons. It can be sown at almost any favorable time before late summer and produces a hay crop in a short period.

The area in alfalfa increased from 477 acres in 1909 to 2,533 acres in 1919. It is the principal leguminous crop of the county, and on account of its value for stock feeding it is one of the important forage crops. The yields range from 1 to 2½ tons per acre in favorable seasons and localities. Rainfall and soil moisture are the controlling factors in successful production, so that shallow depressions in the

uplands which receive surface waters can often be used profitably for alfalfa if not too wet. Where good stands are obtained in favorable years, the crop maintains itself well, provided conditions in succeeding years are not too unfavorable. It does best in deep fertile soil high in lime. On a few farms fair yields have been obtained by planting in rows and cultivating the plants as in growing corn.

Minor crops of the county include emmer, potatoes, pop corn, kafir, sweet clover, Sudan grass, and other tame hay grasses. These crops are grown in small patches on many farms. Potatoes are grown only for home consumption. Sudan grass yields well and probably could be used more extensively for forage. Vegetables and truck crops are produced mainly for home use, but some are grown on a small scale to supply local market demands.

There are a few small orchards scattered over the county, but fruit growing is unprofitable owing to unfavorable climatic conditions. Late spring frosts prevent the setting of the fruits and severe winters and droughts injure the trees.

As is the case throughout most of west-central and western Nebraska, the raising and feeding of livestock, ordinarily combined with grain farming, is an important industry, but its relative rank in Perkins County has generally decreased in the last 10 years.

According to the Federal census, there were 7,040 horses, 542 mules, 9,046 beef cattle, 3,523 dairy cattle, 47 sheep, 35 goats, 10,693 hogs, 43,113 chickens, and 1,950 other fowls, in Perkins County in January, 1920.

Little or no stock raising is practiced on a number of farms in the so-called hard-land belt of the western part of the county. In other sections of the area the industry is well established. As a rule pasturage on dead grasses during the winter has been modified by feeding during severe seasons. Cattle and horses are the chief sources of income. Most of the cattle are shipped as stockers and feeders to Omaha and some are handled cooperatively, enabling the small farmer to sell more profitably. The ordinary farmer has 20 to 30 head, but some ranchers have much larger herds. The predominant herds are grade Hereford and Shorthorn, and some are Polled Angus. Very few of the animals are purebred, but the herds are usually sired by purebred bulls, which have improved the quality of the stock generally in recent years. Many of the cattle are run on the range throughout the year, hay being fed during severe weather. The range ordinarily has a carrying capacity of 1 animal to 7 to 15 acres if supplemented by winter feeding. The stock is usually sold in the fall when 2 or 3 years old.

A small herd of horses is raised on nearly every farm. The stock has been improved from the western broncho to medium draft-horse weighing 1,000 to 1,200 pounds. Horses are seldom fed grain during the winter, but are allowed to run on the range, except in the severest weather, when they are driven into shelter and fed hay. Most of the horses are grade Percherons.

There are several dairy herds consisting of grades. The products are marketed locally. Nearly every farmer keeps a few cows, but there are no strictly dairy farms in the county. The State census reported 2,033 milk cows in the county in 1920. Cream and butter are marketed, and some milk is sold to regular town patrons, but

most of it is used on the farm. Dairying has proved a valuable adjunct to general farming on farms where it is practiced. Most of the herds are Shorthorn grades, but there are a few Jersey and Holstein grades. Dairy products, excluding those for home use, were valued at $71,871 in 1919.

Hogs are not raised extensively, but are gaining importance as the production of alfalfa and of early planted and early maturing corn varieties is extended. A few hogs are raised on many farms, but low market prices have somewhat discouraged those engaged in the industry. Poland-China is the leading breed.

A few sheep are shipped in annually for summer grazing, and some ranchers carry the stock during the winter.

Nearly every farm has a flock of poultry, but few engage in poultry raising as a specialty. Perkins County had 3,487 dozen of all grades in 1920. The surplus products are sold locally. Small numbers of turkeys, geese, and ducks are raised, as well as chickens. The poultry industry has proved profitable on many farms, and there appears no reason why it should not be developed further, as most conditions are reasonably favorable for increased production. Poultry and eggs produced in 1919 had a value of $89,507.

The county has no natural forest growth. A few trees were planted on timber claims; these include ash, boxelder, and locust. Fires, cattle, low soil moisture, and hot winds have caused the death of most of the trees.

The more abundant and harmful weeds are the Russian thistle, pigweed, and dwarf sunflower. The Russian thistle should be kept from maturing seed by cultivation or destroyed by fire when matured. Pigweed is readily eradicated by early cultivation while small, but hoeing and pulling are occasionally necessary. Close cutting and cultivation destroy the young sunflowers and prevent the older plants from maturing seed. Cockleburs are troublesome, especially on sandy lands, but are easily killed by early cultivation. They should be pulled up when half grown and must be burned if allowed to mature. The locust, or grasshopper, and the cutworm are occasional pests. Wheat rust and corn smut are injurious plant diseases.

The extent and distribution of the farmed areas have been influenced by certain soil textures and to a small degree by topography. The staple crops are grown on nearly all the different soils except the sand dunes and small areas of badly eroded land. Experience has shown that in favorable years the heavier, more level soils of the flat table-lands are well adapted to the production of grain crops, but during average or droughty years the lighter textured and sandier soils are more dependable and produce the more certain crops, though the yields may not be high.

Wheat is seldom raised on the sandier lands, but is confined to the loams, the silt loams, and heavier sandy loams. The corn crop is practically certain on the sandier soils unless the season is too short to mature the grain, but even then it furnishes some forage. Except on sod lands, the small grains as a rule are not so profitable on the sandy as on the "hard" lands. On the other hand, corn frequently fails on the heavier soils because of excessive drought at critical periods. The areas of eroded and stony land and the sand dunes are devoted to grazing. Alfalfa is especially well adapted to certain terrace soils of lower Stinking Water Creek, owing to subirrigation, but

is not extensively planted here. Certain slopes and depressions of the upland are favorable for alfalfa.

On account of the low average annual rainfall and its variable seasonal distribution, cultural methods not practiced in the more humid parts of the State are necessary for success. Although the advisability of summer fallowing has been questioned, it is quite commonly practiced in this county. Dry-farming methods are generally followed on the heavy soils, but sandy lands which blow readily are not summer tilled on account of high winds which cause the soil to drift. Frequent cultivation is necessary to reduce all weed seedlings. A rather rough surface is advantageous on the heavy soils, as it prevents sheet water from running off during heavy rains. The heavier soils hold more moisture than the sandy types, but it is less available for crop use, and under the average climatic conditions certain crops, such as corn, are more dependable on the lighter soils. Owing to the relatively small supply of moisture available, thin plantings of all crops are required to insure maturity. On new land a thin furrow slice of sod is turned over and the land receives no further tillage. Wheat is generally the first and most profitable crop. Where corn is planted, it is grown without cultivation. Summer tillage is practiced to some extent for fall wheat, but few farmers summer fallow their land before sowing wheat. Where small grain is grown continuously the present general practice is to plow the land about once in three years. Occasionally the land is harrowed after the grain comes up, but frequently the seed is merely drilled in the stubble and the crop receives no further attention until it is ready to harvest. However, the moisture supply is the chief factor controlling cropping and rotation; fertility and tillage are of secondary importance.

Dry-farming practices in this area are more or less experimental and little attention is given to definite and systematic crop rotations. Generally, however, wheat and the small grains follow two years of corn. Grasses or legumes are not introduced in the rotation, and for the present are probably not necessary. Grain fields are often kept in the same crop year after year. Oats occasionally are an intermediate crop between corn and wheat. Sometimes wheat is drilled in between corn rows. Potatoes generally follow a small grain. On many farms corn and wheat have been grown on the same land for a number of consecutive years, but as the land is new and the available moisture supply is low there is no immediate danger of exhaustion of the heavier lands.

Land is usually prepared for corn by disking early in the spring, between April 15 and May 10. On old corn or grain stubble the crop is usually planted with a lister, 20 to 24 inches and occasionally 30 inches apart in the rows. Double disking is most common on land where winter wheat follows small grain or corn.

Summer tillage of fallow land is gaining favor among many farmers. Where such tillage is practiced effectively the land is plowed in the fall and disked at necessary intervals during the summer to kill the weeds. If the tillage is neglected, the land soon becomes infested with weeds, which sap the accumulated moisture and defeat the purpose of the method.

Although summer tillage obtains the larger immediate yield of winter wheat, the use of corn land for wheat is probably more profit-

able. This plan insures equally thorough and possibly more regular cultivation of the soil, and the value of the corn and forage more than offsets the value of the increase in yield of wheat on land that is summer tilled without cropping.

Commercial or mineral fertilizers are not used. Some manure is applied to the land. This is especially beneficial on sandier lands, where the manure should be spread as evenly as possible and be mixed with the surface soil, the increased humus or organic matter assisting the loose soils to resist drifting.

Farm laborers are not always readily obtainable, and most of the work is done by the farmer and his family. Usually there is sufficient help available to supply the necessary extra labor during harvest. Most of the farm laborers are American born. In 1920 a few men were hired by the year, but during the busy seasons labor is generally paid by the day and occasionally by the hour. Those operating tractors or performing other labor requiring special training and skill command the higher wages. Some farmers and ranch owners employ entire families, giving them, in addition to wages, the use of a house, garden, cows, and chickens.

Farm improvements on the whole are fairly good. All places are supplied with some labor-saving machinery. On some farms the equipment consists entirely of tractors and tractor implements suited for farming on an extensive scale, but on most farms horse-drawn gang plows and cultivators are used. In general, the tractor is considered unprofitable on the small farm. Binders and headers are used on most farms harvesting grains, and local threshing machines handle the grain after it has been cut. A few farmers own combines and do their cutting and threshing in one operation. The work stock consists of fairly good horses and mules. In 1920 the farm implements were valued at $79,575. There were 55 trucks in the county, 128 gasoline tractors, 110 gasoline engines, and 477 automobiles on farms. The fences are all of barbed wire and usually kept in good repair.

The Federal census of 1920 reports a total of 585 farms, of an average size of 600.2 acres, of which 58.8 per cent is classed as improved land. All farm property is valued at $36,728 per farm; 82.5 per cent of this represented land value, 7.9 per cent buildings, 3.7 per cent implements, and 5.9 per cent domestic animals.

The average amount expended for labor amounted to $723.50 on the 461 farms reporting, and $403.85 was spent for feed per farm on the 310 farms reporting.

According to the same authority 64.3 per cent of the farms were operated by owners in 1920. A considerable number of farms were jointly occupied by owners and renters. Most of the tenant farms are rented on shares; a few are leased on a cash basis; and some are leased on a share and cash basis. The owner generally receives one-third of the crop delivered at the elevator, the tenant furnishing seed, labor, and equipment.

The assessed value of farm land, as reported by the census, has increased from $1.36 in 1900 to $50.47 an acre in 1920. In 1921 the price of farm land ranged from $10 an acre for sand dunes to $60 or $75 an acre for hard lands having favorable location near

town; but some land is reported to have sold as high as $100 an acre during the boom period.

SOILS.

The dominant factors in the development of the soils of this region have been the influence of a subhumid climate and its resultant short-grass vegetation. Not only has the total amount of precipitation been low, but the supply available for the use of plants at critical growing periods has been uncertain. These conditions have not favored a luxuriant grass vegetation nor the accumulation of so large a quantity of organic matter in these soils as prevails in the soils farther east. The content of this constituent, however, is sufficient to give the undisturbed surface soil a dark color.

The well-drained soils of the upland, having been acted upon by climatic forces everywhere uniform within the area, approach a uniformity in color and structure and present fewer differences in characteristics than the parent materials from which they have developed. This is shown by the similarity of the soils derived from the sandy materials of the Ogallala formation and those derived from the loess. In color they are identical and the whole soil profile is similar. In like manner the soils of the higher terraces have reached a stage of maturity at which they closely resemble the upland soils, and can hardly be said to differ from them except in topography and position.

The important characteristics of the soils, therefore, are determined to a very large extent by weathering under conditions of low average rainfall. The color of the mature soil is rather dark brown at the surface, of the upper subsoil brown to light brown, and of the lower subsoil gray or pale yellow. The soils are in general loose and granular or friable and are underlain by moderately compact, granular subsoils. The upper subsoils in some types have a compact structure. The lower subsoils in areas of normal weathering are calcareous at 24 inches, but on certain flat areas, where leaching has been more complete, no effervescence occurs to a depth of 3 feet.

The large areas of wind-laid sand and some of the more recently deposited colluvial slope materials have either not reached that stage of maturity in which soil profile like that of the heavier upland soils has developed or, because they are composed largely of quartz sand and lose their soluble salts readily, they may never develop such a soil profile.

The sedimentary rocks from which the material giving Rosebud soils are derived belong to the Ogallala formation of late Tertiary age. The surface strata on the High Plains consists of fine sandstone having a high lime content. This weathers into silt loam and fine sandy loam, with the characteristic Rosebud profile. Variations of texture and structure of soils derived from this formation bear a relation to different lithologic phases of the Ogallala and Arikaree formations and to stages of weathering as determined by variations in topography. Where erosion has been severe, the white layer is not present and the brown surface soil extends to the bedrock. Such soils are classed with the Canyon series. The loess soils have the same general characteristics as the soils derived from the older formations. The Colby series occurs on slopes where the rapid removal of the soil by erosion has not permitted the development of the typical undisturbed loess soil.

The Dawes soils have developed under conditions that favored a more thorough leaching and compaction of the subsurface layer. The same conditions on the flat bench lands have resulted in the formation of the Yale soils.

The vast Dunesand areas are made up of wind-blown sand eroded in comparatively recent times, and some of it is still subject to shifting at any time. The porous sand has permitted the leaching of most of the soluble salts as soon as released by weathering, and, with the exception of the accumulation of a small amount of organic matter in the sands that have remained stationary for any length of time, no change has taken place in this deposit since its formation. Some areas of wind-laid sand, however, have stayed in position for some time, and the breaking down by weathering of the feldspars and minerals other than quartz has contributed sufficient fine material to give a loamy texture to the soil and subsoil. Soils formed in this manner have been classed with the Valentine series. The alluvial soils occur in various stages of development. The Tripp and Cheyenne series occupy high terraces and have reached about the same stage of maturity as the soils of the upland. The Tripp series has a profile almost identical with that of the Rosebud. The Bridgeport series is younger, and the soils do not have the lime accumulation in the subsoil.

The soils of this area have been classed into soil series on the basis of differences in color, structure, and details of the soil profile and the source of the parent material. The soil series is divided into soil types, which differ from each other mainly in the texture or relative coarseness or fineness of the surface soils. The type is the unit of soil mapping.

The Rosebud series includes types with dark-gray to brown, moderately calcareous surface soils and a highly calcareous light-gray to almost white, floury subsoil. The Rosebud soils are derived from the light-colored, calcareous, unconsolidated Tertiary deposits of the High Plains. The topography ranges from gently undulating to very hilly and steeply rolling. The more hilly areas are dotted with white exposures of the underlying formations. Waterworn gravel is abundant in the subsoil and in places in the soil. Six types of this series are mapped in Perkins County.

The surface soils of types of the Dawes series are grayish brown, brown, or dark brown. The upper subsoil is usually brown to dark brown, with a moderately friable and compact structure and a heavier texture than the surface soils. At depths of 20 to 30 inches this grades into light-gray, highly calcareous, silty material, which is chalklike when dry and is very similar to the subsoil of the Rosebud series. A marked feature of the Dawes series is the removal by weathering of nearly all the lime from the surface soil and upper subsoil and its concentration in the lower subsoil. The types characteristically occur in basinlike depressions and valleylike areas of the upland or on the higher parts of the level and less eroded table-lands. Drainage channels are either absent or poorly developed. Four types of this series are mapped.

The types of the Valentine series are characterized by brown to dark grayish brown surface soils, and a light-brown to yellowish-brown lower subsoil. The subsoil is friable and only moderately compact, grading at 2 to 3 feet into loose sand. A characteristic fea-

ture is the absence of calcareous material. The Valentine soils occupy level to gently rolling valleys and basins where their position has favored the accumulation of organic matter. They are composed largely of partly weathered wind-blown materials derived originally from the Tertiary sandstone. They differ from the members of the Rosebud series in the absence of a light-colored subsoil and in their lower lime content. The Valentine series is represented in this county by seven types.

The surface soils of the types grouped in the Canyon series are brown to grayish brown and average 6 to 8 inches in depth. The subsoil is yellowish gray. Both soil and subsoil contain fragments of partly disintegrated, soft, calcareous conglomerate of the Tertiary Mortar Beds. The types of the series are mainly residual from the calcareous conglomerate, sand, and silt of the Tertiary beds. They occupy rounded hills and ridges whose lower slopes in places are sharply eroded and precipitous. They differ from the Rosebud series in not having the white lime accumulation in the subsoil. The Canyon gravelly sandy loam is mapped.

The types of the Colby series have ashy-gray to brownish-gray surface soils which grade abruptly into a light-yellowish or whitish, floury, highly calcareous subsoil. They are derived from loess and have an open structure. The topography varies from rolling to sharply rolling and the drainage is good. The material in the surface zone has been moderately weathered and slightly modified by wind action. The Colby series is represented here by a broken phase of the very fine sandy loam.

The surface soils of the types of the Scott series are dark brown to dark gray in color and heavy and refractory in texture. The upper subsoil is a gray silty clay, grading into a stiff, heavy, compact, almost black clay. It is sticky and plastic when moist, but hard and brittle when dry. Both soil and subsoil have a bluish-gray cast when thoroughly desiccated. The series consists of material derived from the higher lying soils, and deposited by sheet water in temporary ponds occupying shallow depressions in the upland. The Scott silty clay is mapped in this survey.

The surface soils of the types included in the Tripp series are brown to light gray, frequently with a dark ashy gray appearance at the surface. The subsoil is light gray to white. Both surface soil and subsoil have a high lime content. The substratum consists largely of gray, stratified, highly calcareous fine sand and silt, with a relatively small proportion of coarse sand and fine gravel. The types are mainly of alluvial origin and occupy the terraces or bench lands above overflow. In places the material has received some admixture of wind-laid material subsequent to its deposition or has been modified by colluvial wash. The topography is comparatively level but drainage is fairly well established. Three types of the Tripp series are mapped in this area.

The surface soils of the types of the Yale series are gray to grayish brown. The upper subsoil is a light-brown compact loam which ranges in thickness from 15 to 18 inches. The lower subsoil is a light yellowish brown, floury silt loam. The soil does not effervesce when tested for lime but the subsoil has a high lime content. The soils occupy low second bottoms above overflow. The surface is flat, but as the rainfall is low the drainage is generally adequate.

The series differs from the Tripp only in the compact structure of the upper subsoil.

The soils of the Cheyenne series are derived from alluvial wash which has partly filled the valleys of streams and draws in the western part of the Great Plains region. The surface soils are brown, with a lighter brown or yellow subsoil underlain at various depths by a substratum of porous sands and gravels. The subsoil is calcareous, and in places the surface soil contains some lime. The surface soils contain much small gravel in places, and the subsoil is gravelly, coarse, and porous. The Cheyenne soils lie mainly above overflow and are well drained. Where the underlying gravel is near the surface the soil is droughty. The Cheyenne gravelly sandy loam was mapped in this survey.

The Bridgeport series consists of types with brown to grayish-brown soils, underlain in places by a subsoil lighter in color, though commonly there is no change in the 3-foot section. The lower subsoil is calcareous in places. The types differ from the Valentine series in their higher lime content and from the Tripp in the absence of the white, floury, calcareous layer in the lower subsoil. They consist of recent-alluvial and colluvial material, carried down from the adjoining uplands by intermittent streams, mingled with sediments brought down from higher lying regions to the west. Wind has also played an important part in their formation. The topography varies from gently undulating to rolling. Drainage is everywhere good. The series is represented here by three types.

The areas of Dunesand include grass-covered sand hills and ridges composed almost entirely of gray sand. The soil is not suited to agriculture on account of its drifting nature when the vegetation cover is removed. In the following pages of this report the soils of Perkins County are described in detail. Their distribution is shown on the accompanying soil map. The table below gives the actual and relative extent of each soil type:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Dawes loam	182,464	32.2	Valentine loamy very fine sand	3,904	0.7
Rosebud loam	100,672	17.8	Yale silt loam	3,136	.5
Dunesand	82,688	14.6	Bridgeport fine sandy loam	3,136	.5
Valentine sandy loam	40,832	7.2	Colby very fine sandy loam, broken phase	2,688	.5
Valentine very fine sandy loam	23,552	4.1	Dawes sandy loam	2,688	.5
Valentine loamy sand	21,760	3.8	Bridgeport loam	1,984	.3
Rosebud very fine sandy loam	20,800	3.7	Canyon gravelly sandy loam	1,088	.2
Valentine fine sandy loam	18,112	3.2	Tripp silt loam	1,088	.2
Dawes very fine sandy loam	17,856	3.1	Rosebud gravelly sandy loam	1,024	.2
Valentine loamy fine sand	7,808	1.4	Bridgeport loamy sand	960	.2
Rosebud silt loam	6,720	1.2	Tripp very fine sandy loam	704	.1
Scott silty clay	4,480	.8	Tripp fine sandy loam	448	.1
Valentine loam	4,224	.7	Cheyenne gravelly sandy loam	192	.1
Dawes fine sandy loam	4,160	.7			
Rosebud sandy loam	3,968	.7			
Rosebud fine sandy loam	3,904	.7	Total	567,040	

ROSEBUD GRAVELLY SANDY LOAM.

The Rosebud gravelly sandy loam as mapped in Perkins County does not have all the characteristics of the Rosebud series and is placed with this series only on account of its supposed relationship in respect to the source of its parent material. Because of its porous,

leachy character, the type has never developed as dark a color as the typical Rosebud soils nor does it have the lime accumulation in the lower subsoil.

The Rosebud gravelly sandy loam in this county consists of brown to dark-brown, loose gravelly sandy loam, with patches of gravel, gravelly sand, and gravelly loam. There is very little textural difference between the soil and subsoil, though the latter becomes yellowish and lighter in color with depth, and in many places is slightly calcareous. The materials vary widely, the sands ranging from fine to coarse and the gravel from small pebbles to stone 3 or 4 inches in diameter. The light-colored granitics are most abundant, but there are large quantities of free quartz and a sprinkling of the dark basics. All the materials are waterworn.

The type occurs principally at the headwaters of small tributaries to the South Platte River in the extreme northwestern part of the county. A peculiar isolated knob of the same material stands noticeably above the surrounding country in section 8, T. 10 N., R. 40 W. In general, this type caps the outer rims of the drainage valleys and is not continuous down the slopes to the stream channels. The soil appears to be derived in part from remnants of older and higher terraces deposited when the larger streams were flowing at much higher levels than at present. The former position of these older channels appears to have been marked by shallow deposits of sand, gravel, and waterworn bowlders, which capped the tops of present hills and ridges at a common level. The parts that were not protected by a gravel deposit have probably been eroded and the protected parts were left as ridges and hills.

The Rosebud gravelly sandy loam has very little agricultural value. It is porous and droughty and the topography makes anything except included areas of other types unsuited to farming. Where the deposits of gravel are thin, some grasses have obtained a foothold, affording fair pasturage. A greater acreage per unit of cattle is required for grazing than on the other Rosebud soils. The type may furnish sand and gravel for local road building and concrete work. This land is generally sold in conjunction with other soils and tends to reduce the value of farms.

ROSEBUD SANDY LOAM.

The surface soil of the Rosebud sandy loam is a loose, friable, dark grayish brown to very dark grayish brown loamy sand to sandy loam 12 to 15 inches deep. The upper layer of 6 inches contains considerable organic matter and has a slightly darker color than the lower part. In places the percentage of silt and very fine sand is relatively high. In other places the soil is extremely coarse and is strewn with limy pebbles of disintegrated bedrock. The subsoil commonly is much coarser in texture than the surface soil and is lighter in color. It is calcareous and contains a large proportion of slightly cemented limestone fragments, and locally it merges into bedrock in the lower part of the 3-foot section. The limy material is locally called "magnesia" or "mortar bed." In places the surface soil also gives a lime reaction from limestone fragments. Normally, however, most of the soluble salts are leached out of the surface soil.

The surface soil is subject to wind erosion and varies considerably in depth. In depressions and on gentler slopes, where the sand has more deeply buried the underlying formations, the light-colored subsoil may begin at 24 or 30 inches or even greater depths, while on exposed knolls or in regions of active wind or water erosion patches of limy material may be exposed. In some of the deeper pockets a compact, sticky upper subsoil has developed.

The type occurs principally in the western and northern parts of the county. It is generally associated with the sand hills, but occupies a few isolated bodies. Doubtless much of the material has been carried by wind from the neighboring sand-hill areas. The topography is level to moderately rolling. Drainage is everywhere thorough and in a few places excessive. Owing to the loose, porous nature of the soil and subsoil, no drainage channels are developed.

The Rosebud sandy loam in this county is of little agricultural value because of its small extent and tendency to drift. The chief crops are corn, barley, sorghum, and rye. Corn, sorghum, and rye are the most profitable crops, but all yields are low. Corn averages 10 to 15 bushels, barley 12 to 15 bushels, rye 10 to 12 bushels, and sorghum 1 to 1½ tons per acre. The pasture and hay lands support principally sand grass, big bluestem, stipa, and bunch grass (little bluestem). Sagebrush is encountered on the sandier areas. Only small yields of hay are obtained, and from 8 to 15 acres are required to pasture 1 animal the year round.

The selling price of the Rosebud sandy loam varies from $15 to $30 an acre; ordinarily it is sold with adjoining lands.

In general the soil has relatively low cropping possibilities, and much of the land should not be tilled because of the danger of drifting when the native grasses are removed and because of the droughty nature of the soil. It is well suited for pasture, but overgrazing and fires should be carefully avoided. The deeper, heavier variations are favorable for moderate cropping, as the soil is mellow and easily worked.

ROSEBUD FINE SANDY LOAM.

The surface soil of the Rosebud fine sandy loam is dark grayish brown to very dark grayish brown friable fine sandy loam averaging 12 to 15 inches in depth. It has a high percentage of fine and very fine sand and a moderate proportion of coarse sand and contains enough clay to give it coherence and to retard removal by the wind. The upper subsoil is a layer of 4 to 6 inches of dark-colored material, which is rather heavy and sticky in places, slightly calcareous, and constitutes a transition zone from surface soil to lower subsoil with respect to lime content. At a depth of 15 to 18 inches this gives way abruptly to the pale yellowish gray to whitish-gray material of the lower subsoil, which is coarser, more friable, and highly calcareous. The surface is generally leached of lime, but the lower subsoil effervesces freely with acid. Locally the surface soil contains scattered fragments of partly disintegrated limestone.

The type varies somewhat in different parts of the county. Fragments of the Ogallala bedrock and beds of sand and lime are encountered in places in the lower part of the 3-foot section. In many places on the slopes the loose sand has been washed or blown away and the white calcareous material is exposed.

The Rosebud fine sandy loam occupies scattered areas on both the north and south uplands. The bodies are irregular in shape and are associated with other sandy soils; they represent a gradation in texture proportionate to their distance from areas of Dunesand. The topography is rolling to gently undulating, but the rolling surface prevails. The material has been derived from weathered sandstone of late Tertiary age. The high sand content is probably due largely to the removal of the finer particles in the process of weathering and to drifting sand. Drainage is everywhere thorough and in a few places excessive, owing to the porous nature of the soil and subsoil.

The type is of small extent. About half of it is under cultivation, and the rest is used for grazing cattle. The native grass vegetation consists of wire grass, buffalo grass, redfieldia, sand-reed grass, and stipa. From 12 to 15 acres are sufficient to pasture 1 cow or horse, but the animals must be fed during severe weather.

Corn, sorghum, and millet are the important crops. Wheat is grown occasionally in small patches and rye is grown frequently. The average yields of crops are not high, but the crops are fairly dependable. Corn produces 15 to 20 bushels per acre and a fair amount of forage. Under favorable conditions or on sod land, wheat produces an average of 8 or 10 bushels per acre. Rye, which is a dependable crop and adapted to a wide range of conditions, averages 8 to 10 bushels per acre. The forage crops, especially sorghum, are excellent yielders and profitable crops on sandy lands.

The Rosebud fine sandy loam is mellow and easy to till. Because it is subject to drifting, the small grains should be protected from injury by the use of manure and other organic matter, the application of which tends to hold the soil in place. Land of this type sells for $15 to $30 an acre, depending upon improvements.

ROSEBUD VERY FINE SANDY LOAM.

The surface soil of the Rosebud very fine sandy loam is a dark grayish brown to very dark grayish brown, mellow, very fine sandy loam 10 to 15 inches deep. It is deeper and darker on the more level areas, where the effects of weathering are undisturbed and the accumulation of organic matter favored. The material is composed of the finest grades of sand and a considerable proportion of silt. The subsoil is a gray to yellowish-gray, silty, very fine sandy loam which rapidly becomes lighter in color with depth until it grades into the loose, floury, white material characteristic of the series.

The subsoil is highly calcareous, but most of the lime carbonate has been leached from the surface soil.

In places the transition zone from dark-colored surface soil to light-colored subsoil has a compact but friable structure. In other places the upper part of a few inches of the whitish subsoil is noncalcareous, but the lower part always effervesces freely with acid. Locally the surface soil extends to depths of 20 inches or more before the calcareous layer is encountered. Within the larger bodies of the type are small areas of loam and silt loam too small to separate on the map, while the areas adjacent to sandy soils include small deposits of sand and fine sand. In some places the subsoil contains a larger proportion of very fine sand and finer materials than typical.

The Rosebud very fine sandy loam is extensively developed in the eastern and southeastern parts of the county and occupies small

scattered areas in the western part. In places it occurs in conjunction with the Rosebud loam about the heads and on the divides between drainage ways, where gentle erosion has removed a part of the silt and clay. Many areas too small to be shown separately on the soil map are included with other types of the series.

The topography is rolling to gently undulating, with the greatest relief along the stream channels. Drainage is good, as there is sufficient slope to carry off surplus water. The loose structure affords excellent underground drainage and much of the rainfall percolates through the porous soil and subsoil.

About 40 per cent of the type is under cultivation. The native grass vegetation consists of buffalo grass, grama grass, western wheat grass, and small amounts of stipa and the sedge carex, or blackroot. From 4 to 7 acres will pasture one animal and the grasses yield one-half to three-fourths ton of an excellent quality of mixed hay per acre. Wherever the sod is broken western wheat grass springs up and furnishes a very desirable hay plant.

The chief crops are corn, wheat, sorghum, oats, rye, and barley. Alfalfa and potatoes are minor crops. The soil is one of the best dry-farming soils in the county, where the topography does not make the drainage excessive. In favorable years very satisfactory returns are realized. Corn produces 15 to 30 bushels per acre and even higher yields under favorable conditions. Wheat produces only 10 to 15 bushels per acre. The smaller grains produce better on the heavier soils if there is sufficient moisture. Sorghums are profitable, yielding 1½ to 2½ tons of forage and occasionally 3 or 4 tons per acre. Oats produce 15 to 25 bushels under favorable conditions. Rye is a dependable crop and furnishes excellent early spring pasturage before the native grasses are available. Rye yields 10 to 15 bushels per acre and barley 10 to 25 bushels. Potatoes do well, yielding from 50 to 125 bushels per acre where sufficient moisture is available. Alfalfa has been grown with moderate success and probably will increase in acreage. There is danger of killing in extremely dry seasons, particularly in those areas having excessive drainage. One or two cuttings are possible, with a total yield of 1½ to 2 tons per acre.

ROSEBUD LOAM.

The surface soil of the Rosebud loam consists of 8 to 10 inches of friable mellow loam which is dark grayish brown in the upper 2 or 3 inches and slightly lighter in color in the lower part. The subsoil is a brown to grayish-brown friable loam or very fine sandy loam, which passes rather abruptly at 15 to 18 inches into a pale-yellow to white silty very fine sandy loam to silt loam. The upper subsoil is moderately compact, but the lower subsoil is loose and friable. The lower subsoil is highly calcareous, but the surface soil seldom reacts with acid.

Small rounded feldspathic and quartzitic gravel is present locally in the subsoil, and the surface in places is strewn with similar pebbles. In the western belt of hard lands these stones are commonly concentrated in spots. Elsewhere, especially in areas lying near sandy soils or dunes, the upper layer of soil is displaced or modified by admixture of sand.

The depth of the soil varies over the county. The heavier upper subsoil layer is lacking in places. In other places the surface soil

and subsoil contain much coarse sand and waterworn gravel, with limestone fragments and lime concretions, which may be present in sufficient quantity to form patches of gravelly loam or sandy loam. Here the material of the lower subsoil lies near the surface or is exposed, as on hillsides, small knobs, or slopes to drainage ways, and the surface color is grayish or white. Regardless of minor local variations, however, the Rosebud loam retains its essential features over extensive areas.

The Rosebud loam is widely distributed and is one of the more extensive soils in the county. It occurs in scattered areas of varying sizes throughout the upland. It is relatively more important in the western part of the county in the hard-land belt, where it occupies the greater part of several townships.

The topography is level to rolling and in places hilly. Some areas occupy the smooth, gently undulating uplands, but most of them are rolling and slightly hilly, and many lie on the eroded slopes along drainage ways or border the rims of numerous shallow basins. The type has been derived by disintegration of the underlying Tertiary formations. It has good surface and internal drainage, but in some of the rolling areas it is excessively drained. Much of the type is drained by intermittent streams flowing in a southeasterly direction.

About one-fourth of the type is under cultivation; the larger part is used for pasture and hay production. The chief native grasses are buffalo grass, grama grass, and wire grass. There is a fair admixture of the sedge, blackroot. Western wheat grass grows on the more level areas and those disturbed by cultivation. Wire grass is conspicuous in the areas devoted to pasture, particularly where the surface is strewn with gravel. Owing to its deep root system and almost total absence of surface roots, wire grass is an excellent indicator of favorable agricultural conditions. The type produces a moderate yield of native hay of very good quality, the yield ranging from one-fourth to 1 ton per acre in favorable seasons. A section of land will provide pasture for 40 to 50 head of cattle the year around, but has a much greater carrying capacity when hay is fed during severe weather.

Corn and wheat are the most important cultivated crops. Wheat is the chief cash crop and occupies a large acreage. Winter wheat is planted most extensively, Turkey being the principal variety. Under dry-farming conditions the crop averages 10 to 12 bushels per acre over a series of years. Higher yields are obtained by summer tillage. Oats, sorghum, emmer, barley, rye, and millet are important minor crops. The yields of crops show wide variation from year to year. The average yield of corn is about 15 to 18 bushels, of oats 22 to 24 bushels. Both crops are fed principally to work stock and cattle. Sorghum yields from 2 to 3 tons of forage per acre, with higher yields in favorable years. It is a very dependable crop because of its drought-resistant qualities. The average yield of emmer is 10 to 12 bushels per acre, barley 20 to 25 bushels, rye 10 to 15 bushels, and millet 1 to 2 tons of hay per acre. Barley is a fairly certain crop, and experiment station tests indicate that more of it might be grown with profit as a feed and cash crop. Rye furnishes excellent early pasture before the native grasses are available and is good in rotations. Millet is considered a desirable and dependable crop on this soil. Oats sometimes are injured by warm dry winds or drought, so that

the heads are poorly filled. Alfalfa ordinarily yields one cutting a season. There is said to be great difficulty in getting a favorable stand, but once well rooted, alfalfa withstands considerable drought. Potatoes are generally consumed on the farms where produced.

No commercial fertilizer is used, but barnyard manure is occasionally applied. There is danger of burning out, however, and the profit in using manure is at present in question.

The sale value of land of this type ranges from $35 to $60 an acre, depending upon improvements and nearness to markets.

As with the Rosebud silt loam, conservation of soil moisture is the most important factor in farming this type, and the soil requires careful handling. It does well in wet years, but good tillage methods should be employed for moisture conservation and better seed beds should be prepared for small grains even at the expense of decreased cultivated acreage. Rolling and hilly areas close to drainage channels should be protected from erosion.

ROSEBUD SILT LOAM.

The surface soil of the Rosebud silt loam has an average depth of 10 to 12 inches and consists of a dark grayish brown to very dark grayish brown, loose, mellow loam containing varying proportions of fine sand and very fine sand. In places it is underlain by a darker brown layer consisting of a few inches of heavy sticky silt loam or light silty clay loam, which is slightly compact in places when undisturbed, but is easily reduced to loose material. The change from the surface soil or the sticky intermediate zone to the subsoil is abrupt. The subsoil is a yellow or grayish-yellow, almost white, floury silt loam or nearly pure silt and continues below the 3-foot section.

The surface soil has a moderate lime content. The subsoil is calcareous throughout, and the white material forming the lower part is largely composed of lime. Fragments of limestone or calcareous sandstone are encountered here and there in the lower subsoil, and the surface is locally strewn with fine gravel composed largely of pinkish feldspathic fragments and quartzitic granite.

The Rosebud silt loam is rather variable in texture. The type is spotted with small bodies of Rosebud loam and has some of the characteristics of the Dawes loam and Dawes silt loam. The partly weathered sandstone of the Ogallala formation underlies the entire type at a depth of 4 to 6 feet, and in the more rolling areas it outcrops in places, giving rise to characteristic white spots on the hillsides.

A small part of the type has been developed on the level plains, but the larger part is gently undulating. It is confined almost entirely to the southwestern quarter of the county, where it occupies hilltops and the crest of numerous low swells. The general direction of the drainage is southeast. Even in the almost flat situations there is sufficient slope to afford run-off for the surface water, and the porous subsoil and substratum insure sufficient underdrainage.

The Rosebud silt loam, although not very extensive, is an important soil in the county. It is excellent for small grains, but under severe drought conditions is less favorable for general farming than the lighter textured soils. About one-fifth of it is under cultivation and the rest is used for pasture and hay land.

Among the native grasses, buffalo and grama are the dominant species. Western wheat grass, wire grass, and the sedge, blackroot,

are of secondary importance. Buffalo grass is green and growing in early spring when the season is most favorable and ripens seed very early. Occasionally, in very dry years, no seed is formed, but the plant will revive and form seed at any period when moisture is available. Grama grass and western wheat grass succeed buffalo grass in growing period. Grama grass requires nearly 60 days to mature seed. Where the white subsoil appears near the surface there is a thin growth of stipa during the early part of the season and a sparse growth of western wheat grass which is more luxuriant as the depth of the surface soil increases. Where the surface has been heavily grazed, a dense growth of wire grass reclaims the land. Most of the weeds and wild flowers flourish in the early season, when moisture is more often plentiful. The behavior of native vegetation would indicate the advisability of growing early maturing varieties of the grains and other crops.

The most important cultivated crops on the Rosebud silt loam are wheat, corn, and oats. As on most of the hard upland soils of the county, wheat occupies the largest acreage. Winter wheat is most popular. Turkey is the favorite variety, but Kanred is increasing in favor. Only the early maturing kinds of corn are planted, chiefly the dent varieties, though the flint varieties appear to be more profitable. Oats are grown to supply feed on the farms and ranches. Alfalfa is gaining favor as a forage crop and has produced good results, but its total acreage is small. Potatoes are produced for home consumption and a few are sold. Part of the type is included in stock farms and ranches on which beef cattle, principally grade Herefords and Shorthorns, are grazed. Dairying is not practiced commercially, though a few milk cows are kept on many farms, and some farmers have a surplus of dairy products for sale. A square mile supports 40 to 60 head of cattle the year around.

Wheat yields from 10 to 35 bushels, depending upon the rainfall and the farming methods. Under good summer tillage high average yields are obtainable. Corn yields 10 to 30 bushels per acre, or, when cut for fodder, from 1 to 3 tons of forage. In average years oats yield 20 to 25 bushels and potatoes 100 bushels per acre, while alfalfa is said to produce an average of 2 tons of forage in two cuttings.

No definite rotation is practiced, as the soil has not become impoverished through cropping. Wheat frequently succeeds itself. Some farmers alternate corn and wheat. Corn usually is listed, as the moisture conditions are better than when planted on a level surface. A small acreage of corn is planted on newly broken sod land. Plowing, disking, and seeding are often performed in one operation with the use of large tractors.

The price of the Rosebud silt loam ranges from $40 to $75 an acre, depending upon improvements and location.

The Rosebud silt loam is naturally a fertile, strong soil, and good crop yields are obtained where careful conservation of soil moisture is practiced. Frequent cultivation is necessary to keep the surface well loosened for corn and other tilled crops and to eradicate all weeds, but no attempt should be made to obtain a dust mulch which will puddle during rains and is subject to removal by wind erosion when dry. A thorough preparation of the seed bed is advisable even at the expense of a loss of acreage.

DAWES SANDY LOAM.

The surface soil of the Dawes sandy loam consists of a loose, coarse, grayish-brown to very dark grayish-brown sandy loam 12 to 15 inches deep. The upper subsoil is a layer of compact, dark grayish brown sandy loam or loam, which is sticky and plastic in places. This generally extends to a depth of 24 inches and locally to 30 inches; it is practically everywhere present, but varies in thickness within short distances. The lower subsoil is a pale grayish yellow or gray loam or silt loam, more friable and granular in structure. Over small areas, especially south of Grant, the surface is strewn with waterworn gravel of varying size and composition, principally feldspar and quartz, and in places this gravel is present throughout the soil section. The surface soil and compact upper subsoil are deficient in lime, but the lower subsoil is high in lime carbonate. On slopes and bluffs, where wind or water erosion is more severe, bedrock or coarse sandy materials and fragments of the Ogallala formation are encountered just below the 3-foot depth.

The Dawes sandy loam has rather wide distribution in the eastern and southern parts of the county, where it is associated with areas of Dunesand. The soil occurs principally on low, gently rolling hills and ridges, but also occupies a few basins and depressions in the sand hills. Owing to the porous nature of the surface soil, water is quickly absorbed and the drainage is adequate. The sticky layer retards the downward percolation and thus makes the soil more retentive of moisture. No drainage channels are developed.

The Dawes sandy loam is a fairly good type for dry farming. About 60 per cent of it is under cultivation. With proper tillage and crop adaptation, fair yields are obtained even under adverse conditions. The dependable crops are corn and sorghum. Although corn may fail to mature grain in a short season, both corn and sorghum produce reliable forage crops. In favorable years corn yields 15 to 25 bushels and sorghum 1½ to 2½ tons per acre. Potatoes and rye do well. The land is not adapted to wheat, oats, and barley, although small acreages are grown. The yields of all crops vary widely, depending on the season, but the production of some crops is nearly always certain where hail or excessive winds do no damage. The uncultivated land is used chiefly for pasture. From 10 to 15 acres are required per animal. The principal native grasses are sand grass and bunch grass (little bluestem).

As much straw and stubble as practicable should be left on the field to prevent drifting during the winter. Since the soil is loose and open, the usual methods for conserving moisture should not be employed, as such practices may cause loss by blowing. Deep plowing especially should be avoided. Crests and hilltops should be left unbroken and used for pasture.

DAWES FINE SANDY LOAM.

The surface soil of the Dawes fine sandy loam is a dark grayish brown to very dark grayish brown, mellow, fine sandy loam, 12 to 15 inches deep, the upper part of which is rich in organic matter. The upper subsoil, which averages about 12 to 15 inches in thickness, is a more compact, grayish-brown, sticky very fine sandy loam to loam, in many places containing a large proportion of fine sand. The lower subsoil is a loose, friable, in places floury, yellowish-gray or white,

silty very fine sandy loam or silt loam. The surface soil and the upper subsoil are leached of lime, but the lower subsoil is highly calcareous.

The soil section is variable in character. The soil appears in places to be only fine sand blown over heavier Rosebud types, whose old surface soil serves as the heavy intermediate layer of the Dawes series. In these situations the upper subsoil is very hard and tough and is penetrated with considerable difficulty. Elsewhere, even in the same field, the sand has so deeply buried the lime carbonate layer that it is not encountered at 3 feet, but appears at slightly greater depths.

The Dawes fine sandy loam occurs in small scattered areas, principally in the eastern half of the county, largely in association with sandy soils of other series and Dunesand. Generally it occupies depressions or caps low knolls, lying somewhat lower than the general level of the surrounding country. No drainage ways are established, but the porous soil admits rainfall easily, and water seldom accumulates on the surface except for a short time. About 40 per cent of the type is under cultivation, the rest being used for pasture and hay land. The native vegetation consists of heavy growths of bunch grass (*Andropogon scoparius*) and other common sand grasses. In favorable spots there are small growths of grama, western wheat, and wire grass. The cover affords fair pasturage, from 8 to 12 acres being required for one animal.

The Dawes fine sandy loam is easily cultivated and is less subject to drifting than the sandy loam. It is retentive of moisture and produces moderate yields even in extremely unfavorable seasons if properly handled. Corn and sorghum are the principal crops, but rye, oats, barley, wheat, and Sudan grass and other forage crops are grown to some extent. The soil is well adapted to corn, sorghum, and Sudan grass, but it is less favorable to small grains, except rye. Corn ordinarily yields 15 to 25 bushels per acre, most of the crop being fed on the farm where produced. Sorghum produces 2 to 3 tons of forage per acre. Rye, which furnishes excellent early pasturage, averages 10 to 12 bushels per acre, oats 20 to 25 bushels, and barley 10 to 25 bushels per acre. Oats often fail to head properly in unfavorable years. Crops are planted and tilled in the same manner as on the Rosebud fine sandy loam. No fertilizers are used and no definite crop rotation is practiced. More organic matter could be used with profit.

Land of the Dawes fine sandy loam is priced at $20 to $35 an acre, depending upon improvements.

DAWES VERY FINE SANDY LOAM.

The Dawes very fine sandy loam consists of a dark grayish brown to dark brown very fine sandy loam or light loam, 10 to 15 inches deep, which passes gradually into a light loam or a heavier stickier loam or silt loam constituting the upper subsoil. The lower subsoil is a yellowish-gray, pale-yellow, or nearly white, silty very fine sandy loam, loam, or silt loam and is highly calcareous.

The upper subsoil varies in thickness from 18 or 20 inches in places to not over 3 or 5 inches in other places, the average being about 10 or 12 inches. In certain areas, particularly southeast of Grant, the heavy upper subsoil is not distinctly developed throughout, but the

soil is more or less compact and the white calcareous layer lies deep below the surface, though generally within the 3-foot section. In the extreme eastern part of the county, especially along the Perkins-Lincoln County line, the heavy compact layer is rather light in color, in places yellowish, but retains its heavy, stiff character.

The Dawes very fine sandy loam is widely distributed over the county. The largest and most uniform areas are southeast of Grant. The soil is of residual origin, weathered principally from the finer textured materials of the Ogallala formation. The surface soil has been somewhat modified by wind erosion and deposition. The surface in general is that of a gently rolling plain consisting of a series of low mounds and ridges, but in some parts the topography is flat or very gently undulating. Drainage is everywhere good and as a rule not excessive. The soil absorbs water readily and is admirably suited for storing water and preventing its loss either by downward movement or surface evaporation.

The type is an important agricultural soil. About half of it is under cultivation; the rest is included in pastures on which beef cattle, principally grade Shorthorns and Herefords, are grazed. The native grasses consist mainly of grama grass, buffalo grass, the sedge, blackroot, and western wheat grass. Sand bur, Russian thistle, and sunflower infest the cultivated fields.

Corn, wheat, rye, oats, and sorghum are the common crops. Both wheat and corn do well, but wheat does not yield as well on this soil in the very favorable seasons as on the loam. Corn yields 15 to 30 bushels, wheat and rye 12 to 15 bushels, oats 20 to 25 bushels, and sorghum 2 to 3 tons per acre. In short growing seasons corn sometimes fails to mature properly. The crop is frequently cut with a corn binder, shocked, and used for fodder. Wheat is the cash crop. Rye is a dependable crop and sorghum is a sure hay crop. As soon as sorghum is harvested the land should be disked to allow the ready absorption of rainfall, unless the soil is one that drifts badly. Sorghum should be planted rather thickly so as to produce a fine-stemmed forage, which is more readily eaten by cattle and more easily cured. The soil is cultivated in the same manner as the Rosebud very fine sandy loam, and no definite crop rotation is followed.

The land is priced at $25 to $60 an acre, depending upon improvements and location with respect to markets.

DAWES LOAM.

The characteristic feature of the Dawes series is the compact upper subsoil layer. The surface soil of the Dawes loam has an average depth of 10 to 12 inches and is a grayish-brown to dark grayish brown friable loam or silt loam, relatively high in organic matter. In places it carries small quantities of fine rounded quartz and feldspar pebbles strewn over the surface. The upper subsoil to a depth of 24 to 30 inches is a dark-brown to grayish-brown or dark-gray, compact, friable silt loam or silty clay loam. The lower subsoil is a light grayish yellow to almost white, highly calcareous, loose, floury silt to silty clay. There is considerable variation in the thickness of the upper subsoil. In some places it extends to 30 inches and in others the layer is very thin, the average thickness being about 12 inches. In places the lower part approaches a silty very fine sandy loam and contains some fine gravel.

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

Over large parts of its area the surface soil varies from the typical and approaches a silt loam in texture. Here the soil contains a smaller proportion of very fine sand than in areas associated with the sandy and Dunesand soils. Extensive areas of this soil were recognized in the vicinity of Grant and northwestward, but their line of demarcation is so indistinct that it appears best to consider the soil a variation of the typical loam.

The Dawes loam occurs in bodies of varying size throughout the upland plains of the county. It occupies flat to gently undulating positions where drainage ways are in their initial stage of development. It also occurs on the flatter surfaces between drainage ways and is widely scattered through all the sandier soil bodies of the county. The nearly level surface favors the retention of moisture and gives the soil a slight advantage over the Rosebud types. The smooth surface is also favorable for extensive farming and the use of motor machinery.

The Dawes loam is mainly residual in origin, being derived by weathering from the white calcareous silty and fine sandy materials of the Ogallala formation. The surface has been slightly modified by wind action and the addition of some wash from higher lying areas.

About one-third of the type is under cultivation; the rest is included in pasture. It is well adapted to agriculture under the prevailing climatic conditions. The native vegetation includes luxuriant growths of buffalo and grama grasses, with western wheat grass and other grasses and herbaceous plants. The livestock industry consists of the raising of beef cattle, which are generally sold as stockers and feeders. Many farmers on this soil keep a few milk cows for home use and sell the surplus dairy products. A few hogs are raised. From 5 to 7 acres per steer are required for pasture land.

Wheat and corn are the principal crops. Wheat is the cash crop. Fair yields are obtained in seasons of normal rainfall, provided distribution is favorable, winter wheat yielding 10 to 40 bushels per acre and spring wheat somewhat less. Under summer tillage methods from 15 to 50 bushels are realized, but the average is close to 25 or 30 bushels. Corn yields 10 to 25 bushels and occasionally higher, and averages about 15 or 20 bushels. Corn is attacked by cutworms and smut, and owing to the short growing season the kernels are frequently soft and immature. Barley produces 10 to 40 bushels and millet yields 1 to 2 tons of hay or 20 to 35 bushels of seed. Oats do well, but are occasionally injured by warm winds at critical periods. Sorghum, Sudan grass, and kafir are good forage crops and yield from 1 to 3 tons per acre on an average. Potatoes thrive in this soil, but are grown mainly for home use.

No definite rotation is practiced, as the soil is not yet impoverished through cropping. New land is broken to a depth of 3 or 4 inches, a tractor and heavy plows being commonly used. Old land is generally plowed every two or three years. Small grains are usually drilled

in on old corn or stubble land, though some winter wheat is seeded between the corn rows. Corn is generally listed. Small acreages are planted on newly broken sod land. Plowing, disking, and seeding are often done in one operation with the use of tractors. No fertilizers are used, but occasionally barnyard manure is applied. Care is necessary in the use of coarse organic manures, which may accentuate conditions of drought.

The sale value of land of this type ranges from $40 to $100 an acre, depending upon local conditions. Some farms with good improvements and good locations with respect to markets are held for higher prices.

This type is naturally very productive where sufficient moisture is available and produces the largest yields of any soil in the county in favorable years. Certain crops, however, fail frequently under the prevailing climatic conditions. Owing to the heavy nature and structure of the soil, absorption is impeded and much of the precipitation escapes as run-off. Usually during the greater part of the season the available water is confined to the upper 2 feet of soil. The root systems of the shallow-rooted crops generally penetrate this entire zone, make large growths in early spring when the moisture supply is plentiful, and so dissipate the water stored. Transpiration is increasingly higher, so that when drought occurs the supply of moisture necessary for continued growth is exhausted. Application of manure and other fertilizers which stimulate excessive vegetative growth is harmful and is so recognized by many farmers, who burn their straw piles, do not apply fertilizers, and have learned by experience that application of manure generally causes "burning out." Thin seeding also is necessary so that adequate moisture may be available for each plant. Corn especially suffers, as it recovers with difficulty and is frequently destroyed at critical periods. Early maturing crops, winter wheat, and dwarf strains which evade the droughts of July are accordingly best adapted, and also crops growing slowly in the early season, as sorghum and Sudan grass, which conserve soil moisture and are able to continue growth much longer. The success of deep-rooted plants like alfalfa is likewise doubtful, though thin planting, planting in rows and cultivating, and planting in favored spots which receive run-off from neighboring areas, may be profitable. Summer tillage is frequently resorted to for fall-sown grains. Under all conditions thorough destruction of weeds is essential, but continuous stirring between rows where no weed growth prevails is unproductive and wasteful of labor.

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

Mechanical analyses of Dawes loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
374870	Soil, 0 to 12 inches.....	1.4	3.1	2.4	13.0	39.9	31.2	8.9
374871	Upper subsoil, 12 to 30 inches.	.6	3.4	2.8	12.5	38.8	30.3	11.5
374872	Lower subsoil, 30 to 36 inches.	.2	3.0	2.8	13.6	42.2	29.7	8.5

VALENTINE LOAMY SAND.

The surface soil of the Valentine loamy sand is a grayish-brown to dark grayish brown, loose, loamy sand, 12 to 15 inches deep. The subsoil is an incoherent gray to yellowish-brown sand resembling the subsoil of Dunesand, but slightly darker in color. On low ridges and knolls, where conditions have been unfavorable for the accumulation of organic matter, the soil is very loose and incoherent. The sand grains are chiefly quartz and feldspar. In general both soil and subsoil are low in organic matter and deficient in lime.

The Valentine loamy sand occurs throughout the county, except in the western belt of hard lands, and is most commonly associated with the Dunesand. The bodies are irregular in shape and many include several hundred acres of land. The topography is gently rolling, being broken by small ridges and knolls having a southeasterly trend. Drainage is good throughout the type, the loose porous sands affording an ample inlet and outlet for all surplus water.

The Valentine loamy sand has little agricultural value, as it drifts when cultivated. It is used as pasture and hay land, and some small areas are cropped. The predominant vegetation is bunch grass (little bluestem). There are many other species, however, including buffalo, big bluestem, sand grass, panic grass, wire grass, and sage. Some wild hay is cut, the yields varying from one-quarter to 1 ton per acre. The selling price of land of this type varies from $10 to $15 an acre.

The Valentine loamy sand is of better quality than Dunesand. The surface zone is stained by organic matter and in places the entire section is dark in color. The type lies lower than Dunesand and is less subject to drifting. Extreme care is necessary in handling the soil when it is placed in cultivation, and only the more favorable spots should be plowed up. Provision should be made to leave the surface as rough as possible to prevent drifting. For this reason cattle should not be pastured in the cornfields, and no more cultivating should be done than is absolutely necessary to keep down weeds. When drifting occurs, the action may be checked temporarily by cultivating deeply enough to bring up the moist soil. Any increase in organic matter will materially aid in holding the soil. This is not a strong soil and most of it probably should be kept in pasture and hay land.

VALENTINE LOAMY FINE SAND.

The Valentine loamy fine sand, to a depth of 12 to 18 inches, is a grayish-brown to dark grayish brown, loose, friable loamy fine sand. The depth and color vary with the topographic position; in the basin areas, where accumulation of organic matter is favored, the soil is deeper, darker, and more coherent. The subsoil is a loose, incoherent, brown to light yellowish brown fine sand or sand, which with depth passes into coarse gray sand resembling Dunesand. Both soil and subsoil are low in organic matter and deficient in lime. The absence of the sticky layer characteristic of the loam distinguishes the type from the Valentine fine sandy loam.

The soil is extensivly developed, but does not occur on the western hard lands except as an outlier of sand-dune areas from which some of the soil material has been derived. The surface is gently undulating and more or less broken by small ridges and knolls.

Surface drainage is not established; the rainfall sinks into the porous sand and is carried away through underground channels.

Some of the type can be successfully farmed, but as a rule it drifts when broken, and for this reason nearly all is used as pasture and hay land. Small areas are cropped to corn, potatoes, sorghum, and rye. The native vegetation consists chiefly of bunch grass, stipa, grama, sand grass, and scattered clumps of sand sage. Hay is cut and produces from one-fourth to three-fourths ton per acre, depending on the rainfall. The type will pasture from 30 to 40 head of cattle per section. The price of this land varies from $10 to $15 an acre.

Parts of the Valentine loamy fine sand can be cultivated to crops under careful management. The soil is well adapted to corn and potatoes. The broken surface, however, should be kept as rough as possible to prevent drifting, and the content of organic matter should be increased by the application of barnyard manure or like materials. Large bodies in the sand hills should be kept in pasture.

VALENTINE LOAMY VERY FINE SAND.

The Valentine loamy very fine sand consists of 8 or 10 inches of dark grayish brown, loose, friable loamy very fine sand, underlain by mellow light-gray or grayish-brown very fine sand, which continues throughout the section. The depth and color of the surface layer varies with the content of organic matter. The light color and non-calcareous nature of the subsoil and the absence of the sticky compact layer distinguish this type from the Valentine very fine sandy loam.

The Valentine loamy very fine sand occurs chiefly in the northeastern and southeastern parts of the county in areas more or less contiguous to Dunesand. The material probably represents well-weathered eolian deposits. The topography is gently rolling to slightly hilly, the surface being dotted with depressions and small pockets. Drainage is everywhere good, owing to the porous nature of the soil and subsoil. There are no established drainage ways.

Practically all the type is included in pasture; a small part is farmed to corn and wheat. The native grasses are principally little bluestem, stipa, sand grass, and grama grass. They yield from one-fourth to three-fourths ton of hay per acre or will support 30 to 40 head of cattle per square mile throughout the year. The land is easily handled and with careful tillage methods should prove a good dry-farming soil. As the land is somewhat rolling, measures to check drifting should be adopted.

VALENTINE SANDY LOAM.

The surface soil of the Valentine sandy loam consists of 12 to 18 inches of grayish-brown to dark grayish brown, loose, friable sandy loam. In places the dry surface has a reddish cast, but the depth and color of the soil vary with the topography. In pockets and basins, where accumulation of organic matter is favored, the soil is deep and dark in color, but on low ridges and knolls the soil is frequently loose and incoherent and rather light brown in color. The subsoil is a brown to dark grayish brown sandy loam or loamy sand which is generally sticky but open and friable. In places it gives way to a light-yellow or light-brown loose sand in the lower part of

the soil section. The substratum is a loose incoherent gray sand resembling the core of sand dunes. Neither soil nor subsoil is highly calcareous and both are low in organic matter.

The type includes one important variation. Southwest of Grant are a number of low hills and ridges where the texture of both surface soil and subsoil is exceedingly coarse. The subsoil, however, retains its sticky character. This development may either represent the sands of old dunes in a mature stage of weathering or possibly ancient beach sands.

The Valentine sandy loam is extensive throughout the county, except in the extreme western part. It is generally associated with sand-dune developments or extends as narrow tongues into the hard lands of the western part of the county. The bulk of the soil material probably represents weathered Tertiary materials, but these have suffered so much modification by wind and water that their exact relation is uncertain. The type occupies low rolling hills and ridges and intervening valleys and basins. Drainage ways are not developed, and the topography favors the accumulation of moisture, but the rainfall readily sinks into the porous sand and there is practically no run-off. Complete loss, however, is retarded by the characteristic sticky subsoil which serves as a reservoir.

This type is a good agricultural soil and about 60 per cent of it is under cultivation. The native vegetation includes little bluestem (bunch grass), sand grass, big bluestem, switch grass (*Panicum virgatum*), some grama grass, sand sage, and other species. These furnish from one-fourth to about three-fourths ton of hay per acre in favorable seasons or support 30 to 40 head of cattle per section.

The Valentine sandy loam compares in agricultural value with the Rosebud sandy loam. It is subject to wind erosion where not properly handled, but areas in depressions where the water content is fairly high are favorable for cultivation. The principal cultivated crops are corn, barley, rye, and sorghum. Wheat and oats also are grown, but generally give poor returns except on sod land. Corn and sorghum are the most profitable crops. Potatoes do well and are raised for home consumption. Corn averages 10 to 15 bushels, rye 10 to 12 bushels, barley 12 to 15 bushels, and sorghum 1 to 2 tons per acre. Land of this type sells for $15 to $35 an acre.

VALENTINE FINE SANDY LOAM.

The surface soil of the Valentine fine sandy loam consists of a grayish-brown to dark grayish brown fine sandy loam fairly rich in organic matter. It has a relatively high proportion of very fine sand and sufficient clay and silt to prevent excessive drifting under normal conditions. At a depth of 15 to 18 inches the material becomes slightly lighter in color and sticky in character. This continues throughout the soil section, except that the color becomes lighter with depth. The type differs from the Rosebud fine sandy loam chiefly in the low lime content of the subsoil.

The type is fairly uniform. The areas are irregular in outline, and some of them, especially the larger ones, include bodies of other soils, chiefly the Dawes fine sandy loam. Locally the dark color extends throughout the section, especially in the lower positions where the surface is nearly flat.

Most of the type is developed in the valleys and basin like depressions of the rolling sand-hill region, but a number occur at their border or extend into the hard-land belt. More commonly, however, the soil is associated with sand dunes. It is probable that the type is derived from material weathered from the sandy strata of the Tertiary formations, to which wind-blown sand and silt have been added.

The drainage is good but not excessive. Practically all the rainfall is immediately absorbed, very little running off. The topography is favorable for the accumulation and retention of moisture, which has favored development of a sticky, less porous subsoil and also the accumulation of more organic matter than the sandier types of the series.

The Valentine fine sandy loam is important agriculturally, especially in the sand-hill regions. About three-fourths of it is under cultivation; the rest is included in stock farms devoted largely to cattle raising. The native vegetation consists of moderate stands of grama grass, needle grass, sand grass, and scattered growths of bunch grass. It produces from one-fourth to three-fourths ton of hay per acre or will support 30 to 40 head of cattle per square mile throughout the year.

The principal crops are corn, wheat, rye, and sorghum. Corn and sorghum are profitable, though yields vary widely from year to year. Corn yields range from 15 to 30 bushels or more per acre, depending on the season. Wheat, the cash crop, produces 10 to 15 bushels, occasionally more; and rye yields 12 to 15 bushels. Sorghum yields from 1 to 2 tons of forage. Potatoes and oats do well, but are grown mainly for home consumption.

Wheat and rye are planted between corn rows. The soil is less subject to drifting than the sandier types of the series, but caution should be exercised, and the crop should be cultivated only enough to kill the weeds and maintain a rough surface mulch. Deep-rooted crops are profitable, as moisture penetrates deeply and the sticky subsoil serves to hold water. Evaporation is low, as a slight wind rapidly establishes a surface mulch after a rain. The soil is not rich in plant-food elements, but can be depended upon year in and year out for at least partial crops.

The land is valued at $25 to $30 an acre, depending on improvements and the proportion of sandier types included.

VALENTINE VERY FINE SANDY LOAM.

The Valentine very fine sandy loam to a depth of 12 or 15 inches is a grayish-brown to dark grayish brown, friable, very fine sandy loam. The surface layer is commonly darker than the lower part, owing to a slightly larger content of organic matter, and is nearly black where conditions have favored plant growth. The subsoil is lighter in color than the surface soil, has a higher silt and clay content, and is sticky and compact. At 30 inches the subsoil grades into a light-brown or gray fine sand to very fine sand. Neither soil nor subsoil is highly calcareous.

In many areas the heavy sticky subsoil is absent, either because of better drainage or because the soil in these areas is of so recent deposition that enough time has not elapsed to allow the downward translocation and concentration of clay in the subsoil. The larger

areas of this soil include patches of Dawes very fine sandy loam, in which the white calcareous material of the lower subsoil is encountered at the bottom of the 3-foot section. The profile in cuts and wells shows that the calcium-carbonate layer may lie below, at, or above the 3-foot depth within short distances. The type doubtless consists mainly of wind-blown material and generally lies at the end of a series of texture changes in the prevailing wind direction away from the parent dune areas. The material has not been evenly distributed, but lies unconformably upon the residual materials, so that the calcareous formations appear at irregular depths.

The Valentine very fine sandy loam is extensive and occupies areas of varying size throughout much of the upland of the county. It is a valuable agricultural soil, owing to its favorable topography, and is preferred to the heavier soils of the county, especially by the older settlers. The topography varies from flat to gently undulating, the surface being relieved by low hummocks and basins. In general, the surface drainage is not well established. The porous subsoil, however, absorbs the light rainfall, and water seldom stands on the surface except immediately after heavy rains.

About 60 per cent of the type is under cultivation, the remainder being used for pasture and hay land. The native vegetation consists of western wheat grass, redfieldia, stipa, and some buffalo and grama grasses. The yields of wild hay range from one-fourth to three-fourths ton per acre, depending on the rainfall. One square mile of this land will support from 30 to 40 head of cattle the year round.

The most important crops are corn, wheat, and oats. Wheat is the cash crop. The corn and oats are fed on the farms. Potatoes are grown for home consumption. Alfalfa is grown in small fields. Rye and sorghum are produced chiefly for forage, the former giving excellent early pasturage before the native grasses are available. The soil is productive, owing to its inherent fertility and the character of its subsoil, which permits the accumulation and retention of available moisture. Corn yields vary widely, ranging in different seasons from 10 to 30 bushels per acre. Wheat produces 8 to 20 bushels and potatoes yield 75 to 150 bushels per acre.

The soil is excellent for general farming and is subject to less drifting than any of the other Valentine types. It is easily handled, absorbs and retains moisture well, and is considered one of the best dry-farming soils in the county.

Land of the Valentine very fine sandy loam sells for $15 to $35 an acre, depending upon improvements and nearness to towns.

VALENTINE LOAM.

The surface soil of the Valentine loam is a dark grayish brown friable loam 12 to 15 inches deep. Its dark color is traceable to its topography, which is favorable for the accumulation of organic matter, the upper few inches of the surface soil being especially dark. The subsoil is a rather heavy, compact, dark-brown loam or silt loam, which generally continues throughout the 3-foot section, though on the margins and on small knolls scattered through the type the calcareous base of the associated Rosebud and Dawes types may be encountered. Usually the material becomes lighter in color with depth, or, in other words, as the content of organic matter decreases.

The total area of the type in this county is not large. The greater part is mapped in the eastern half of the county. It is typically developed in depressions throughout the uplands where surface wash from surrounding higher lands has contributed silt and clay. No surface drainage ways are established, but in general the slope of the country as a whole is sufficient to dispose of the surplus water.

About 20 per cent of the type is under cultivation, the rest being used for pasture and hay land. The native vegetation is principally grama, buffalo, and western wheat grass, and the sedge, blackroot. Wild hay yields from one-fourth to three-fourths ton per acre, depending on the rainfall. Wheat and corn are the principal crops. The oat crop is usually profitable, but is sometimes injured by drought. Corn does better than on other heavy soils of the county, as the topographic position favors the accumulation of run-off from adjacent soils. Wheat is the principal cash crop, but the yields vary from 10 to 30 bushels per acre. Corn yields 15 to 30 bushels and oats 15 to 35 bushels. In general the same cropping methods prevail as on other loam and silt loam soils of the county. Early maturing and dwarf varieties should be planted, thin seeding should be practiced, and weeds eradicated as completely as possible.

CANYON GRAVELLY SANDY LOAM.

The surface soil of the Canyon gravelly sandy loam consists of 6 to 12 inches of grayish-brown loamy sand containing relatively large proportions of angular limestone pebbles and fine gravel which give the soil a loose, porous structure. The subsoil consists of lighter colored sandy and silty materials of the Ogallala formation.

The type includes areas of stony loam, too small to map, in which the surface soil is lighter in color, the stone content is greater, the slopes are steeper than on the typical soil, and rock outcrops are common. The soil has lower value than the gravelly sandy loam. In other places the type includes areas of soil having a relatively large proportion of finer materials, chiefly of the finer grades of sand, with some silt and clay.

The Canyon gravelly sandy loam is confined to isolated knolls and low ridges scattered through the uplands of the county. The topography is rolling to hilly and the bedrock is exposed in many places. The stony loam occupies the rougher areas, while the gravelly sandy loam occurs where the surface is less eroded. Many of the hills and ridges are capped by the hard, nearly white, calcareous conglomerate of the Ogallala formation.

The soil is droughty and unsuited to agriculture and most of it is used for pasture. It supports moderate growths of sand, needle, bunch, grama, buffalo, and wire grasses and the sedge, blackroot, and affords fair grazing. From 12 to 20 acres are required to support one horse or cow. The type is sold only in connection with adjoining soils of higher agricultural or grazing value.

COLBY VERY FINE SANDY LOAM, BROKEN PHASE.

The Colby very fine sandy loam, broken phase, includes areas of eroded stream slopes, bluffs, and ridges, lying in T. 9. N., Rs. 35 and 36 W., in the southeastern corner of the county, capped by rather

thick deposits of loess. The surface soil is a grayish-brown silty very fine sand, and is underlain at an average depth of 4 to 7 inches by a pale yellow or light yellowish gray silty very fine sand, which grades rather quickly into the unweathered, loose, floury, loess material. Both soil and subsoil are highly calcareous. The high content of lime carbonate, together with some clay and organic matter, assists materially in binding the soil and retarding erosion.

The topography is rolling to hilly, with numerous steep slopes and some small precipitous bluffs. The land is dissected by small intermittent streams which have cut deep, perpendicular-walled valleys into the originally level upland surface. Small areas are included in which the surface is much less rugged and the land should properly be classed as a rolling phase. Owing to the steepness of the slopes, drainage over most of the area is good to excessive, with the exception of included stream valleys and several small areas that have escaped excessive erosion. Landslides are common, and consequently the slopes in many places present a succession of steps known as cat-steps.

The Colby very fine sandy loam, broken phase, is used only for grazing and hay production. Where erosion has been severe the slopes are almost barren of vegetation or support only a sparse growth of pasture grasses, weeds, and shrubs. Much of the land, however, supports good stands of nutritious grasses, including little bluestem or bunch grass, buffalo grass, wire grass, grama grass, June grass, and the sedge, blackroot. The narrow bottoms of some of the ravines and small hollows support good stands of native grass, which is cut for hay. In connection with the adjacent areas of level land, the phase is peculiarly adapted to stock raising, as the canyons afford protection for cattle during the winter and the pasturage during the greater part of the year is good. With winter feeding, 7 to 10 acres will support one steer, but 12 to 20 acres are required for pasturage throughout the year. The cattle are principally grade Herefords and Shorthorns. They are shipped as stockers and feeders.

Land of this phase sells for $10 to $25 an acre, but is almost always included in sales with adjoining level areas. Overgrazing and fires are the two most important abuses to be guarded against in the use of this soil.

SCOTT SILTY CLAY.

The surface soil of the Scott silty clay consists of 10 to 12 inches of dark grayish brown to dark-gray compact silty clay. The upper subsoil is a gray to dark-gray, tough, refractory silty clay. Both the soil and upper subsoil are sticky and plastic when wet, but hard and brittle when dry. They are rich in organic matter and have a much darker color than the lower zones. At 24 to 30 inches the subsoil becomes lighter in color and grades into a compact, sticky, fine sandy loam, which is not highly calcareous. At 36 inches or more this gives way to a light sandy loam or loam, pale yellowish gray in color, slightly mottled, and becoming whitish and calcareous with depth.

Near areas of sandy soils the surface soil varies from a loam to silt loam or silty clay loam, according to the amount of wind-blown sand incorporated, and the heavy impervious layer does not extend to as great depths. In the shallower basins, where surface wash has been less extensive, the white calcareous subsoil typical of the Rose-

bud series may be encountered in the lower part of the section, or in areas where the type has been developed over loess the lower subsoil may be unweathered loess. Where the surface soil is deep, however, the subsoil in many places shows no appreciable change in color or texture to a depth of 3 feet or more, and in general the entire section is so compact as to be almost impervious to water.

The Scott silty clay occurs in sinklike depressions widely distributed over the upland. The areas range in size from 1 or 2 acres to 20 or 25 acres, and many are too small to be shown on the map. The soil consists of sediments carried by sheet water from the surrounding higher lands into shallow depressions, locally known as buffalo wallows. As these have no drain or outlet, the water escapes only by evaporation or seepage. The water moving into the subsoil carries the finer particles in suspension and deposits them throughout the soil section. After heavy rains water stands on the surface for a few days to a week or two.

On account of its poor drainage, the type is used mainly for pasture and hay land. Occasionally it is broken in conjunction with neighboring areas and planted to corn or wheat, but the crops either "drown out" or "dry out," depending on the season. The native vegetation includes western wheat grass, which is cut for hay, sparse growths of grama grass and buffalo grass, large quantities of carex, some gumwood, smartweed, and in wet places meadow marigold. Owing to the more favorable moisture conditions the growth of vegetation is more luxuriant than on other upland types.

The soil could be cropped if adequate drainage were provided, but this is not practicable over most of the type. Special treatment is required, as the soil is too compact in its natural state, and its impervious character is unfavorable for accumulation of moisture.

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

Mechanical analyses of Scott silty clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
374808	Soil, 0 to 12 inches	1.0	1.8	1.0	8.2	23.2	31.6	33.2
374809	Subsurface, 12 to 27 inches	.8	1.8	1.0	9.5	27.3	26.6	33.0
374810	Subsoil, 27 to 36 inches	1.2	10.0	6.0	23.2	43.2	7.0	9.3
374811	Substratum, below 36 inches	.8	4.6	2.7	20.2	40.0	13.9	17.8

TRIPP FINE SANDY LOAM.

The surface soil of the Tripp fine sandy loam is a dark grayish brown fine sandy loam 10 to 12 inches deep. The upper few inches are somewhat darker than the lower part, owing to a higher content of organic matter. The subsoil is a grayish-brown, friable fine sandy loam, moderately calcareous. While there is fine material present, the surface soil contains much coarse material and is subject to slight wind erosion when plowed.

The type occurs in one area along the lower Stinking Water Creek valley. It is derived from sediments carried down from the adjoining uplands and deposited when the stream was flowing at a higher

level than at present. The surface is nearly flat, but has sufficient slope to carry off surplus sheet water, and the porous subsoil favors underdrainage.

The type is unimportant agriculturally, owing to its small extent. About 70 per cent is under cultivation, the rest being used for pasture and hay land. It supports a sparse growth of vegetation typical of sand soils. The principal crops are corn and wheat. Corn does well in seasons of normal rainfall. The crop is fed to cattle and hogs. Wheat is not well adapted to this soil.

TRIPP VERY FINE SANDY LOAM.

The surface soil of the Tripp very fine sandy loam is a dark grayish brown to very dark grayish brown very fine sandy loam 12 to 15 inches deep. In places it is slightly compacted at the surface, but for the most part it is loose and friable. Locally the upper surface soil is darker in color and contains more organic matter than the fine sandy loam, so there is less tendency toward wind erosion. The soil is moderately calcareous, but the lime content increases with depth. The subsoil consists of a slightly lighter colored very fine sandy loam which grades rapidly into a lower subsoil of gray, loose, floury, very calcareous silt and very fine sand, which has a smooth feel and in many places a yellowish tinge.

The Tripp very fine sandy loam occurs in two irregular-shaped areas in the Stinking Water Creek Valley, where it occupies both low and high terrace positions. The parent materials are in part recent and in part old terrace deposits. The original deposits have been modified by wash from the adjacent uplands and by the addition of some wind-blown silt and fine sand. The surface is almost flat, sloping very gently toward the main stream, but drainage is fairly good, as the surplus water is usually absorbed by the porous soil and subsoil.

Practically all the type is in cultivation. It is well adapted to all the common crops, such as potatoes, corn, wheat, oats, alfalfa, and vegetables, but only corn, wheat, and alfalfa are planted. Corn yields from 15 to 35 bushels, wheat 10 to 30 bushels, and alfalfa 2 or 3 tons per acre. Potatoes and vegetables are grown for home use.

The land is prepared in the spring as soon as the frost is out of the ground. Old fields are plowed every third or fourth year. Corn or wheat stubble is generally prepared for small grain by double disking. No definite crop rotation is practiced and no commercial fertilizer is used. This soil is very productive, easily handled, and remarkably retentive of moisture. The surface of the low terrace is comparatively near the water table. The high lime content is favorable for alfalfa.

TRIPP SILT LOAM.

The surface soil of the Tripp silt loam is a dark grayish brown fairly heavy, but friable, silt loam 12 to 15 inches deep. The soil is usually fine and contains little sand of any grade. The subsoil is a grayish-brown loam or coarse sandy loam having a high gravel content, which continues throughout the 3-foot section. Both soil and subsoil are highly calcareous.

In the western part of the county, where this type borders the small intermittent drainage ways, the color in places is dark through-

out the soil section. The soil mass is generally permeated with small gravel of varied composition, but principally quartzitic and feldspathic fragments. As mapped here, the type includes gravelly loam and gravelly very fine sandy loam, but the average texture is that of a loam.

The Tripp silt loam occupies a small acreage in the county. It occurs on the low terraces of Stinking Water Creek and borders a few tributaries in the western part of the county. The soil consists of reworked alluvial and colluvial sediments washed from the uplands and modified by wind-blown sand and silt. The surface is level to gently undulating, but slopes slightly toward the stream channel. The run-off is generally sufficient and the internal drainage is adequate to excessive.

Approximately 30 per cent of the type is under cultivation, the remainder being in pasture. Grama grass, buffalo grass, western wheat grass, and wire grass constitute the principal covering and make fair pasturage. Corn, wheat, and sorghum are the major crops. Corn does fairly well, yielding from 10 to 25 bushels per acre, depending on the season. Wheat yields 10 to 30 bushels and sorghum produces 2 to 3 tons of forage per acre. Most of the corn is fed on the farms where produced. The ears are generally snapped and stored for winter feed or the stalks cut for fodder.

The type is handled in much the same manner as the heavy upland soils. No definite rotation is practiced and no commercial fertilizers are used, but barnyard manure is occasionally applied to the fields.

YALE SILT LOAM.

The surface soil of the Yale silt loam consists of 12 or 15 inches of dark grayish brown friable silt loam. The upper subsoil is a lighter grayish brown loam or silt loam which is either compact in places or slightly sticky and cohesive. The lower subsoil, beginning at about 30 inches, is a grayish-yellow or gray calcareous silt loam containing varying quantities of very fine sand. Beds of sand and gravel are present at no great depth below the 3-foot section. While the surface soil and upper subsoil do not effervesce, they are probably not deficient in lime.

In the western part of the county, where this type borders the numerous dry drainage ways, there are commonly large quantities of waterworn quartzitic and pink feldspathic gravel strewn over the surface and embedded in the soil section. Gravel and wind-blown and colluvial sand give rise to local variations in texture ranging from gravelly loam to gravelly sandy loam and silt loam, but the average texture is a silt loam. The gravel is conspicuous in road cuts and in banks of drainage channels.

Although the type is the most extensive of the terrace soils in the county, its total area is not large. It occupies parts of the low terraces of most of the valleys, occurring in long narrow bands ranging from a few rods to over half a mile in width. The topography is flat, sloping gently toward the main axis of the stream. Surface drainage and underdrainage are adequate, as the slope is usually sufficient to carry off all surplus water in a short time. Where large quantities of gravel are present the run-off is excessive.

A very fine sandy loam variation was included with this type on account of its small area. It differs from the Yale silt loam in the slightly larger proportion of very fine sand in the surface soil. This soil occurs in two small bodies in the Stinking Water Creek Valley.

Only a small part of the Yale silt loam is under cultivation. The chief crops are wheat and corn. Owing to the low rainfall, wheat averages from 10 to 15 bushels over a series of years. Corn yields from 10 to 30 bushels, depending on the rainfall. Most of the corn is fed to cattle and work stock, but the wheat is sold. The greater part of the type is in pasture and hay land. The native grasses are mainly buffalo, grama, wire grass, sand grass, and little bluestem. From 30 to 40 head may be pastured on one section throughout the year. Native hay yields from one-fourth to three-fourths ton per acre, depending on the seasonal rainfall.

CHEYENNE GRAVELLY SANDY LOAM.

The Cheyenne gravelly sandy loam consists of 15 to 18 inches of dark grayish brown gravelly sandy loam, underlain by a grayish-brown calcareous gravelly sandy loam containing large quantities of coarse sand and gravel, chiefly quartzitic and feldspathic. At 36 inches a coarser substratum is encountered which is slightly calcareous. In places there is no difference between soil and subsoil throughout the section, but at some depth a loose, unconsolidated mass is always encountered. Fragments of lime-cemented sandstone give a calcareous nature to the soil body.

The type occurs as narrow strips of alluvial wash in the bed of a large intermittent stream tributary to the South Platte River in the northwestern part of the county. The parent material, which is derived from the Ogallala formation by disintegration and has been subjected to little weathering, has been carried down by torrential rainstorms and deposited in the valley. Owing to the exceedingly open structure of the soil and subsoil, drainage is in most places excessive and the soil is very droughty.

Where the surface soil is loose and unconsolidated the land is almost worthless, hardly producing enough grass for pasturing. These bodies support sparse growths of sand reed grass and thin patches of buffalo grass and grama. The better areas, where the gravel beds lie deeper, support some western wheat grass, wire grass, and sand sage.

Under good dry-farming methods some crops can be successfully grown on this type where the soil is not too droughty. Among these are sorghum, corn, potatoes, garden truck, and melons. Corn and wheat produce fair crops in good years. The soil is well adapted to potatoes and garden truck. Land of this type sells for $10 to $20 an acre, depending on location, improvements, and utilization.

BRIDGEPORT LOAMY SAND.

The surface soil of the Bridgeport loamy sand is a loose to fairly coherent dark grayish brown loamy sand 15 to 18 inches deep. The surface is frequently darker, owing to a higher content of organic matter. The subsoil is a light-brown to grayish-brown sand or loamy sand, which gradually becomes lighter in color with depth. Both soil

and subsoil are deficient in lime and low in organic matter. In places there is little change in color or texture within the section.

The type is mapped in irregular shaped areas on the low and high benches of Stinking Water Creek and its tributaries. It consists of alluvial and colluvial material washed from the adjoining uplands and modified severely by wind. Along the upper course of the valley the modification by wind has been so great that the soil is nearly indistinguishable from the Valentine loamy sand, except in topography and position. Drainage is excessive owing to the porous soil and subsoil.

The Bridgeport loamy sand is agriculturally important, although small in extent. About 40 per cent is in cultivation, the rest being used for pasture and hay land. The native vegetation consists of stipa, redfieldia, sand reed grass, and sparse growths of buffalo and grama grasses. One section is able to support 25 to 35 head of cattle throughout the year. The soil is low in organic matter, tends to blow easily, and must be handled cautiously. It is adapted to the production of potatoes and watermelons.

BRIDGEPORT FINE SANDY LOAM.

The Bridgeport fine sandy loam consists of a dark grayish brown, loose, friable fine sandy loam, with practically no change in color or texture throughout the 3-foot section. Locally the surface layer is darker than the rest of the soil because of a higher content of organic matter. Both soil and subsoil are deficient in lime, although small particles of lime are encountered here and there. In places the texture varies to a fine sand or a sandy loam.

The type occupies both high and low terraces of Stinking Water Creek Valley and its principal tributaries. The bodies are very irregular in outline. The surface is slightly rolling to gently undulating, and drainage is adequate owing to the open structure of soil and subsoil.

The Bridgeport fine sandy loam is fairly important agriculturally. About one-half is under cultivation and the rest is used as pasture and hay land. The native vegetation consists chiefly of stipa, sand reed grass, redfieldia, little bluestem, and big bluestem. From one-fourth to one-half ton of hay per acre can be cut. From 15 to 20 acres are required to pasture one cow or steer the year round.

Corn, sorghum, and potatoes are the principal crops. Corn is well adapted and a dependable crop that produces 10 to 20 bushels per acre in most average years. Sorghum is a valuable forage crop and produces from 1 to 2½ tons per acre under favorable conditions. Potatoes yield well, but are grown mainly for home consumption. Oats, rye, and barley are minor crops that yield moderate returns.

The surface is subject to blowing, and care must be exercised after the removal of the native grass to maintain as rough a surface as possible. Much organic matter can be incorporated with beneficial results. The land sells for $15 to $30 an acre, depending upon improvements.

A few small areas of very fine sandy loam have been included with this type. They are worthy of mention on account of their productiveness and easy tilth. The Bridgeport very fine sandy loam to a depth of 15 to 18 inches is a loose, mellow very fine sandy loam, dark

grayish brown in color, excepting the immediate surface layer, which is darker than the bulk of the soil on account of a larger content of organic matter. The subsoil usually shows but little change in color or texture, but in places is gray or grayish brown, a trifle coarser in texture, or slightly calcareous.

About 60 per cent of this soil is under cultivation; the rest is used for pasture and hay. Native hay yields one-fourth to three-fourths ton per acre, depending on the season, while a section of land will support from 30 to 40 head of stock the year round.

The loose, friable, yet moderately heavy texture of the soil makes it an ideal dry-farming soil in this region of low rainfall. It is less subject to drought than the heavier soils of the county and less susceptible to wind erosion than those of lighter texture. The small grains do not yield as high as on the hard lands in favorable years, but crops are fairly dependable on this type with careful tillage. The selling price of this land ranges from $35 to $60 an acre.

BRIDGEPORT LOAM.

The surface soil of the Bridgeport loam is a grayish brown to dark grayish-brown, friable loam, 12 to 15 inches deep, usually containing a fairly large proportion of very fine sand. The immediate surface layer is rich in organic matter, which gives it a darker color than the lower part of the surface soil. There is little difference in texture or structure between soil and subsoil. In places there is no difference in color, but more commonly the subsoil is somewhat lighter. Both soil and subsoil have a low lime content. Locally the surface is strewn with quartzitic and feldspathic gravel, which in places lightly penetrates the subsoil section.

The Bridgeport loam is of small extent in Perkins County. It occurs principally on the low terraces along tributaries of Stinking Water and Blackwood Creeks. The type consists of sediment washed down from the uplands and deposited over the valley slopes and bottoms. Its surface is nearly flat, sloping gently down the valley and toward the stream channel. The slight slope affords ample drainage.

The type has a favorable topography and is a fair dry-farming soil. Approximately one-fourth of it is under cultivation. The uncultivated part is used for pasture and hay production. The sod includes the bluestems, buffalo and grama grasses, and the sedge, blackroot. Wire grass is conspicuous in areas heavily pastured. From one-fourth to about 1 ton of good hay per acre can be cut. Wheat, corn, and oats are the principal crops. Wheat is the cash crop and yields from 10 to 30 bushels per acre, depending on the season. Corn yields from 10 to 25 bushels and oats 10 to 30 bushels per acre. This land sells at $30 to $65 an acre, depending upon improvements and location.

DUNESAND.

The surface soil of Dunesand consists of 10 to 12 inches of grayish-brown sand, which is fine to medium in texture, loose and incoherent in structure. The subsoil is similar to or coarser than the soil, except for its lighter color, which is due to the smaller content of or-

ganic matter. This loose sand extends to some depth beyond the 3-foot section. The sand grains are chiefly of quartz and feldspar. When viewed at a distance the dunes have a grayish-brown appearance when the surface is dry. Both soil and subsoil are noncalcareous and do not contain enough organic matter to prevent the soil from blowing when the protective covering of grasses is removed.

Dunesand occurs throughout the county, except in the extreme western and northwestern parts, in large and small areas of irregular shape. The surface is sharply rolling, wind being the active agent in forming a succession of monotonous irregular dunes. In the rougher places "blow-outs" are common, the soil being under active wind erosion. Pockets and ridges also vary the billowy appearance of the landscape. The dunes have a southeasterly trend.

Although there are no continuous drainage ways, the drainage is adequate throughout the type. The loose, porous soil and substratum absorb all the rainfall, even on the steeper slopes. The soil is unusually retentive of moisture, however, considering its loose structure.

Dunesand is of no importance in crop production. It is used almost exclusively for pasture land, a small amount of hay being cut on the more level areas. As a rule, the surface is reasonably sodded. The characteristic native vegetation includes yucca, bunch grass, sand-reed grass, redfieldia, and sand sage. Small bunch grass occurs in clumps in a few places, and scattered growths of cactus and artemisia and sparse growths of grama and buffalo grass are found where the surface is more compact. The grassed pockets of old blow-outs support good growths of sand-reed grass suitable for hay, and a few of these spots contain dense growths of buffalo grass. This land is capable of maintaining 35 to 40 head of cattle per section. There is usually good pasturage for eight to nine months of the year, but the range must be supplemented by winter feeding during severe weather.

Areas of Dunesand sell for an average of about $10 to $12 an acre. The preservation of native sod on this land is most important. Blow-outs and overgrazed patches plainly show the disastrous effects of disturbing the soil-binding root systems. No attempt should be made to cultivate these areas and prairie fires should be kept under complete control.

SUMMARY.

Perkins County lies in southwestern Nebraska and adjoins the northeast corner of Colorado. It comprises an area of 886 square miles or 567,040 acres and is situated on the Perkins Table in the eastern edge of the High Plains region, a division of the Great Plains. The surface is, in general, nearly flat, but has minor relief features, including local sand-hill developments, intermittent drainage ways, shallow depressions, low gravelly hills and mounds, and a small remnant of a loess cap. The average elevation is 3,400 feet above sea level, the general slope being eastward.

The county is without well-established drainage, but supplies intermittent headwater drainage to the South Platte River and Redwillow, Blackwood, Stinking Water, and Spring Creeks. Surface and internal drainage are generally sufficient, however. Well water is abundant and of excellent quality.

The first settlement was in 1885. Two years later the county was organized from a part of Keith County. Grant, the county seat, is in the central part of the area. The 1920 census gives the population of the county as 3,967.

The county is served by the Holdrege-Curtis-Sterling branch of the Chicago, Burlington & Quincy Railroad, which is intermediate between the main line of the Union Pacific on the north and the Culbertson-Imperial branch of the Burlington on the south. All points in the county are within 10 or 12 miles from a shipping point. The roads are of earth construction and generally follow section lines.

There are several rural mail routes. The county high school is at Grant. The local markets are Elsie, Grainton, Grant, Madrid, and Venango, but some products are handled in neighboring counties. The outside livestock and agricultural markets are Denver, Lincoln, Kansas City, Omaha, and St. Joseph.

The climate is adapted to the production of certain grain and forage crops and to combined grain farming and livestock ranching. The average rainfall is 18.07 inches, about 80 per cent of which falls during the average growing season of about 142 days. The mean annual temperature is 49.2° F. High evaporation and irregular distribution of seasonal rainfall, which is frequently inadequate at critical periods, often curtails yields, particularly in the "hard lands." As most of the tillable lands are fertile, climate is the controlling factor in crop production.

The early history of the county differs from that of neighboring counties in that farming constituted the earliest occupation and cattle ranching did not begin until 1898 and 1899. The present-day agriculture is of two kinds—(1) grain farming, principally with power machinery, and (2) combined grain farming, forage production, and stock ranching. No fertilizers are used. Barnyard manure usually "burns out" the crops on the heavy soils, but is beneficial on the sandy types by adding organic matter and checking wind erosion.

Dry farming is the basis of agricultural prosperity of the county. Corn and wheat occupy 80 per cent of the cultivated area and are the important crops. Cattle and sheep feeding and hog raising are carried on in conjunction with general farming on many farms. Wheat is the cash crop. Wild hay, oats, sorghum, millet, rye and barley are the minor crops. Corn, oats, wild hay, sorghum, and alfalfa are the main sources of stock feed. Vegetables and truck crops are grown for home consumption and local markets. Owing to unfavorable climatic conditions, fruits are unprofitable.

Cattle ranging is practiced principally in the sand hills. The cattle are generally shipped as stockers and feeders to Omaha. Grade Hereford and Shorthorn are the principal beef breeds. Many farms maintain a few dairy cows and raise poultry and a few hogs.

Wheat is raised mainly on the hard lands. Corn is best adapted to the sandier soils under prevailing moisture conditions. The eroded and stony lands and the sand hills are best suited to grazing. Native hay is cut from nearly all soil types. All crops are grown on nearly every soil type, with varying degrees of success, but in general matured crops are most assured on the lighter textured soils, which have more moisture available for plant growth and lose less of the irregularly distributed precipitation.

Dry-farming practices are more or less experimental, but early planting, thin seeding, and weed control are important essentials. Little attention is given to definite and systematic crop rotation. Most of the grain is drilled, very little being broadcasted.

Farm labor is not always readily obtainable, but extra labor can usually be secured during harvest seasons. Equipment is generally adequate and farm improvements on the whole are fairly good.

Over 60 per cent of the farms are operated by owners. Most of the tenant farms are rented on shares, but a few are leased for cash.

The main factors operating to produce the present soil conditions have been the influence of subhumid climate and its accompanying native vegetation, consisting predominantly of short grass. The soils have the general features common to regions of low rainfall. They are brown to grayish brown in color, generally calcareous, low in organic matter, and friable in structure. The textures range from sands to silty clays.

The soils are grouped into 10 series on the basis of differences in color, structure, details of soil profile, and the source of the parent material. The series include the Rosebud, Dawes, Scott, Valentine, Colby, Tripp, Cheyenne, Yale, Canyon, and Bridgeport. They are represented in this county by 28 soil types and 1 miscellaneous classification, Dunesand.

The types of the Rosebud series have brown to grayish-brown, friable surface soils and a gray or light-colored calcareous subsoil. They occur throughout the uplands, occupying areas varying from a few acres to large tracts. Their total area is large. The heavier types are generally shallow and droughty and the sandier types are more retentive of moisture. In favorable years the loam and silt loam are most profitable in wheat, but produce fair yields of all crops. Under average conditions corn is best adapted to the lighter soils.

The Dawes types are characterized by brown to grayish-brown surface soils underlain by a compact to heavy upper subsoil resting on a friable, calcareous, lighter colored lower subsoil. The soils are productive when sufficient moisture is available. The Dawes loam is the most extensive soil type in the county. Wheat and corn are the principal crops. About the same crop possibilities obtain as on the corresponding Rosebud types under prevailing climatic conditions, but in favorable years the Dawes soils produce better than other soils in the county.

The Valentine soils are valuable for general farming, grazing, and hay production. They are derived mainly from wind-blown materials. The soils are productive under the prevailing climatic conditions, but the sandier types are low in organic matter and tend to blow under cropping when not properly handled. Dunesand, which is also wind-blown material, has value only as grazing land.

The Canyon gravelly sandy loam is suited only to grazing, as the soil is too shallow to insure crop production.

The Colby very fine sandy loam, broken phase, is used chiefly for grazing and hay land, owing to its unfavorable topography. Small areas are suitable for dry farming.

The Scott silty clay occupies small depressions on the uplands and terraces. It is of little agricultural value because of its poor drainage and tough impervious subsoil. Its chief value is for hay and pasture.

The types of the Tripp series are excellent terrace soils adapted to all crops grown in the county.

The Yale types are grayish-brown surface soils underlain by a compact upper subsoil and a light-colored calcareous lower subsoil. They are terrace equivalents of the Dawes soils and have about the same crop possibilities.

The Cheyenne gravelly sandy loam is of alluvial origin. It is droughty, owing to its coarse porous structure, but produces fair crops of corn and vegetables.

The types of the Bridgeport series occupy valley slopes, terraces, and bottom lands that have been modified more or less by wind-blown and colluvial materials. The loam is suited to general farming under moderately favorable rainfall conditions, and the sandy types are good dry-farming soils when properly protected from wind erosion.

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