U. S. DEPARTMENT OF AGRICULTURE.
BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF THE FORT LARAMIE AREA, WYOMING-NEBRASKA.

BY

J. O. VEATCH, IN CHARGE, AND R. W. McCLURE.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

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

WASHINGTON:
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1921.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., January 6, 1920.

SIR: I have the honor to transmit herewith the manuscript report and map covering the survey of the Fort Laramie Area, Wyoming-Nebraska, and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1917, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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MAP.

SOIL SURVEY OF THE FORT LARAMIE AREA, WYOMING-NEBRASKA.[1]

By J. O. VEATCH, In Charge, and R. W. McCLURE.—Area Inspected by THOMAS D. RICE.

DESCRIPTION OF THE AREA.

The Fort Laramie area is situated in the eastern part of Wyoming and western part of Nebraska. It comprises the central part of Goshen County, Wyo., extending from the Nebraska State line westward a distance of 23 to 30 miles, and a part of Scotts Bluff County, Nebr. The North Platte River flows across the northern part and the area includes the greater part of the irrigable land in Wyoming lying within the North Platte Project of the United States Reclamation Service. The total area surveyed is 566 square miles, or 362,240 acres.

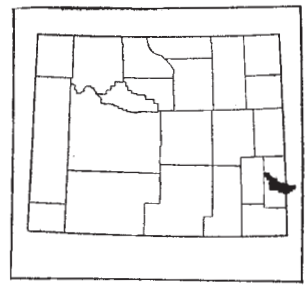

FIG. 1.—Sketch map showing location of the Fort Laramie area, Wyoming-Nebraska.

The Fort Laramie area lies in the Great Plains region and in the western part of the High Plains. But while properly a part of the High Plains region, it presents a more complex topography than the smooth or rolling tableland typical of that region. Most of the area is included in a great lowland erosion plain (the southern part of which is known as Goshen Hole), which lies several hundred feet below the level of the High Plains table land. The Goshen Hole lowland (applying this name to the whole lowland area) is bordered on the west, north, and south by high, abrupt escarpments rising to the High Plains proper, and has a width from north to south of 40 to 50 miles. Its western boundary is a short distance below Fort Laramie, while to the east it gradually merges into the valley of the North Platte in Nebraska. The North Platte River occupies an independent valley within the northern part of the Goshen Hole lowland, the latter being the work of erosion of tributary streams rather than an old valley of the North Platte itself.

The principal topographic features of the area consist of (1) the North Platte Valley, (2) the Goshen Hole lowland plain, (3) the Goshen Hole escarpment or "rim", and (4) the High Plains proper or high tableland.

[1] This survey was made at the request of and in cooperation with the U. S. Reclamation Service, Department of the Interior.

The valley along the North Platte River consists of a recent-alluvial plain or first bottom bordered by alluvial terrace plains. The first bottom lies 4 to 12 feet above the channel of the stream and reaches a width of one-half mile to two miles. It is bordered by a narrow, nearly level terrace plain which lies 20 to 50 feet above the river and which is best developed on the northern side of the stream. The outer edge of this terrace is marked by a well-defined bluff rising to a high terrace plain which lies 125 to 175 feet above the river. This latter plain has a maximum width of several miles and on the whole is nearly level or gently rolling, but in places there have been accumulations of wind-blown sand, resulting in a characteristic sandhill topography. On the south side of the river only narrow remnants of this higher terrace are found. The lower terrace here also is poorly defined, and merges by a gradual slope into the upland of the Goshen Hole country.

The Goshen Hole lowland plain in general is a strongly rolling and dissected erosional plain, but in a few places it has a very gently rolling or undulating surface. Some small areas have a choppy topography, due to sandhills formed by wind action. The southwestern part in places is characterized by flat lowlands containing small isolated conical clay buttes capped with slabs of hard rock inclosed by steep wall-like slopes. The surfaces of the flats are mainly features of destructive erosion and not of alluvial deposition. Shallow ponds or " water holes " are common in these flat lowlands. Where the Brule formation is the underlying rock the topography is characterized by high ridges with smooth, gradual slopes. The general elevation of the Goshen Hole country is 4,200 to 4,600 feet above sea level, or 200 to 500 feet above the North Platte River.

The Goshen Hole escarpment is marked by nearly barren cliffs, with talus slopes at the base which rapidly merge into the plains of the Goshen Hole lowland. The cliffs are composed of white or grayish rocks, in places carved by wind and water into bizarre and picturesque forms. The escarpment is incised by deep canyons which carry water during periods of heavy rainfall into the tributaries of the North Platte. The escarpment rises 400 to 700 feet above the adjacent lowlands.

The High Plains tableland is a treeless, rolling plain with few drainage courses, and without any conspicuous topographic features. Near the edge of the Goshen Hole escarpment, however, it becomes deeply rolling or moderately broken. Only a very small area of the High Plains proper is included within the limits of the present survey. The elevation is approximately 5,000 feet above sea level.

Horse Creek is the only important tributary of the North Platte River. It rises in the Laramie Mountains of Wyoming, flows easterly across the High Plains and, entering the Goshen Hole from the

southern side, flows northerly and easterly through the lowland until it joins the North Platte in Nebraska a short distance east of the Wyoming line. The waters of the North Platte River and Horse Creek have been appropriated for irrigation purposes. There are numerous small drainage courses throughout the area, but these are dry except for very short periods after heavy rainfalls. There is naturally little wet or poorly drained land, since the rainfall is very low and the topography is generally rolling, but a few small areas of flat valley land in the Goshen Hole, underlain by relatively impervious clay, are saturated with water during part of the year, and contain a few permanent ponds. The lower parts of the first bottom along the North Platte River are in a wet and marshy condition after spring rains and during periods of high water in the river. A number of local drainage problems have arisen on account of seepage from irrigation ditches.

The upland parts of the Fort Laramie area are grass-covered plains entirely treeless and nearly devoid of shrubs, except for very small patches on the Goshen Hole escarpment and on the steep bluffs along the North Platte River, where there is occasionally a scattered growth of stunted pine (*Pinus ponderosa*) and cedar, together with a few shrubs such as the skunk willow, mountain mahogany, and wild plum. Sage, principally sand sage (*Artemisia filifolia*) and valley sage (*Artemisia nana*), greasewood, and salt sage (*Atriplex canescens*) are found, but they do not predominate in the vegetation over large stretches of country. The North Platte River is skirted by a growth of cottonwood, the only large tree of this region, together with the willow, buffalo berry (*Shepherdia argentea*), and an occasional box elder.

The water supply for farm and ranch use is obtained almost entirely from drilled and bored wells, equipped with windmills. In general, an abundant supply is available. The depth of the wells varies widely with the topographic situation and the geological formation penetrated, and ranges from 20 to 200 or 300 feet. A few artesian wells have been obtained in the southern part of the area. While the water doubtless is relatively high in mineral matter in most localities, there are only a few instances where alkali salts occur in such quantity as to render the water unfit for use.

The old Oregon Trail, which was one of the first routes traversed by early pioneers and emigrants to the far West, passed through the Fort Laramie area. A trading post was established at Fort Laramie in 1834, and in 1849 the Government established a fort here, making it one of the principal stopping places and trading points on the route. There were very few permanent settlers in this region prior to about 1870. The early settlers were engaged principally in raising cattle on large ranches, and the population has always been

sparse. It is only during the last 10 years, with the extensive development of irrigation and dry-land farming, that there has been a notable increase. The total population of Goshen County is now (1917), estimated at about 6,000, or about 3 persons per square mile. Torrington, the principal town and trading point, has a population of about 800.[1] Most of the inhabitants are native Americans, but there is a small population of Russians and Japanese, who are employed mainly as laborers on the irrigated farms.

Transportation facilities are afforded by the Alliance & Casper branch of the Chicago, Burlington & Quincy Railroad. A proposed line of the Union Pacific Railroad would pass through the central part of Goshen County on the south side of the North Platte River.

The wagon roads of the area have not yet been improved. In some of the low places where there are clay soils the roads become muddy and rough in the spring, while in the areas of loose sand travel is laborious, greatly limiting the loads hauled and increasing the cost of transportation. On most of the higher land, the roads, although ungraded, are hard and in good condition for travel throughout the year.

The principal markets for the agricultural products of the area are Omaha, St. Joseph, Denver, and Kansas City. Most of the cash crops, such as potatoes, wheat, and beans, are sold to local buyers who ship to city markets. Sugar beets are grown on contract and shipped to sugar factories in Scotts Bluff County.

CLIMATE.

The climate of this area is semiarid and otherwise characteristic of that of the northern High Plains. According to Weather Bureau observations at Fort Laramie, extending over a long period of years, the average annual precipitation is 12.54 inches. The rainfall is for the most part in the form of light local showers or heavy downpours of short duration. Within the limits of the county there is frequently considerable variation in rainfall in a single season, showers occurring in one section at a critical time and leaving an adjacent neighborhood dry, and consequently with diminished crop yields.

The rainfall closely approaches the lowest limit at which it is believed dry farming can be successfully carried on. However, the greater part of the rain falls during the growing season, more than 70 per cent occurring from March to August, inclusive. The rainfall is generally heaviest in May, and gradually decreases to November, which is the driest month. The rate of evaporation is lower than in the High Plains of the Southern United States, so that a somewhat greater proportion of the rainfall is available for plant use. There is a much greater number of hours of sunshine than in

[1] Since this report was written the preliminary announcement of the population of Goshen County and its civil divisions in 1920 has been issued by the Bureau of the Census, as follows: Goshen County, 8,064; rural, 8,064; Lingle, 363; Torrington, 1,301.

the humid region to the east, which is an important factor in the rapid growth of plants. The snowfall is very light, but is sufficient to add considerable moisture to the soil where the ground is listed in the fall. Hailstorms are frequent in the spring and early summer, and cause some damage locally to growing crops.

The mean annual temperature is 47° F. There is a wide range between the miximum summer and the minimum winter temperature. There is also a wide range in the daily temperature in summer, the nights becoming quite cool even during the hottest weather.

The average growing season, or period between killing frosts, extends from May 17 to September 18, an interval of 124 days. Frosts have been known to occur as late as June 7 and as early as August 25, although such occurrences are rare. Corn is the crop most frequently injured because of the shortness of the growing season.

The prevailing winds are from the west and northwest, and are strongest in the spring and fall months. Wind frequently causes much damage to crops by blowing out the seed and even young plants, particularly on the deep, fine sand soils.

The following table shows the more important climatic data as compiled by the Weather Bureau from observations at Fort Laramie:

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

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1860).	Total amount for the wettest year (1915).
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	27.0	75	−41	0.47	1.11	0.44
January	24.9	70	−40	.43	T.	.19
February	26.9	69	−48	.44	.10	.96
Winter	26.3	75	−48	1.34	1.21	1.59
March	35.0	80	−24	.68	T.	1.51
April	45.3	92	10	1.65	.60	4.90
May	55.4	94	16	2.38	.25	5.16
Spring	45.4	94	−24	4.71	.85	11.57
June	65.5	102	21	1.76	.67	3.37
July	79.0	106	34	1.54	.32	3.16
August	71.3	104	29	1.04	T.	2.39
Summer	71.9	106	21	4.34	.99	8.92
September	58.4	104	13	1.04	.43	3.52
October	46.8	91	8	.76	T.	1.54
November	35.2	79	−31	.35	T.	T.
Fall	46.8	104	−31	2.15	.43	5.06
Year	47.0	106	−48	12.54	3.48	27.14

AGRICULTURE.

In the early history of this part of Wyoming the agriculture consisted almost entirely of ranching, or the raising of cattle and sheep upon the public range, and there was scarcely any production of cultivated crops either on the dry land or under irrigation. At an early date, however, the farmers undertook the diversion of stream waters upon meadows for the purpose of increasing the yield of the native hay grasses, and later, with the growth of settlement and consequent restriction of range, and on account of the increased value of the stock, a need was felt for growing a greater quantity of more nutritious feedstuffs for winter feeding, so that irrigation projects began to be considered. The Torrington Canal, one of the first in the North Platte Valley, was constructed in 1884 and the Lucerne Canal was begun in 1884 and completed in 1892. These canals obtain water from the North Platte River and irrigate parts of the first bottom and low terrace along this stream. Following the construction of these canals other ditches were successfully constructed by individuals, associations, and the Federal Government, until at the present time practically all of the more productive irrigable land on the first bottom and terraces along the North Platte River in this area can be watered. A number of ditches have also been dug for the purpose of watering the alluvial lands along Horse Creek. The Interstate Canal, constructed by the United States Reclamation Service, was opened in 1907 and 1908. The water for this canal is diverted from the North Platte River at Whalen. The irrigable area in Wyoming under this canal is approximately 18,000 acres, but only a small percentage is actually under cultivation; there is a much larger area under this canal in Nebraska. The land watered is the high terrace on the north side of the river. The Fort Laramie Canal of the United States Reclamation Service, which is now nearing completion, has an irrigable area of approximately 55,000 acres in Wyoming, lying on the south side of the North Platte River. The area actually under irrigation at the present time (1917) in Goshen County is estimated at about 25,000 acres, the greater part being included within the limits of this soil survey. Irrigation farming is now the basis of the agricultural prosperity of the county.

Dry farming is comparatively recent. Practically all of the dry-land farms have been established within the last 10 or 12 years, and probably 75 per cent of the dry-land farmers have entered the country within the last 3 to 5 years. The public land was taken up rapidly under the homestead laws, and little cultivable dry land within easy access of transportation remains. Dry farming is still more or less experimental, although where the soil conditions are favorable, proper tillage methods followed, and varieties of crops

suited to the climate selected, it has been demonstrated that dry farming may be successfully carried on. There seems to be a gradual increase in the size of the farms beyond the 160 acres allotted under the homestead laws, and an increase in the number of stock per farm. The rapid settlement of the dry land has resulted in curtailing the free range, has caused the breaking up of many of the larger ranches, and is forcing those still engaged in ranching to fence their pastures.

In irrigated farming, alfalfa, Irish potatoes, and sugar beets are the principal crops, followed by oats, wheat, corn, and barley. A considerable acreage of the native wheat grass and other less nutritious native grasses is irrigated, along both the North Platte River and Horse Creek. Irish potatoes, sugar beets, and wheat are the principal cash crops. Winter feeding of cattle and hog raising are carried on in conjunction with farming.

On the dry-land farms, wheat, corn, oats, dry beans, and Irish potatoes are the principal products. A great variety of other crops have been grown in a more or less experimental way, including alfalfa, sweet clover, barley, sorghum, hog millet (proso), emmer, and Sudan grass. Wheat is the principal cash crop, followed by beans and potatoes. Generally a small number of stock, principally cattle, are kept, but neither stock raising nor feeding is extensively carried on or is a regular part of the farm operations.

Alfalfa is the principal crop on irrigated land, both in acreage and value. It is estimated that there are 13,000 to 14,000 acres under irrigation in Goshen County, the greater part of this acreage lying within the limits of this soil survey. The average annual yield is between $2\frac{1}{2}$ and $3\frac{1}{2}$ tons per acre, three cuttings generally being obtained. Hailstorms frequently cause considerable damage to the first cutting. The crop is mainly used as winter forage for stock, but a considerable proportion is shipped out of the area. Alfalfa is grown also on the dry-land farms, with some success. Usually only one cutting a year is obtained, the yields ranging from one-half to 1 ton per acre. The hay is reported to be of excellent quality. A considerable part of the crop is harvested for seed, and with a good stand yields of $1\frac{1}{2}$ to 2 bushels per acre have been obtained.

Irish potatoes are one of the principal crops of the area, and potato growing is a specialized industry on several of the irrigated farms. It is estimated that there are about 2,500 acres under irrigation. The yields ordinarily range from 100 to 150 sacks per acre (a sack weighing 100 pounds or a little more), but more than 200 sacks have been obtained. The potatoes usually are harvested soon after the first of October. The Triumph, King, Eureka, and White Pearl are the principal varieties. Fields of one-half acre to 8 or 10 acres are devoted to potatoes on most of the dry-land farms. The yields show

a wide variation, ranging from almost complete failures to more than 100 bushels per acre, depending on the soil, the season, and the care in cultivation. In most instances the crop is grown with the expectation of having a surplus for sale. The quality is generally considered fully equal to that of the potatoes grown under irrigation. The best yields and quality have usually been obtained on the lighter textured soils, both in dry-land farming and under irrigation.

The growing of sugar beets is a specialized industry on many of the irrigated farms. It is estimated that about 1,700 acres were planted to this crop in 1917. The acreage varies, however, from year to year, depending upon the price paid and the demand for competing crops. The ordinary yield is 10 or 12 tons per acre. Beets are grown under contract with a sugar company, and are sold on the basis of weight. The tops are retained by the grower or land owner, and are valued highly as feed for sheep and cattle.

Spring wheat is grown principally, although there is a tendency to seed a greater acreage of fall wheat than formerly. The Kubanka durum is the principal variety on dry land, while the Bluestem and Marquis are grown on both the dry land and irrigated farms. Turkey is the principal variety of fall or winter wheat. The yields on dry land have shown a wide range, from 4 or 5 to as much as 20 bushels per acre, the average for a period of years being probably near 10 bushels. On irrigated land the ordinary yields are 30 to 40 bushels. Fall-sown wheat is liable to be winterkilled, but when moisture conditions are favorable for seeding and where the winter is not unusually severe the yields equal or exceed those of the spring varieties. Hailstorms are the cause of considerable damage to the wheat crop locally, and on the lighter soils, particularly, the young plants may be blown out by winds. A very small acreage is devoted to emmer.

Oats are grown to provide a grain feed for work stock and also as a forage crop. The crop does exceptionally well under irrigation, the ordinary yields ranging from 60 to 70 bushels per acre and more than 100 bushels being obtained under the most favorable conditions. On the dry land farms the growth of straw is generally short and the grain yield low.

Corn is an important crop notwithstanding the fact that the late, cold springs and the shortness of the growing season are unfavorable for a heavy growth of plant and proper maturity of the grain. Flint corn is more likely to mature, but the dent varieties are more generally grown. The ordinary acreage yield on dry land is probably near ten or twelve bushels, and on irrigated land about 40 bushels. Very little of the grain is shipped from the area, the crop being used for feeding work stock, sheep, and hogs. A number of silos recently have been constructed and have proved profitable, since

a large percentage of the feed value of the crop can thus be saved, regardless of whether the grain matures.

Beans have greatly increased in acreage during the last three or four years, especially on the dry land farms. The fields range in size from two or three to as much as 80 acres. The principal varieties are the large white Navy bean and the pinto or Mexican bean. Yields ordinarily vary from 600 to 800 pounds per acre, but in some instances as much as 1,000 pounds per acre is reported.

There are a number of native grasses used for hay and forage. The native wheat grass (*Agropyron* sp.) under irrigation yields 1½ to 2 tons per acre of a nutritious and highly valued hay. In favorable seasons small yields, about one-half ton per acre, are obtained on certain dry-land soils. On bottom land along the North Platte River, in addition to wheat grass, there is a considerable harvest of wild hay, consisting principally of such species as sand grass, slough grass, bunch grass, big bluestem, switch grass, wild rye, and salt grass. Sweet clover is increasing in acreage and gives promise of becoming a valuable crop, particularly on those soils least suitable for alfalfa. There are small patches of sorghum, hog millet, Sudan grass, and brome grass, which are grown with varying degrees of success.

Very little fruit is grown in the area. The climate is too severe for the production of orchard fruits on a commercial scale, but hardy varieties of apples and plums can be grown, and small orchards in protected situations ordinarily yield sufficient fruit for home use. Gooseberries do well and currants, blackberries, and raspberries produce fruit when proper winter protection for the bushes is provided.

Cattle raising or ranching is still carried on extensively in the Fort Laramie area. The public range, however, is being rapidly taken up by homesteaders, so that it is becoming necessary for the ranchmen to purchase or lease land and put their pastures under fence. Sheep raising has never been as important an industry as cattle raising. The principal nutritious native pasture grasses are grama grass (*Bouteloua oligostachya*) and wheat grass (probably principally *Agropyron tenerum*). Buffalo grass (*Bulbilis dactyloides*) is present, but in much less abundance than grama grass. Other species of less importance are needle grass (*Stipa comata*), wire grass (*Aristida longiseta*), a sedge blackroot (*Carex* sp.), bunch grass (*Andropogon scoparius*), big bluestem (*Andropogon furcatus*), and sand grass (*Calamovilfa longifolia*). Sand sage (*Artemisia*), salt sage (*Atriplex canescens*), and greasewood (*Sarcobatus vermiculatus*) are abundant in places and afford considerable forage for sheep. The range ordinarily has a carrying capacity of one cow or steer to about 15 acres if supplemented by winter feeding.

Hog raising is an industry of considerable importance in the irrigated districts, alfalfa being used as a forage and pasture crop.

Winter feeding of stock is extensively carried on. It is confined principally to sheep feeding, and is practiced to a less extent with cattle and hogs. Alfalfa, native hay, beet tops, corn, and barley are the home-grown feeds used, while a large quantity of corn, linseed-oil cake, and cottonseed meal is shipped in by feeders.

Dairying is of little importance, although there seem to be possibilities of this industry being carried on successfully in conjunction with farming, both on the dry land and on irrigated lands. A number of pit silos have recently been constructed. Corn, and to a less extent a mixture of corn and sunflowers, is used for ensilage.

The surface method of irrigation is followed exclusively in this area. The cultivated-row crops, such as beets and potatoes, are irrigated by running the water down the furrows between the rows, while crops like alfalfa and the small grains are flooded by damming the flow of the distributing laterals with movable canvas dams. Practically all the crops on irrigated land are spring sown, and plowing and seed-bed preparation are done in the spring. On the deeper and looser sandy soils, which are subject to drifting, watering prior to seeding and directly thereafter is necessary. A corrugated roller is used to some extent for compacting the soils. A method of obtaining a stand of alfalfa on these soils is to water the land immediately after the harvesting of small grain and to seed the alfalfa in the stubble. More cultivation is necessary on the heavier soils to prevent the formation of a compact surface crust.

Alfalfa is generally given three waterings during a season, the first in May, the second in July, and the third at any time from August to late in September. Beets are ordinarily given two or three waterings, but in some cases a greater number, particularly on the lighter textured soils. Large amounts of water are ordinarily used on potatoes, which frequently receive four to six irrigations. Small grain is usually flooded twice. The land from which native hay is cut is frequently soaked throughout the summer. The irrigation practices in the area vary widely, depending upon the character of the soil, the topography, rainfall, and the skill and judgment of the individual. The duty of water is placed at 2.5 acre-feet per season by the United States Reclamation Service. The amount of water used, however, has been in many instances more than twice this amount. The general tendency at present is to use large amounts of water on all crops.

In dry-land farming plowing is generally done in the late spring, and shallow plowing is the rule. A very small number of farmers list the land in the fall or give early spring tillage. On new land a thin furrow slice of sod is turned over, and the land receives no further tillage. Corn is generally the first crop, and is grown without

cultivation. Level planting, rather than listing, is practiced for all crops. Summer tillage is given for fall wheat only to a small extent, and few farmers summer-fallow their land. Where small grain is grown continuously the present practice is to plow the land about once in three years. Generally 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 for harvest. Alfalfa on dry land is sown both broadcast and drilled in rows. An objection to the row method is that the crop is more likely to be blown out, particularly on the lighter soils.

There is no generally established or definite system of crop rotation. On irrigated land where sugar beets are grown, this crop is followed, after two or three years, by a grain, after which the land is seeded to alfalfa. Alfalfa gives profitable yields for 6 or 7 years, and in some instances stands have been maintained for a much longer period. Most growers prefer to plant potatoes after alfalfa. Dry farming in this area is in a more or less experimental stage, and little attention has been given to a plan of crop rotation.

Mineral fertilizers have not yet been used in this region. Cattle and sheep manure are applied to the land on irrigated farms, especially where sugar beets are grown.

Farm labor in this region is not always readily obtained. Farm and ranch laborers are paid about $40 a month, and board. During the busy season of harvesting beets and potatoes labor is in great demand and the daily wage is $4 to $5, with board. Some Russian and Japanese labor is employed.

Irrigated farms in the Fort Laramie area range in size from about 40 acres to as much as 300 or 400 acres, with an average of about 160 acres. The irrigation unit under the United States Reclamation Service projects is approximately 80 acres. On the dry land the homestead taken under the public-land laws is 160 acres, but many of the homesteaders increase the size of their holdings by the purchase of deeded land or relinquishments on adjacent homesteads, thus acquiring 320 or 640 acres.

A considerable percentage of irrigated land is rented, generally on a share basis. The landowner receives one-half of the alfalfa in the stack and one-third of the grain. Where potatoes are grown there are several different plans of sharing, depending upon the apportionment of the cost of seed, machinery, sacks, and hauling. Where the landowner furnishes the seed and the machinery he receives one-half of the crop. Where beets are grown on a share basis the landowner receives one-fourth of the crop and has the option of buying the tops at a stipulated price. A small total area of irrigated land is rented for cash, the price ranging from $10 to $20 an acre, depending upon

the character of the soil, the crops, and other factors. Only a very small area of dry land is farmed by tenants. The share system is most often followed, the owner receiving one-third of the crops.

Irrigated farms at the present time (1917) have a value of $100 to $150 an acre. Dry land ranges in selling price from $2 or $3 to $10 or $15 an acre.

SOILS.

The soils of this region, like all those of the drier portion of the northern Great Plains, owe their most prominent characteristics largely to climate. A grayish color predominates; the subsurface layer is much lighter in color than the top soil; there is a high relative percentage of soluble mineral salts, a concentration of lime and other salts at shallow depths, a friable and granular structure at certain depths, and a low content of humus.

The soil profile for all of the deeper soils shows: (1) a top soil loose or friable in structure; (2) a subsurface compact layer, or zone of concentration of soluble mineral salts; (3) a friable, granular, loosely coherent substratum; and (4) bedrock.

The general character of the soils is essentially a factor of the climate, but a number of other factors, such as age of the soil, geology or source of the inorganic material, and topography, determine the chemical and physical characters of importance in agriculture.

The top soil is generally light colored, with suggestions of yellow and brown, and for want of better descriptive terms might be described as grayish yellow or grayish brown. The darkest color, resulting from organic matter, is not at the surface, but generally a few inches below the surface, or at the top of the layer of concentration. The thickness of the humus-containing layer varies from 3 or 4 inches to as much as 30 inches. The intensity of color and the thickness are largely factors of age and to a less extent of topographic situation. Some of the alluvial soil forms an exception, the humus or organic matter here being originally contained in the alluvium as deposited or, where it appears at greater depths, representing buried organic soils.

The degree of concentration of mineral salts, apparently chiefly lime, in the subsurface layer (zone No. 2), and consequently the degree of compactness of this layer, are dependent upon the age of the soil, modified to some extent by topographic situation. There is, under similar topographic conditions, a series ranging from the most recent soils, showing little change in structure with depth, or no appreciable concentration in the subsurface layer, to the oldest soils, showing a high degree of concentration and consequently a very compact and relatively impervious subsurface layer. This layer seldom extends to depths greater than 30 to 40 inches, and marks approxi-

mately the maximum depth to which rainwater descends. Below it the material is therefore dry, and friable or granular. The thickness of this friable substratum is variable, depending upon geological conditions, and ranges from a few inches to as much as 20 to 30 feet. Its friability is more or less independent of mechanical composition.

While the climate is recognized as the dominant factor in determining the character of the soil, the geological factor is by no means negligible, and a number of features of the soil can be explained only through knowledge of the geological history, the lithology of the geologic formations, and the origin of the soil material. The texture is largely determined by the lithologic character of the formation from which the inorganic base of the soil is derived; while frequently the soil and the geologic formation are practically synonymous. The substratum, or bedrock, which nearly always influences plant growth in some manner either directly or indirectly, is of course purely geologic. In places where the soil overlying two different geological formations has been classed as the same type on the basis of texture and structure, minor differences may be observed which are traceable to the geological formations. For example, the silt loam soil overlying the Laramie formation has a faint greenish-yellow shade of color not observable in the same type overlying the Brule formation. In areas of the Chadron formation the clay texture of the soil is almost entirely a result of the composition of the parent geological formation, and the reddish or pinkish color in some of the soil is inherited directly from the formation.

The older geological formations exposed in the area are Cretaceous and Tertiary in age.[1] The Laramie formation, upper Cretaceous or lowermost Tertiary in age, is the surface formation over a large area in the central part of the Goshen Hole lowland. The strata are in part of brackish-water origin and consist principally of grayish, yellowish, and pinkish soft and partly indurated clays, with beds of buff and grayish, calcareous sandstone. A thin bed of dense, bluish flint appears in places. Outcrops of the strata are found to a limited extent on erosion slopes, where they produce small areas of clay and clay loam soil with fragments of the harder rocks scattered over the surface.

The older Tertiary formations are the Chadron and the Brule, belonging to the White River group, Oligocene in age. The Chadron is composed principally of soft, whitish, greenish, and reddish sandy clays with beds of greenish-gray, arkosic, calcareous sandstone. This formation is the source of most of the heavy clay soil in the central

[1] Notes on the stratigraphy have been obtained largely from Water Supply Paper No. 70, by G. I. Adams, U. S. Geological Survey, 1902.

and western parts of the Goshen Hole lowland. The sandstones form areas of both deep and shallow fine sandy loams and very fine sandy loams, depending upon the topography.

The Brule formation consists mainly of whitish or flesh-colored, semi-indurated silt and silty clay, in massive beds. The beds are mainly jointed and the material, being calcareous, slakes and rapidly disintegrates into small blocks or crumbs upon exposure. The beds, although commonly described as "clay," are not highly impervious, but admit water near the surface comparatively freely, on account of their hard and minutely jointed character. Thin beds of hard limestone and some sandstone and conglomerate are found, but they are of little importance in relation to the soils except locally. The Brule formation occupies the greater part of the central and northern portion of the Goshen Hole lowland, and is the source of the greater part of the upland soil in this area. Where the soils overlying it are shallow it is locally known as "hardpan."

The Arikaree is the youngest Tertiary formation in the area. It belongs to the Loup Fork group and is Miocene in age. This formation consists mainly of calcareous, grayish very fine sand, slightly cemented, with local beds of conglomerate or gravel. It is the formation occupying the upper part of the cliffs of the "rim" or Goshen Hole escarpment, and also occurs in the bluffs of the North Platte River above Fort Laramie Station. The Arikaree is the formation underlying the table-land or High Plains in this area. It is the principal source of the soil material on the High Plains and has probably furnished a large part of the alluvium of the terraces along the North Platte River.

Pleistocene and Recent deposits occur in the North Platte Valley. On the north side of the river there is a high terrace, 125 to 175 feet above the stream, underlain by an old-alluvial deposit of sand with gravel at the base, the deposits reaching a thickness of 20 to 60 feet. The more recent alluvial deposits consist mainly of fine sand or fine sandy loam overlying a bed of gravel at depths of 2 to 4 feet in the lower bottoms and 6 to 10 feet on the first terrace or higher bottoms.

The upland of the Goshen Hole on the south side of the river is covered by a mantle of surficial deposits and soil, reaching a thickness of 2 or 3 to 40 or 50 feet. This material consists of silt and fine sand, probably derived mainly from the geological formations of this area, although little of it is purely residual. It represents wind deposits, or exists as talus at the base of escarpments and as thick deposits of colluvial wash forming long, gradual slopes from the higher ridges. Small areas of sand dunes, both old and recent, are distributed throughout the area.

All of the soils, even the sands, probably contain a high percentage of soluble mineral salts, or an abundance of the essential mineral elements of a soil, and are therefore naturally productive. The lime content at some depth is notably higher than at the surface.

Under natural conditions there is only a very small amount of "alkali land," or soil which contains sufficient alkali to injure the growth of useful vegetation. However, under conditions of poor drainage, due to seepage from irrigation ditches, alkali areas rapidly develop. An analysis of alkali crust collected in a seepage spot gave the following results:

Chemical analysis of alkali crust.

Constituent.	Per cent.	Constituent.	Per cent.
Ions:		Conventional combinations:	
Calcium (Ca)	0.14	Calcium sulphate ($CaSO_4$)	0.48
Magnesium (Mg)	.00	Sodium sulphate (Na_2SO_4)	6.99
Potassium (K)	Trace.	Sodium carbonate (Na_2CO_3)	16.65
Sodium (Na)	12.77	Sodium bicarbonate ($NaHCO_3$)	10.80
Carbonic acid (CO_3)	9.42	Sodium chloride (NaCl)	.76
Bicarbonic acid (HCO_3)	7.84	Sodium nitrate ($NaNO_3$)	.03
Chlorine (Cl)	.46		
Sulphuric acid (SO_4)	5.06	Per cent soluble	32.67
Nitrates (NO_3)	.02		

A general relation is observable between the native vegetation and the soil type. This relation is maintained principally in texture, but there is also a relation to chemical character and to the depth, structure, and lithologic character of the subsurface layers. The difference in vegetation is in a measure confirmatory of the correctness of the soil classification, which is based on physical and chemical characteristics. The natural vegetation, where undisturbed by man, is also more or less indicative of the agricultural possibilities of the land.[1] There are certain vegetation types in the area where one or a few species predominate, as, for example, the short-grass type, the sand-sage type, the greasewood type, and the salt-grass type and others.

On the deep silt loam and silty clay loam soils a short-grass type of vegetation predominates, consisting mainly of grama grass (*Bouteloua oligostachya*), with less buffalo grass (*Bulbilis dactyloides*). Buffalo grass is not as abundant in this area as grama, and seems to show a preference for the heavier soils. In places on the silt

[1] An extensive study of this relation in the Great Plains has been made by Dr. H. L. Shantz, of the Bureau of Plant Industry, U. S. Department of Agriculture. See Bulletin 201, Bureau of Plant Industry.

loam soils the vegetation is a mixed short-grass and wheat-grass (*Agropyron tenerum*) type, the wheat grass being most abundant in swales and on the heavier phases of the silt soils. Wild alfalfa (*Psoralea tenuiflora*) is also abundant in places on the silt loam soils.

Where the soils are slightly lighter in texture, analyzing a very fine sandy loam or fine sandy loam, although similar in topography to the silt loams, the vegetation becomes of a more mixed type, with such species as wire grass (*Aristida longiseta*), needle grass (*Stipa comata*), and blackroot (*Carex* sp.) more abundant, while wheat grass is less abundant than on the silt or silty clay loams.

On the deep, loose sandy soils of the upland, sand sage (*Artemisia filifolia*) is a characteristic growth.

The heaviest clay and clay loam soils here are characterized by a sparse cover of grasses in which wheat grass predominates; there is a scattered growth of *Atriplex canescens*, and a legume (*Sophora sericea*) seems to be quite common. On shallow or gravelly soils on the upland broom weed (*Gutierrezia sarothae*) is most common (although this species may be very abundant on the heavily overgrazed land on other soil types), while yucca appears here also to a greater extent than on other soils.

On most of the deep sandy soils of the bottom land along the North Platte River sand grass (*Calamovilfa longifolia*) is the principal species. Grama is common on these sandy soils, but it makes a sparse growth and appears to be taller than on the upland, while buffalo grass appears to be almost entirely absent.

On the soils containing much alkali, especially where sodium carbonate is present, the vegetation is the greasewood (*Sarcobatus vermiculatus*) type mixed with salt grass (*Distichlis spicata*). Saltwort (*Suaeda* sp.) and tickle grass (*Sporobolus airoides*) are also characteristic on these soils. In other situations there is salt grass mixed with *Atriplex canescens*.

The pine and cedar growth of the area is confined to the thin soils or nearly barren land on the Goshen Hole escarpment and the bluffs of the North Platte River above Fort Laramie. Sage (*Artemisia nana*) seems to be confined to the loose and porous, calcareous talus soils in the same localities.[1]

The classification of the soils for the purpose of mapping is based, to a great extent, upon texture of the surface material, the structure of the subsurface layer, the lithologic character of the substratum, and, so far as practicable at the present time, upon actual soil differences rather than upon geological origin or processes by which the soil material was accumulated. The texture in this area is especially important, whether the land is utilized for dry farming or is

[1] Credit is due to Mr. R. E. Piemeisel, of the Bureau of Plant Industry, for determination of most of the plant species mentioned in this report.

irrigated, because of its relation to the movement of water, the moisture-retaining capacity, and the stability of the soil under cultivation when exposed to wind. Sands and sandy loam types predominate, but there are also considerable areas of silt loam, clay loam, and clay soils. Small bodies of soil of different textures and belonging to different series are closely associated, so that there are no extensive, uniform areas of any one type.

The upland soils of the Fort Laramie area are classed in the Rosebud, Valentine, Orella, Goshen, Dawes, and Canyon series; the terrace or second-bottom soils in the Tripp and Cheyenne series; and the first-bottom soils in the Laurel, Minatare, and Orman series.

The soils of the Rosebud series are grayish to light brown, with a gray or almost white color in the lower part of the 3-foot profile. The soil becomes compact and heavier in texture below a few inches in depth. The compact subsurface layer extends to 30 to 40 inches and is succeeded by friable, granular soil material representing rock disintegration. This series is found on the High Plains table land, where it is derived principally from the Arikaree formation. With similar topography the soils here have a darker color and represent a greater degree of concentration of mineral salts and clay in the subsurface layer than the older soils of the Goshen Hole lowland.

The Valentine series is characterized by a friable or loosely coherent structure throughout the 3-foot profile, with very little or no change in texture with depth. The soils are comparatively recent in age and for the most part represent accumulations of wind-blown sand which have been stable for a sufficient length of time to be converted into soil. The soils are distinguished in this respect from the sand dunes of the area, which are more or less barren, the sand still being in motion under the action of the wind.

The Orella series is characterized by compact surface soils. The humus-containing layer is comparatively thin, and is succeeded by relatively impervious clay or clay loam which rests upon bedrock at shallow depths. The heavy subsurface clay layer is a geological condition rather than a zone of clay concentration, that is, the clay is residual from the weathering of a clay formation, and there has been little or no addition through downward percolating rain water. The soils in this area occur principally in lowland flats underlain by the Chadron and Brule formations. The residual clay or bedrock in places has a pinkish, greenish-gray, or reddish color, similar to that of these geological formations.

The Goshen series is similar in soil profile to the Rosebud and Dawes, differing principally in the slightly darker surface color and the greater thickness of the humus-containing layer. There is a subsurface zone of concentration, varying from only slightly compact to moderately heavy, which extends to 30 to 40 inches and is succeeded

by a friable substratum. The soil material is generally deep. The Goshen soils occupy shallow basins in the upland and swales at the heads of drainage courses.

The Dawes series is characterized by a moderately compact to highly compact subsurface layer beginning at depths of 4 to 20 inches. The greater degree of concentration of mineral salts and the more clayey and more impervious character of the subsurface layer extending to 30 to 40 inches constitute the essential difference between this and the Rosebud series. The topography is level or flat to gently rolling.

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

The Tripp series is characterized by a friable or loose surface soil over a heavier and more compact subsurface layer, with a sand and gravel substratum at shallow depths but exceeding 3 feet. The surface soils range from grayish to dark grayish and brown, with a notably lighter shade at depths of 20 to 36 inches, especially in the heavier types. The Tripp soils in this area occur on low alluvial terraces along the North Platte and Horse Creek. The heavier subsurface layer represents mainly the original texture of the alluvium. There has been, however, considerable concentration of lime and other mineral salts in this layer.

The soils of the Cheyenne series are characterized by a coarse, porous subsoil or substratum of sand or gravel at 3 or 4 feet or less from the surface. The soil profile differs from that of the Tripp series in the absence of the heavier layer over the gravel bed, but there is a lighter or grayish color beneath the humus-containing layer which is probably due to a concentration of lime.

The soils of the Laurel series are characterized by a stratum of coarse sand or sand and gravel at shallow depths. Commonly there is very little difference in the texture of the material above the gravel bed, but the lithologic character is not uniform, the soil frequently consisting of alternating layers of sand and silt or clay. This series occupies the first bottoms along streams. The content of organic matter is generally equal to that in the higher lying soils and in the case of the heavier types is probably larger.

The soils included in the Minatare series differ from the Tripp and Laurel, with which they are closely associated in this area, in their more plastic and more impervious structure, their more calcareous

character, and their greater content of alkali. The color is dark grayish at the surface and grayish or bluish drab beginning at a depth of 1 foot or so. A gravel substratum is present at small depths. The Minatare soils are naturally poorly drained. They represent the lower lying land in the alluvial flats where water stood and heavier soil material was deposited.

The Orman series includes types having a relatively impervious structure throughout the 3-foot profile. The top soil is dark drab to light brown, and the lower soil layers grayish to pale yellow. The Orman soils are similar to the Orella, but are deeper and contain a little more organic matter. They are of alluvial origin.

There is a large area of nonagricultural land which can not for various reasons be classified into soil series. This includes Rough broken land and Dunesand.

The following table shows the names and the actual and relative extent of the various soil types mapped:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Rosebud silt loam	49,664	19.2	Tripp loamy fine sand	8,384	2.3
Shallow phase	19,968		Goshen silt loam	6,272	1.7
Rosebud very fine sandy loam	40,640	13.4	Tripp very fine sandy loam	6,016	1.7
Shallow phase	7,936		Canyon very fine sandy loam	5,888	1.6
Rosebud loamy fine sand	29,568	8.2	Minatare clay loam	5,760	1.6
Orella silty clay loam	23,680	6.5	Tripp silt loam	1,536	1.1
Dawes very fine sandy loam	23,104	6.4	Colluvial phase	2,624	
Orella clay	21,312	6.0	Cheyenne loamy fine sand	2,176	.6
Poorly drained phase	512		Dunesand	2,048	.6
Valentine loamy fine sand	14,272	5.7	Tripp fine sandy loam	1,408	.4
Colluvial phase	6,528		Orman clay	1,344	.4
Orella fine sandy loam	19,840	5.5	Tripp loamy very fine sand	1,280	.4
Laurel fine sandy loam	12,992	3.6	Laurel silt loam	1,088	.3
Rough broken land	12,928	3.6			
Dawes silt loam	12,032	3.3	Total	362,240	
Tripp fine sand	11,392	3.1			
Laurel fine sand	8,192	2.8			
Shallow phase	1,856				

ROSEBUD LOAMY FINE SAND.

The Rosebud loamy fine sand typically consists of a light yellowish brown, incoherent or loosely coherent fine sand to a depth of 4 to 6 inches, underlain by slightly more compact, pale-yellowish fine or very fine sand. In most places there is very little organic matter below a depth of 8 to 12 inches. The type shows the usual concentration of lime and the lighter or grayish color at 10 to 20 inches,

although in general it is less compact and more pervious than the silt loam and very fine sandy loam types. In the natural condition the soil is free from injurious amounts of alkali. The depth to bedrock is variable, ranging from 3 or 4 to 15 feet.

This type grades on the one hand into the Rosebud very fine sandy loam and on the other into the Valentine loamy fine sand, and the distinctions in many places are more or less arbitrary.

The Rosebud loamy fine sand is one of the most widely distributed types in the area. The topography is for the most part gently undulating, but the surface in places is billowy or uneven, owing to the accumulation of low, rounded hills or hummocks of sand by the wind. A sandhill topography, however, is not developed to the same degree as in the areas of Valentine sand. The greater part of the type could be irrigated, but much of it would require leveling.

A considerable percentage of the type is already irrigated, and a large part of it lies within the irrigable area of the Fort Laramie Canal, soon to be placed in operation. Under irrigation, alfalfa and potatoes are the principal crops, alfalfa yielding $2\frac{1}{2}$ to $3\frac{1}{2}$ tons per acre for the season and potatoes 100 to 125 sacks, or 175 to 225 bushels. Only fair results have been obtained in growing small grain and there have been many failures.

Under dry-farming methods corn, beans, potatoes, and alfalfa have given good results. The soil retains moisture better than the heavier soils and requires less labor in tillage, but is more subject to drifting.

The virgin land affords good pasturage, but does not withstand as close grazing as the heavier soils. The most conspicuous plant species are sand sage (*Artemisia filifolia*) and sand grass; the short grasses are principally grama and wire grass, but needle grass and blackroot, a sedge, are common species.

Under irrigation the soil is easily kept in good tilth even where large amounts of water are used. The soil structure allows a free movement of water, and since most of the land is sufficiently sloping to provide good drainage there is not likely to be any serious accumulation of alkali. However, in the more uneven areas seepage ponds are likely to form in the basins between the sand hills, especially if large amounts of water are used.

Land values on the Rosebud loamy fine sand at present (1917) range from $5 to $15 an acre for dry land, and from $75 to $100 for irrigated land.

The results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of this type are given in the following table:

Mechanical analyses of Rosebud loamy fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480351	Soil	0.0	4.0	8.0	47.0	27.5	7.6	6.0
480352	Subsoil	.1	5.7	9.0	39.3	21.9	15.6	8.4
480353	Lower subsoil	.1	4.2	8.0	41.7	30.4	8.2	7.6

ROSEBUD VERY FINE SANDY LOAM.

The Rosebud very fine sandy loam typically consists of light-brown, friable very fine sandy loam or fine loam over a heavier, compact subsurface layer, which is underlain by beds of grayish or whitish, highly calcareous, friable materials. Bedrock is encountered at average depths of 4 to 8 feet. The friable or loamy surface soil extends only to 4 to 8 inches, below which the soil becomes quite compact and grades into pale-yellowish silty clay loam. The humus-containing layer, showing a dark color from organic matter, extends to 18 to 20 inches, and the heavy subsurface layer to about 3 feet. The grayish or whitish lowermost layer is composed of very fine sand and silt and seems to represent simply the disintegrated Arikaree formation, which in this area is the principal source of the mineral matter of the soil.

Where the topography is similar, the surface soil is darker and the subsurface layer heavier or more compact than is true of the older soils of the Goshen Hole country.

The typical Rosebud very fine sandy loam is found on the nearly level or gently undulating areas of the higher table-land or High Plains. Only a small total area is mapped, since only a small portion of the High Plains is included in the present survey.

The type lies at too high an elevation for possible irrigation and can be used only for dry farming. The more nearly level areas appear to give good yields, particularly of wheat. Flax is sown as a sod crop. Barley and potatoes are grown with a fair degree of success.

The soil is easily plowed and cultivated, and in the level situations retains moisture a little better than the heavier types. Small grains do not give as good results as on the heavier soils.

There is a thick cover of forage plants, and the type affords excellent pasturage. The vegetation is of a mixed character, with a large variety of species. The short grasses, grama and buffalo, probably predominate, while blackroot (*Carex* sp.) is very abundant.

A variation of the Rosebud very fine sandy loam is widely distributed over the upland of the Goshen Hole country on the south side of the North Platte River. It consists of a deep soil showing very little change in texture with depth except that there is a slightly compact and more calcareous subsurface layer at shallow depths, succeeded by a loose, friable substratum. Bedrock is reached at depths of 4 to 15 or 20 feet. The sandstones or sandy members of the Brule, Chadron, and Laramie formations seem to be the principal source of the soil, although the bedrock may consist of silts and clays of these formations. The color appears grayish when the soil is dry and yellowish brown when wet, the deeper soil material being gray or pale yellowish. Under natural conditions the top soil is free from injurious concentrations of alkali. Most of the type has good drainage, but it is not excessively rolling or broken, and except for a few isolated areas on knolls or on the tops of the higher ridges it is favorably situated for both irrigation and dry farming. A small acreage is irrigated under the Springer and the Goshen County ditches, and gives good yields of alfalfa and small grain. A considerable acreage will also come under the Fort Laramie Canal. The top soil is loose and friable, and with the pervious subsoil no especial difficulties in handling the soil are to be expected.

Rosebud very fine sandy loam, shallow phase.—The soil profile of the Rosebud very fine sandy loam, shallow phase, is very similar to that of the silt loam, shallow phase, the two soils differing mainly in texture. The higher content of fine and very fine sand in this phase produces a more pervious structure. Some patches of fine sandy loam and loamy very fine sand are included, since their separation in this case would be of very little or no agricultural value. A few patches of very shallow soil also are included, consisting simply of a few inches of heavy fine sand over bedrock.

Bedrock, consisting of the indurated silt or sandstones of the Brule, Chadron, and Laramie formations, commonly lies at depths of 3 feet or less, and rock outcrop is frequent in the places of shallowest soil mantle.

This phase occurs on the steep slopes of drainage valleys, the crests of ridges, and in the areas underlain by the Chadron formation on the top and slopes of small mesas or buttes capped with sandstone. On account of its shallow character and its unfavorable topography it is not likely to have more than a very small value either for dry farming or for irrigation. The pasturage value is less than that of the Rosebud silt loam, shallow phase. There is a smaller amount of grama grass, with more wire grass and blackroot, and the grass cover is not quite as heavy. Broom weed is common in the shallowest areas.

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

Mechanical analyses of Rosebud very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480320	Soil	0.1	1.2	1.1	18.9	54.9	18.1	5.8
480321	Subsoil	.0	.2	.2	3.9	46.5	37.8	11.5
480322	Lower subsoil	.3	1.4	.8	9.4	58.8	25.1	4.4

ROSEBUD SILT LOAM.

The Rosebud silt loam is nearly uniform in texture in soil and subsoil. The soil profile typically consists of (1) moderately friable silt loam, 4 to 10 inches deep; (2) a layer slightly compact, owing probably to a concentration of lime and other soluble mineral salts; (3) a friable, pulverulent silt, beginning at about 3 feet; and (4) bedrock, reached at depths ranging from 4 to 20 or 30 feet. The top soil is brown or pale yellowish brown, and the material lying at some depth, pale yellowish or whitish. When the soil is dry it has a columnar structure beginning at 6 or 8 inches and extending to the base of the compact layer.

Some minor variations appear in this soil, due to differences in the source of the soil material and in the topographic situation. In general, where the Brule formation has been the principal source of the material the soil is lighter in color than in the areas underlain by the Laramie formation, in which case a pale greenish yellow color is frequently observed and the top soil shows a tendency to become slightly stickier and more compact after being wet. The subsurface layer is more compact in the older than in the more recently formed soil, and as the topography becomes flatter the soil approaches the characteristics of the Dawes silt loam.

Under natural conditions the topsoil is free from injurious amounts of alkali, but under conditions of poor drainage alkali doubtless would soon accumulate. The soil appears to be highly calcareous.

The Rosebud silt loam is one of the most extensive types on the upland of the Goshen Hole country on the south side of the river, in both Wyoming and adjoining parts of Nebraska. It is developed for the most part on long, gentle slopes, and to a less extent on the tops of ridges in the gently rolling uplands. The topography is generally favorable both for dry farming and for irrigation.

The native vegetation consists of a thick cover of grama grass, with a smaller proportion of buffalo grass and wheat grass. In places wild alfalfa (*Psoralea tenuiflora*) is abundant.

A considerable part of the type is already used for dry-land farming, and a large portion of the land under the Fort Laramie Canal is of this type. Under proper dry-farming methods good yields of all the common dry-land crops have been obtained. The average yields of small grain are perhaps a little higher than on the sandy soils of this and other series. More labor is required in cultivation than on the sandy soils and the type is a little slower in warming up in the spring.

On the dry-land farms it is probable that deep fall plowing and listing or early spring tillage would be profitable. Under irrigation it is probable that the soil will be a little more difficult to handle than the fine sandy loam or fine sand types such as are at present under irrigation in this area. Water does not move as rapidly as through the sandier types, and heavy irrigation will probably soon result in serious injury. However, the soil is deep, with a high moisture-retaining capacity, and without being excessively heavy or impervious, and under proper handling it may be expected to give excellent yields and to be more durable than the sands. Small grains should do well. Manure applied to the land would be beneficial.

Rosebud silt loam, shallow phase.—The Rosebud silt loam, shallow phase, is a brown to yellowish-brown silt loam underlain at 8 or 10 inches by a more compact, thin layer of silt or silty clay loam. The soil is characteristically shallow, bedrock being encountered at a depth of 15 to 30 or 40 inches. Commonly the soil is slightly cemented beginning at a depth of 3 or 4 inches, and it becomes more compact or heavier in texture just beneath the humus-containing layer, or at a depth of 10 to 12 inches, again becoming more friable or coarse and granular at the contact with the bedrock.

In some of the areas of shallower soil the humus-containing material rests directly upon the bedrock at a depth of a few inches. In the flatter situations the silt loam soil overlies a stiff, dark-colored clay which rests directly upon the bedrock, the soil here closely approaching the character of the Orella series.

The Rosebud silt loam, shallow phase, is mainly residual from the Brule formation and to a less extent from the Chadron. It occurs widely distributed in small areas on the upland, principally in the country underlain by the Brule formation. It mainly occupies the steeper slopes, the crests of ridges, and to a less extent gently sloping or nearly level areas.

Only a small percentage of the phase is used for dry farming, and none of it has been placed under irrigation, although a considerable

acreage will be included in the irrigable area of the Fort Laramie Canal. In general the soil is too shallow and too droughty for profitable dry farming, and the shallow character is also its chief objectionable characteristic for irrigation farming, but where the topography is favorable the phase can probably be used to a small extent. The Brule formation, which is the bedrock in most places, is not highly impervious and will permit underdrainage if properly tiled.

Native grasses form a thick cover except in the areas of shallowest soil. They consist principally of grama grass, with less buffalo and wheat grass.

The following table gives the average results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the typical Rosebud silt loam:

Mechanical analyses of Rosebud silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480348, 480362.	Soil	0.0	1.4	1.4	11.3	52.7	25.3	7.7
480349, 480363.	Subsoil	.1	1.2	1.7	11.0	43.8	30.1	12.1
480350, 480364.	Lower subsoil	.1	.7	.7	5.1	41.8	36.7	15.1

VALENTINE LOAMY FINE SAND.

The Valentine loamy fine sand consists of a deep, incoherent fine to very fine sand nearly uniform in texture and structure throughout the 3-foot section. It is light brown when dry, becoming medium brown when wet. There is generally very little organic matter below a depth of 6 to 8 inches. The soil is derived principally from deposits of wind-blown sand or from old dunes, where the sand has been stable for a sufficient length of time to be converted into soil. The Valentine differs from the older soils of the area like the Dawes and Rosebud in that there is no compact subsurface layer or zone of lime concentration beneath the humus-containing soil. The sand deposits forming the soil reach a thickness of 10 to 30 or 40 feet.

The principal areas of this type are found on the high terrace plain on the north side of the river and also on the valley slopes on the south side where the sand appears to have been blown from the bottom land and terraces. Small areas are found wherever there are extensive tracts of sandy soils of other series.

The loose, incoherent structure of the soil and its tendency to drift are the chief objections to its use for farming. The uneven surface and hilly topography render irrigation impracticable over most of the type, although there are considerable tracts which could be

watered. Alfalfa produces fair yields, but difficulty may be met in obtaining a stand, and sweet clover might give better results.

There is a thick stand of coarse grasses, but the land will not stand close grazing. Sand grass, bunch grass, and a small proportion of big bluestem (*Andropogon furcatus*) are found, with considerable needle grass. Sand sage (*Artemisia filifolia*) is a characteristic plant.

Valentine loamy fine sand, colluvial phase.—The Valentine loamy fine sand, colluvial phase, consists of a brown to grayish-brown, loose, structureless fine sand extending to a depth of 3 feet or more. The surface soil generally contains sufficient silt to produce a loamy texture. The sand is slightly coarser at some depth, and in places pockets of gravel are encountered. A darker color from organic matter extends to depths ranging from 3 or 4 to 20 inches, depending upon the topography and the age of the soil.

This phase occurs at the base of escarpments and bluffs and consists of colluvial wash or alluvial-fan deposits. Its principal occurrence is at the foot of the high terrace escarpment on the north side of the river, where the material has been washed largely from the soil or alluvium of the terrace. The slopes are moderately steep and in places hilly, but flatten out toward the river and merge into the level land of the first terrace, which is occupied chiefly by soils of the Tripp series. Aside from its topographic position, the chief difference between this phase and the fine sand soils of the adjacent terraces is the absence of a heavier subsoil layer as compared with the Tripp soils and the smaller content of organic matter and the absence of the lime-concentration layer as compared with the high-terrace fine sands.

Where this phase is favorably situated for irrigation, good average yields, for the North Platte Valley, of alfalfa, potatoes, and sugar beets have been obtained. The soil has the disadvantage of a light texture and loose structure and is subject to serious drifting, but it is well drained and free from alkali accumulations. Large quantities of water are required for the production of crops, and the phase is unsuitable for dry farming.

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

Mechanical analyses of Valentine loamy fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480318.....	Soil.....	0.5	6.4	8.0	59.4	18.3	3.6	3.7
480319.....	Subsoil.....	.2	7.6	9.8	62.6	14.0	2.0	3.8

ORELLA FINE SANDY LOAM.

The Orella fine sandy loam typically consists of a light-brown, moderately compact fine sandy clay loam, 12 to 15 inches deep, underlain by a lighter colored, heavier clay or clay loam layer, with a gray or pale-yellow, friable, granular layer beginning at 24 to 36 inches. Bedrock is encountered at depths ranging from 4 to 15 or 20 feet. There is commonly a 2 to 4 inch veneer of fine or very fine sandy loam. The soil is most compact and darkest in color in a stratum beginning at 6 to 8 inches and extending to 15 to 20 inches.

This type is apparently residual from the weathering of sandy clay members of the Chadron formation. The heavy or compact subsurface layer seems to be due more to geological influence and less to concentration of silt and mineral salts than in the Dawes very fine sandy loam and silt loam. In some places a pinkish color is present in the lower part of the 3-foot profile, apparently inherited from the sandy clay members of the Chadron formation. Small bodies of soil where the unaltered clay of the present formation is present at shallow depths, with only a very thin friable substratum, are included with the type, although they really represent an upland phase of Orella clay loam.

The principal occurrence of the Orella fine sandy loam is in townships 22 and 23, ranges 62 and 63. It occupies low ridges and nearly level or gently rolling upland. It lies at higher levels and is better drained than the associated clay and silty clay loam types of the Orella series, and is a better soil both for dry farming and for irrigation.

A small proportion of the type has been placed under cultivation. On account of the dense structure of the soil at a depth of a few inches heavier teams are required for deep plowing than on the lighter-textured soils, particularly in the breaking of sod land. The tilth of the soil improves with continued cultivation and deep plowing. Good yields of wheat, corn, and oats have been obtained under dry-farming methods. None of the type is under irrigation at the present time, and only a very small acreage lies within the irrigable area of the Fort Laramie Canal. Where the topography is favorable the land can probably be successfully farmed under irrigation.

This soil has a thick cover of grasses and makes good pasture. The native vegetation is a mixed type without the predominance of any one or two species, as on some of the other types. There is a thick stand of grama grass in places, with considerable wheat grass, but wire grass and needle grass are also common. Where the wind has heaped the surface veneer of fine sandy loam into little hummocks, cactus and *Artemisia frigida* occur. Salt sage makes a scattered growth.

A sandier variation of the Orella fine sandy loam is included with that type. It occurs principally in township 23, range 63, in the central-western part of the Goshen Hole, associated with bodies of Orella clay and silty clay loam in situations where the latter types occupy the low-lying flats, while the Orella fine sandy loam occupies the slopes and tops of the low ridges between or bordering the flats. The soil consists of a grayish to pale reddish brown, loose fine sandy loam or very fine sandy loam, 6 to 15 inches deep, overlying a pinkish to reddish, compact fine sandy loam to tight clay loam. The compact subsoil layer usually grades at 2 to 4 feet into the bedrock, consisting of reddish or reddish and gray mottled sandstone and clay, with only a very thin, friable layer intervening. None of this sandier soil has been put under cultivation. Much of it occurs in small bodies associated with larger areas of rough land of little value for farming purposes, and it is therefore unfavorably situated for either dry farming or irrigation. However, where the topography is favorable and the area sufficiently large the soil can probably be successfully farmed. The native vegetation consists mainly of wire grass, needle grass, blackroot, and a smaller proportion of grama. Salt sage (*Atriplex canescens*) is a common growth in places, and broom weed is conspicuous, especially where the land has been closely grazed. Cactus and *Artemisia frigida* occur in the deeper, sandier places. The pasturage value is only fair.

The results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of this type are given in the following table:

Orella fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480388	Soil	1.8	5.5	4.5	25.9	28.7	17.6	17.4
480389	Subsoil	1.1	6.6	6.1	29.5	24.9	11.8	19.9
480390	Lower subsoil	.1	1.8	2.2	8.3	32.7	36.8	18.5

ORELLA SILTY CLAY LOAM.

The Orella silty clay loam has typically a dark grayish brown soil grading at 6 to 10 inches into compact, grayish-brown or drab silty clay. Bedrock is encountered at shallow depths, the heavy subsoil generally resting directly upon it; where an intermediate friable layer is present it is very thin. The soil contains more organic matter than the Orella clay, and is deeper. It becomes sticky when wet and tends to puddle, but if undisturbed the top soil when dry assumes a coarse granular or crumbly structure for an inch or two.

The Orella silty clay loam is widely distributed in small bodies throughout the Goshen Hole lowland on the south side of the river. It is generally associated with the clay type. It occurs in flats in drainage valleys and on low-lying, benchlike slopes, generally at a slightly higher level and with better drainage than the clay.

A small percentage of the type is dry-farmed, and when properly handled it has given fairly good yields. Several good fields of alfalfa have been established. Heavier teams are required for breaking the land and more labor is required for proper cultivation than on the lighter textured soils.

A few small fields have been irrigated, with poor or only fair results. This type will form a small but considerable part of the irrigable area under the Fort Laramie Canal. Some difficulty may be experienced in irrigation farming on account of the heavy texture of the soil and the lack of free underdrainage. Heavy watering probably would soon result in water-logging. Under judicious irrigation small grains should give good results.

The native grass growth consists mainly of wheat grass and buffalo and grama grasses. The cover is not quite as thick as on the silt loam soils.

ORELLA CLAY.

The Orella clay is a stiff, calcareous soil having a compact, relatively impervious structure. The content of organic matter is low, and in many places the color from humus does not extend to a depth of more than 2 to 4 inches. The soil is plastic and sticky when wet and becomes hard and dry, later breaking up into coarse granules or crumbs. The texture is generally a clay, the content of silt is relatively large and in places there is some sandy clay included. For the most part the color is either gray, brown, or drab, but greenish, yellowish, and reddish shades are also found.

The soil is characteristically shallow, bedrock lying seldom more than 3 feet below and in many places within 6 or 8 inches of the surface. The soil is mainly residual from clay beds of the Chadron, Brule, and Laramie formations. In a number of places where the soil is derived from the Chadron formation, gravel is scattered over the surface but is not mixed with the soil. Some of the type derived from the clay beds of the Laramie formation occurs on eroded slopes of stream valleys and on knolls in the upland, and is simply the clay of this formation covered by a thin veneer of silt or clay loam. Fragments of stone and gravel are generally present in such areas.

The Orella clay is found principally in the valley of Cherry Creek and in the central-western part of the Goshen Hole in T. 24, R. 62,

and Ts. 23 and 24, R. 63. Small bodies are distributed throughout the area on the south side of the river. It occurs mainly in basins and in lowland flats which are simply poorly defined natural drainage valleys. In most of the flats the drainage is poor, and shallow ponds or water holes are common, many of them holding water throughout the greater part of the year.

On account of its heavy texture and relatively impervious structure, considerable difficulty may be expected in handling this type under irrigation, and it is not of high value for cultivated crops either under dry farming or irrigation.

The native vegetation consists mainly of a sparse growth of wheat grass, with occasional small patches of buffalo and grama grass. The legume *Sophora sericea* is common along with the wheat grass, and there is a scattered growth of salt sage.

With judicious irrigation it is possible that wheat grass would give profitable yields of hay. Sweet clover might be grown as a hay and forage crop.

Orella clay, poorly drained phase.—The poorly drained phase of the Orella clay is found in the beds of shallow, intermittent ponds and in inclosed basins which are covered with water for short periods after heavy rainfall. The soil generally is slightly darker at the surface, from organic matter, than in the typical Orella clay, and there is evidence of a higher content of alkali at the surface. Clay and clay loam textures both occur in these poorly drained situations and have not been differentiated in mapping. In some of the inclosed basins there has doubtless been a small amount of wash, but there is generally a drab or greenish, plastic, stiff clay subsoil grading into bedrock at depths of 3 feet or less. The poorly drained phase has very little agricultural value.

The following table gives the average results of mechanical analyses of samples of the soil of the typical Orella clay, and the results of mechanical analyses of samples of the soil and subsoil of the poorly drained phase:

Mechanical analyses of Orella clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
Typical soil:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480306, 480313	Soil	0.4	4.3	3.8	13.3	13.9	25.7	38.5
Poorly drained phase:								
480307	do	.2	1.8	2.0	18.2	23.2	17.3	36.7
480308	Subsoil	.1	3.1	2.8	16.8	31.1	12.4	34.1

GOSHEN SILT LOAM.

To a depth of 20 to 36 inches the Goshen silt loam consists of a brown, moderately compact silt loam or fine loam containing a relatively large proportion of organic matter. A more compact or heavier subsurface layer extends from 8 or 10 inches to 3 or 4 feet, and generally is underlain by more friable material. The soil profile is similar to that of the Rosebud and Dawes silt loams, but the type differs in the darker color and slightly greater thickness of the humus-containing layer and, in comparison with the Rosebud silt loam, in the more compact or heavier character of the subsoil.

The Goshen silt loam occurs in shallow basins and in the swales of drainage depressions, principally in areas of Rosebud silt loam and very fine sandy loam. It receives drainage from adjacent slopes and the material is in part colluvial, having been washed in from the higher land. In drainage depressions much of the soil has been dissected by gullies, its value thereby being lessened both for dry farming and possible irrigation. Most of the areas are small, ranging from 2 to 40 or 50 acres.

On account of drainage from adjacent slopes this soil naturally receives more moisture than the adjacent types and as it is more retentive it has given fair results under dry farming. Except for a few inclosed basins, where drainage might be deficient, it can probably be successfully farmed under irrigation.

The type supports a thick stand of the native grasses, principally wheat grass, grama grass, and buffalo grass. The wheat grass attains a thicker and taller growth than on the higher land, and gives fair yields of hay of good quality without irrigation.

DAWES VERY FINE SANDY LOAM.

The Dawes very fine sandy loam typically consists of a loose, grayish-brown or light-brown very fine sandy loam or fine loam, 6 to 15 inches deep, resting upon a subsurface layer of compact, yellowish-brown very fine sandy loam to clay loam. The latter extends to 20 to 36 inches, and is underlain by a pale-yellow or gray substratum of very fine sandy loam or clay loam, more friable and granular in structure. Bedrock is encountered at depths ranging from 4 to 10 or 15 feet.

The subsurface layer is generally heavier in texture than the surface soil. It is characterized by a high concentration of soluble salts, and in places contains a high percentage of alkali. Where this is the case this layer shows a dark yellowish color, with black splotches in places, probably due to the action of sodium carbonate

upon organic matter. Where the thin surface veneer of fine sand has been blown or washed off nearly barren patches of hard alkali soil occur.

The principal difference between this type and the Rosebud and Tripp very fine sandy loams is in the more compact and heavier texture of the subsoil layer in comparison with the Rosebud and in the greater concentration of soluble salts in this layer and the smaller organic content as compared with the Tripp. In origin the soil material is either residual or alluvial.

The Dawes very fine sandy loam is widely distributed on the south side of the river, although its total area is comparatively small. It occurs principally as narrow strips of alluvial bottom land and in shallow, poorly drained flats at the heads of drainage courses. The areas containing relatively little alkali occupy flat or gently sloping benches. Part of the type has an uneven surface, on account of gullies and hummocks of wind-blown material.

Very little of the type is under cultivation, although the better drained areas of low alkali content could probably be successfully farmed. Alkali is a handicap to irrigation farming, but where the surface is not too uneven and drainage is adequate the type can probably be irrigated profitably. It is not probable that a high content of alkali will be found below 3 feet, even in the areas of greatest concentration.

The native vegetation on this soil is characteristic. On the shallower areas and areas of high alkali content greasewood, salt sage, salt grass (*Distichlis spicata*), tickle grass (*Sporobolus airoides*), and saltwort (*Suaeda* sp.) are common. Where the surface soil is deeper and the soil contains less alkali there is a better growth, consisting mainly of wire grass, needle grass, and grama. Salt sage occurs, but the other plants characteristic of soils of high alkali content are not present.

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

Mechanical analyses of Dawes very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480325, 480334.....	Soil.....	0.1	0.6	0.6	13.5	63.1	16.4	5.9
480326, 480335.....	Subsoil.....	.1	.2	.3	7.4	51.9	23.7	16.6
480327, 480336.....	Lower subsoil.	.0	.1	.4	16.5	52.0	20.0	11.0

DAWES SILT LOAM.

The soil profile of the Dawes silt loam consists of (1) a grayish-brown to light-brown, compact silt loam, 12 to 18 inches deep; (2) a pale-yellowish or grayish, compact silty clay loam or clay, extending to 36 to 40 inches; (3) friable, pale-yellowish silt; and (4) bedrock of indurated silt or clay of the Brule or Chadron formation, encountered at depths of 4 to 8 feet. The surface soil is friable but becomes compact and slightly cemented at 3 to 6 inches, showing a columnar structure when dry. A darker color, due to organic matter, extends to 18 to 24 inches. The distinguishing characteristic of this type in comparison with the Rosebud silt loam is the heavier and more impervious character of the subsurface layer, in which a concentration of lime and other soluble salts has taken place. Under natural conditions the alkali content of the surface soil is not high enough to injure useful vegetation, but it is probable that alkali would rapidly accumulate under conditions of poor drainage.

This type is widely distributed over the northern part of the Goshen Hole lowland on the south side of the river, but it does not occupy large areas. It occurs on the flatter upland and on nearly level or gently sloping benches along valleys. The topography is favorable both for dry farming and for irrigation.

Much of the type is dry farmed, and a large area will later be irrigated from the Fort Laramie Canal. Where the soil is properly cultivated, fair average yields of wheat, corn, alfalfa, and beans are obtained on dry land. The type is more difficult to plow than the lighter textured soils, and unless deeply plowed in the fall or early spring and thoroughly cultivated it does not hold moisture as well.

Under irrigation it is probable that this type would soon become water-logged if heavily watered, on account of the heavy subsurface layer and the restricted underdrainage. The surface soil shows a greater tendency to compact and bake than that of the sandy types and does not warm up as rapidly. This soil may not be suitable for the growing of potatoes, but it should give good results with small grain.

The native vegetation is a mixed type made up of short grasses, grama and buffalo grass, and wheat grass. Salt sage (*Atriplex canescens*) is common in places and may bear a relation to the high content of soluble mineral salts in the subsurface layer.

CANYON VERY FINE SANDY LOAM.

The Canyon very fine sandy loam differs from the Rosebud very fine sandy loam principally in the shallower depth to the bedrock. The surface soil or humus-containing layer is thinner and frequently

rests directly upon the whitish, disintegrated sand of the Arikaree formation without the heavier and more compact intermediate layer which characterizes the Rosebud. The surface soil is also frequently lighter in texture, consisting of loamy fine sand or very fine sand. Patches of gravelly soil and rock outcrops are common.

This type is found in the deeply rolling, more eroded country adjacent to the Goshen Hole rim. It is poorly suited for farming because of the steep slopes, which cause rapid run-off, and the shallow character of the soil. It affords fair pasturage, but is of less value than the more nearly level soils. Grama grass, needle grass, and bunch grass are the more nutritious species. Bear grass (*Yucca* sp.) is common on the patches of thinner and more gravelly soil.

TRIPP FINE SAND.

The Tripp fine sand consists of a loose, brown fine sand, 2 to 4 feet in thickness, succeeded by a heavier layer ranging in texture from fine sandy loam to silty clay, with a substratum of sand and gravel at depths of 6 to 10 or 15 feet. The surface soil generally shows a dark color caused by organic matter to a depth of 20 to 30 inches, and is somewhat darker at a depth of a few inches than at the immediate surface, but on the whole the organic matter content does not seem to be lower than in the heavier types of the series. The intermediate layer or subsoil is grayish in color and apparently more calcareous than the surface soil. In some places it is but slightly heavier than the surface soil, and here there is very little textural difference above the gravel substratum. In the depressions and in the flatter areas the soil is darker and loamier in texture in the first 6 or 8 inches.

The Tripp fine sand represents the deeper and looser sand soil on the first terrace along the North Platte River, extending from Torrington to Fort Laramie Station. Small bodies are found on the south side of the river and along Horse Creek. The surface generally is nearly level, but in places is slightly hummocky or uneven, as the result of drifting of the sand by wind.

The topography is generally favorable for irrigation, and the gravel substratum provides free underdrainage. The intermediate layer between the top soil and the substratum retards the rapid downward movement of the irrigation water to some extent, so that the soil is not quite as pervious as the sand types on the high terrace and first bottom, but liberal watering is nevertheless required for the production of good yields.

Alfalfa, potatoes, and sugar beets are the principal crops grown under irrigation. Good yields are obtained, although the average may be slightly lower than on the heavier soils such as the Tripp and

Laurel fine sandy loams. This type is not so well suited for small grain, since the loose soil is subject to drifting, but it has the advantage of being easily tilled, well underdrained, and free from injurious accumulations of alkali. It is ordinarily poorly suited for dry-land farming.

The native vegetation consists principally of sand grass, bunch grass (*Andropogon scoparius*), and other coarse species, with a small proportion of grama grass. Sand sage and *Artemisia frigida* are common.

The results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of this type are given in the following table:

Mechanical analyses of Tripp fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480379	Soil	0.8	8.6	8.6	41.5	31.6	6.1	2.9
480380	Subsoil	.1	.6	.6	10.5	40.4	34.5	13.5
480381	Lower subsoil	8.8	17.2	11.2	58.3	3.2	.9	.6

TRIPP LOAMY FINE SAND.

The Tripp loamy fine sand consists of a grayish to light-brown, loose fine or very fine sand, underlain by a thick stratum of gravel and coarse sand at depths of 6 to 20 feet. The gravel bed is a factor of considerable importance under irrigation, but it lies at such depths that it has little or no influence on the growth of crops on dry-farmed areas.

The surface soil is deeper and perhaps even less coherent than that of the Rosebud loamy fine sand, in places being simply a loose, structureless fine sand to a depth of 3 feet or more. A grayish, slightly more compact and siltier layer is often present at depths of 30 to 48 inches.

The Tripp loamy fine sand occurs principally on the high terrace lying 125 to 175 feet above the North Platte River on the north side of the stream, but a few small areas are found on the south side. This is the principal soil irrigated under the Interstate Canal.

The soil is pervious, permitting the rapid downward movement of water, and has very free underdrainage. Large amounts of water are required for crops, and the excessive use of water has resulted in the formation of seepage lakes and marshy areas both on the terrace and at the base of the terrace escarpment.

The soil is loose and subject to drifting and for this reason is not well adapted to small grain, although it is probable that with continued irrigation and manuring a more favorable soil structure will

be formed. The soil is comparatively free from injurious amounts of alkali. Alfalfa and potatoes have been the most successful crops.

The following table gives the average results of mechanical analyses of samples of the soil and the results of mechanical analyses of samples of the subsoil and lower subsoil of the Tripp loamy fine sand:

Mechanical analyses of Tripp loamy fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480372, 480382.	Soil	1.2	2 3	1.8	44 4	38.7	6.2	5.4
480373	Subsoil	1.2	3.9	3.1	42.1	30.8	10.9	8.2
480374	Lower subsoil	1 0	4.9	3.9	52.3	20.5	8.5	8.8

TRIPP LOAMY VERY FINE SAND.

The Tripp loamy very fine sand is a light-brown, loose soil consisting almost entirely of very fine sand. Owing to its smaller content of silt and clay than the Tripp very fine sandy loam, the surface soil is looser and less coherent. It probably absorbs water a little more readily, but on the other hand is more likely to drift.

This soil is of small extent. Its principal occurrence is in the valley of Rawhide Creek. An area covering approximately one square mile is mapped in sections 2, 11, and 12, T. 22, R. 58, in that part of the area lying in Nebraska.

The surface in general is nearly level, but in places is slightly uneven from the shifting of the sand by the wind. The agricultural value of the type is about the same as that of the Tripp very fine sandy loam, except that it is not so well suited to the production of small grain.

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

Mechanical analyses of Tripp loamy very fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480370	Soil	0.0	0.1	0.1	10.9	62.4	19.3	6·9
480371	Subsoil	.0	..1	.4	18.1	42.9	30.5	7.8

TRIPP FINE SANDY LOAM.

The Tripp fine sandy loam consists of a brown, friable surface soil, 20 to 30 inches in thickness, underlain by grayish, compact silt or fine sandy clay loam to a depth of 3 to 4 feet. A sand and gravel substratum is reached at depths ranging from 4 to 10 feet. In the

low and flatter places the top soil is slightly heavier and more coherent than a fine sandy loam, but it becomes coarser at a depth of a few inches.

This type is of small extent. The principal areas are mapped at Torrington and near the State line just west of Henry, Nebr. It lies on the first terrace, 20 to 40 feet above the North Platte River. The surface is nearly level but has sufficient slope for irrigation, while the gravel substratum is near enough to the surface to provide good underdrainage.

Sugar beets, alfalfa, and potatoes have been grown with success under irrigation. The soil is more coherent and better supplied with organic matter than the associated fine sand types, and is somewhat better adapted for small grain.

The results of mechanical analyses of samples of the soil and subsoil of this type are given in the following table:

Mechanical analyses of Tripp fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480375	Soil	2.1	5.9	5.3	30.5	40.0	9.2	7.0
480376	Subsoil	.9	3.3	4.3	26.7	25.3	29.0	9.8

TRIPP VERY FINE SANDY LOAM.

The Tripp very fine sandy loam is a brown, moderately compact very fine sandy loam or fine loam overlying a grayish, compact silt or silty clay loam. A substratum of gravel or sand is present at depths ranging from 6 or 8 to 15 or 18 feet. The top soil is well supplied with organic matter and is darker on the whole than most of the older upland soils, the dark color from organic matter generally continuing to a depth of 20 to 36 inches. Beginning at 8 or 10 inches, the soil with depth becomes slightly more compact, assuming a columnar structure when dry, and is heavier in texture or less pervious. This more compact layer, which shows considerable concentration of lime, extends to 3 or 4 feet, and is there underlain by more friable material consisting of silt, clay, or very fine sand.

The alluvial formation from which the type is derived consists of interbedded layers of silt, very fine sand, and silty clay, with a bed of coarse sand or gravel at the base. The thickness of the separate layers and the textural character vary, influencing the soil accordingly. In many places gully and creek-bank exposures reveal two or three old soil layers within a thickness of 12 or 15 feet, each former surface soil being underlain by a heavier and lighter colored subsoil of silt or clay, the profile of the buried soil being similar to

that of the type at present. On the south side of the river the alluvial terrace merges by a gradual slope into the upland without any topographic feature to distinguish it from the gentle slopes or benches of colluvial wash, so that the outer boundary of the terrace, and accordingly the boundary lines of the type, as mapped, are frequently arbitrary.

The Tripp very fine sandy loam occurs on nearly level or very gently undulating terraces lying 20 to 50 feet above the North Platte River and Horse Creek. The natural drainage is generally sufficient to prevent the accumulation of injurious amounts of alkali at the surface, although excessive watering might easily give rise to alkali areas, since soluble salts are concentrated at shallow depths. The topographic situation, together with the favorable texture, which is neither heavy nor so light as to cause the soil to drift seriously, renders the type well adapted for irrigation farming.

All the staple crops of the area are grown with success. Alfalfa yields about 3 tons per acre; sugar beets, 10 to 12 tons, with some instances of exceptionally large yields; potatoes, 200 to 300 bushels; and wheat, 35 to 40 bushels. Manure is applied to the fields with good results. The type does not require as liberal irrigation as the fine sand soils of this and other series on the terraces and bottom land. The native vegetation consists principally of short grasses, but these are mixed with a variety of other species such as wire grass and needle grass. Salt grass and tickle grass (*Sporobolus airoides*) are abundant in places and probably indicate the spots containing the largest quantity of alkali.

The better improved land of the Tripp very fine sandy loam in this area and in adjacent parts of Nebraska is valued at $100 to $125 an acre.

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

Mechanical analyses of Tripp very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480331	Soil	0.0	1.6	2.5	32.3	43.5	13.1	7.4
480332	Subsoil	.0	1.1	1.2	17.1	51.8	20.6	8.6
480333	Lower subsoil	.0	.6	1.3	19.0	36.2	24.4	18.7

TRIPP SILT LOAM.

The Tripp silt loam consists of a brown, compact silt loam, containing organic matter to a depth of 20 to 30 inches, overlying a more compact and heavier layer of grayish silty clay loam or clay.

The soil becomes more friable in structure at 4 or 5 feet and is underlain by a gravel substratum at variable depths, like the other members of this series.

This type is of small extent. Three small areas are mapped on the first terrace on the south side of the North Platte River. Some patches too small to map separately are included with the Tripp very fine sandy loam.

The type is suitable for both irrigated and dry-land farming. It has about the same topography and drainage conditions as the Tripp very fine sandy loam, but because of its slightly heavier texture shows a slightly greater tendency to compact and clod under irrigation.

Tripp silt loam, colluvial phase.—The Tripp silt loam, colluvial phase, is a light-brown or light grayish brown, friable silt or silt loam, continuing to a depth of 3 feet or more with scarcely any change in color or texture. The type is similar to the Rosebud silt loam, differing principally in its looser, more pervious structure and smaller amount of organic matter. Pockets or thin layers of gravel are present in the lower part of the soil section or at the contact with the bedrock.

The type consists of recent deposits of talus or colluvial wash and alluvial-fan material at the base of escarpments, principally along the Goshen Hole rim. The deposits range in thickness from 3 or 4 to 30 or 40 feet.

Much of the land is steeply sloping and gullied, and of little value either for dry or irrigation farming. Fair yields, however, have been obtained under dry-farming methods on the more gently sloping areas.

There is a good growth of grama grass and blackroot along with coarser species such as bunch grass (*Andropogon*), so that the type affords fairly good grazing. Sage (*Artemisia nana*) is a characteristic growth at the base of the Goshen Hole escarpment.

CHEYENNE LOAMY FINE SAND.

The Cheyenne loamy fine sand typically consists of a light-brown, loose, loamy fine sand which becomes slightly compact at 10 to 20 inches and grades into a grayish, highly calcareous fine sandy loam. A porous gravel or coarse sand substratum is present at shallow depths, usually at 3 feet or less.

In the shallower areas the type consists simply of a few inches of fine sand over gravel. Patches of loamy fine sand and fine sandy loam are combined in the type as mapped, since the separate mapping of these textures would be of no agricultural value.

The Cheyenne loamy fine sand occupies only a small acreage. It is confined to the high alluvial terraces along the North Platte

River, being found on the more rolling and eroded parts where the finer alluvium has been largely removed down to the gravel substratum.

None of the type is under cultivation. It is not likely to be of much value either for dry farming or for irrigation, on account of its structure, which is unfavorable for the retention of moisture, and the gravel substratum, which lies so near the surface as to permit too rapid movement of irrigation water.

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

Mechanical analyses of Cheyenne loamy fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
480323	Soil	0.8	4.7	4.1	36.5	46.1	4.0	4.2
480324	Subsoil	2.9	10.2	6.4	32.1	40.4	4.8	3.1

LAUREL FINE SAND.

The Laurel fine sand is a light-brown or grayish-brown, fine or very fine, incoherent sand, changing at 20 to 40 inches into fine sandy loam or loamy fine sand. A gravel substratum is generally present at about 4 feet. The alluvium varies considerably, consisting in some places simply of structureless fine sand 8 to 10 feet in thickness resting upon gravel, while at other places gravel is encountered within a few inches of the surface. The soil is lighter in color and contains less organic matter than the Laurel fine sandy loam.

The type is confined to the first bottom along the North Platte River, the largest area lying on the north side of the river above Torrington. Numerous small bodies are included within the areas shown as Laurel fine sandy loam. The surface is slightly uneven, and in places there are hillocks of loose sand accumulated by the wind.

Under irrigation the Laurel fine sand gives good yields of alfalfa, although some difficulty may be experienced in obtaining a good stand on account of drifting of the soil. On selected areas potatoes and sugar beets apparently give as good results as on the fine sandy loam type. The texture of the soil is not favorable for the growing of small grain. Sweet clover might be more profitably grown in some places than alfalfa. On account of the pervious character of the soil and the free underdrainage large amounts of water are required in irrigation, but the type has the advantage of good drainage and is free from alkali. It is droughty under dry farming, and probably will not give profitable yields of any of the staple crops. There is a variety of native grasses and other forage plants, but the type does not stand close grazing.

Laurel fine sand, shallow phase.—The soil on the islands in the North Platte River channel and in the most recently abandoned channels of the flood plain is for the most part simply a shallow phase of the Laurel fine sand. The surface soil consists of grayish-brown, incoherent, fine or very fine sand overlying gravel at a depth of 6 to 30 inches. In some places in the recently abandoned channels there is a 2 to 4 inch veneer of dark-gray silt or brown mucky fine sand over the gravel.

The phase is subject to overflow, and its water table is generally within 3 feet or less of the surface. It is practically useless for farming purposes, but has a little value for pasture. The tree growth consists of cottonwood, willow, and buffalo berry. There is a sparse growth of sand grass, bunch grass, switch grass, and grama.

LAUREL FINE SANDY LOAM.

The Laurel fine sandy loam is a gray or light-brown fine sandy loam overlying a substratum of sand and gravel at depths of 2 to 4 feet. Generally there is very little change in texture or structure above the gravel bed. Typically the soil profile includes a light-brown fine sandy loam, well supplied with organic matter, 6 to 10 inches deep; interstratified fine sand and silt, gray in color or showing brownish mottling, to 2½ feet; and yellowish fine or very fine sand, grading into coarse sand and gravel at 3 feet. The type is of alluvial origin and shows the general lack of textural uniformity characteristic of recent-alluvial soils.

In the swales, representing old channels, and in the flatter, more poorly drained areas the soil is darker and heavier than typical, while on the ridges or hummocks it is lighter in color and contains more sand. In places there is a grayish silty clay layer a foot or more in thickness between the top soil and the gravel substratum. A large part of the soil included in this type is a very fine sandy loam, and there is also considerable fine sand.

The type seems to contain more organic matter, particularly in the heavier areas than the soils on the higher flood plains, and when wet it is darker colored. The soil is calcareous, and in the flatter situations shows a moderately high content of alkali in places.

The Laurel fine sandy loam is confined principally to the first bottoms along the North Platte River, with a very small area along Horse Creek. Most of it lies only 5 to 8 feet above the streams, but the type is rarely subject to overflow, although water stands on some of the lower land and the water table rises within 20 to 30 inches of the surface during periods of high water in the streams.

Most of the type along the North Platte River where favorably situated has been placed under irrigation. The average yields of

alfalfa are about 3 tons per acre, sugar beets 10 to 12 tons, potatoes about 200 bushels, wheat 35 bushels, and corn 40 bushels. Yields of 1½ to 2 tons of wheat-grass hay are obtained.

Under dry-farming methods the soil may be droughty, and it does not give any better average results than the upland types.

In most places the Laurel fine sandy loam is friable and easily maintained in good tilth without baking or clodding, but it is more coherent than the fine sand types of the bottom land and terraces. The gravel substratum permits free underdrainage, and large amounts of water are ordinarily necessary in irrigation.

The uncultivated land is used for hay production and pasture. The most common native species are slough grass, salt grass, and little bluestem. Coarse species such as switch grass, big bluestem, and wild rye grow along the irrigation ditches. Along Horse Creek the first bottom is very narrow and the land unfavorably situated for irrigation on account of the winding course of the stream. It is used for pasture only and is of little agricultural value.

LAUREL SILT LOAM.

The Laurel silt loam is a gray to brown soil which becomes lighter in color with depth, but shows little change in texture or structure. The substratum of gravel or coarse sand is encountered at depths of 3 to 5 feet. The soil is slightly less pervious than the Laurel fine sandy loam, being intermediate in texture and perviousness between that type and the Minatare clay loam.

There is a considerable aggregate area of this type in the bottom land along the North Platte River, but since most of the bodies are small and have no clearly defined topographic expression they have been included in mapping with the Minatare clay loam and other types of the Laurel series. Only one small tract, lying on the south side of the river near the State line, is shown on the soil map, but a somewhat larger acreage of the type is found to the east, in Nebraska. The type is irrigable and has about the same value as the better drained Minatare clay loam.

MINATARE CLAY LOAM.

The Minatare clay loam consists of a dark grayish brown to light-brown clay loam underlain at depths of a few inches by gray or bluish-drab clay. A substratum of coarse sand and gravel lies at depths of 30 inches to 4 feet. The top soil varies in texture from a compact silty clay loam to a sandy clay loam and the lower soil from a sticky silty clay to a sandy clay. The soil throughout the layer above the gravel bed usually contains a large amount of organic matter. It is relatively impervious, but the gravel bed affords good underdrainage.

This type occurs, in association with the Laurel soils, in the first bottoms along the North Platte River, where it occupies the flatter or more poorly drained land. The surface soil contains moderate to large amounts of alkali, depending upon the drainage.

The better drained areas contain only small quantities of alkali. They give good yields of small grain and alfalfa, but are not well suited to cultivated crops. The wetter areas and those of high alkali content are of little value for any purpose unless reclaimed by drainage.

Hay is cut from the native grasses, which are principally cord grass, switch grass, little bluestem, and wheat grass. On the land containing more alkali there is a growth of salt grass, with saltwort (*Suaeda*) and scattered greasewood (*Sarcobatus*).

The Minatare clay loam as mapped includes the flatter and more poorly drained land on the first terrace above the flood plain along the North Platte River and Horse Creek. There is probably less organic matter here than in the first bottom, and the color of the soil is not as dark. The chief difference, however, is in the greater depth to the sand and gravel substratum. Because of the higher topographic position the water table is at a greater depth from the surface except where the ground is affected by seepage from irrigation ditches. The soil has a moderately high content of alkali, as is indicated by the growth of salt grass, wild barley, salt sage, and other resistant plants. The terrace variation is of very small extent and minor agricultural importance.

ORMAN CLAY.

The Orman clay is a stiff, plastic, highly calcareous soil similar in structure to the Orella clay, but differing in its slightly darker color and the greater depth to bedrock. The typical soil consists of a brown, humus-containing layer 8 to 10 inches in thickness, over a light-brown silty clay which extends to depths of 3 to 15 feet.

This soil is of alluvial origin, and its principal occurrence is in a narrow strip along Cherry Creek. A smaller area is mapped along White Earth Creek. Because of the stiff, heavy character of the soil and the unfavorable structure and topographic situation in respect to drainage, the type can hardly be expected to have more than moderate value either under irrigation or for dry farming. Small yields of alfalfa and sweet clover and good yields of native hay might be obtained.

The native vegetation consists principally of wheat grass, with a smaller amount of buffalo grass and grama grass and a scattered growth of salt sage (*Atriplex canescens*). Wheat grass under natural conditions makes a better growth than on the Orella clay.

ROUGH BROKEN LAND.

Rough broken land comprises the cliffs and canyons of the Goshen Hole escarpment, the higher bluffs along the North Platte River, and the steeper escarpments of terraces and buttes in the Goshen Hole lowland. In addition to steepness of slope, much of the land is covered with large angular fragments of bedrock, cobblestones, and bowlders. The type has no value for farming, but scattered patches of talus soil support a sparse growth of grasses and herbs which afford some pasturage for cattle and sheep. Stunted pine and cedar trees appear in places and are of considerable local value for posts and fuel.

Throughout the Fort Laramie area, but especially on the higher part of the Goshen Hole lowland, the type as mapped includes small patches of gullied land. Most of this simply represents "bad lands" on a small scale, occurring principally on ridge slopes and at the heads of drainage courses. The accumulations of soil have been swept off, both by wind and water erosion, down to the bedrock, which is in most cases the hard, whitish silt or clay of the Brule and Chadron formations. These patches of eroded land vary in size from 1 or 2 to 30 or 40 acres. Frequently the numerous gullies of the "bad lands" unite into a single gully occupying a deep narrow trench in the colluvial wash of a ridge slope. The bad lands and single gullies, although occupying only a small area, are frequently so situated in a section of land that they greatly depreciate its value for farming.

DUNESAND.

Dunesand includes active dunes and the most recently formed sandhills. In some places the sand is still being shifted by the wind, while in others the dunes are so recent that a soil or humus-containing layer has not yet been formed. The sand is light brown when wet, incoherent, and fine to very fine in texture. The surface is quite barren in the blowouts and in places where the wind is most active. In other places there is a scattered growth of sand sage and coarse grasses. The largest area of Dunesand is found on the high terrace north and northeast of Torrington.

SUMMARY.

The Fort Laramie area lies in the eastern part of Wyoming and the western part of Nebraska, comprising an area of 566 square miles, or 362,240 acres, in the central part of Goshen County, Wyoming, and the western part of Scotts Bluff County, Nebraska. It is situated in the Great Plains region, and most of its area is included in what is known as the Goshen Hole country.

The North Platte River flows through the northern part of the area and is bordered by a broad belt of bottom land and level alluvial terraces. The upland is a rolling, treeless plain. The general elevation ranges from about 4,000 to over 5,000 feet above sea level.

The country is thinly settled. Transportation facilities are afforded by the Alliance & Casper Branch of the Chicago, Burlington & Quincy Railroad, which traverses the North Platte Valley.

The climate is semiarid. The average annual rainfall is only 12.54 inches, but the greater part of the rain falls during the months from April to September, inclusive. The mean annual temperature is 47° F. The summers are short and are characterized by moderately hot days and cool nights. The average growing season is 124 days.

Farming is carried on both under irrigation and under dry-farming methods. The area surveyed comprises the greater part of the irrigable land in Wyoming included in the North Platte Project of the United States Reclamation Service. Alfalfa, potatoes, sugar beets, and wheat are the principal crops grown under irrigation. Sheep and cattle feeding and hog raising are carried on in conjunction with general farming. On the dry land wheat is the principal cash crop; corn, potatoes, beans, oats, rye, and alfalfa are also grown. Yields are small in comparison with those obtained under irrigation, although it has been demonstrated that farming dependent on the rainfall can be profitably carried on.

Cattle raising on the native pasturage is still an important industry.

The soils have the general characteristics common to regions of light rainfall, being light in color, calcareous, low in organic matter, and friable in structure, except where derived from clay formations. There is a wide range in texture, but fine sand and very fine sandy loam soils predominate. Only a very small proportion of the soils carries an excess of alkali in the surface soil.

The classification of the soils into series is based mainly upon structure, depth, and chemical character. The principal series are the Rosebud, Dawes, Orella, Valentine, Tripp, and Laurel.

The soils of the Rosebud series have a friable structure in the surface portion, a very slightly compact subsurface layer, and a deep, friable substratum. They are productive and suitable both for irrigation and dry farming. The fine sand requires large amounts of water under irrigation.

The Dawes series includes soils having a friable surface layer, a very compact or heavy subsurface layer, which in places carries much alkali, and a friable substratum. These soils are productive, but they are less pervious than those of the Rosebud series and do not have so free underdrainage.

The Orella series comprises relatively shallow soils with an impervious structure. Three types are mapped in this area, the fine sandy loam, clay, and silty clay loam. The Orella soils are difficult to handle on account of their heavy texture and restricted underdrainage.

The Valentine loamy fine sand is a deep, loose fine sandy soil of recent origin, derived mainly through deposition by wind. The soil is productive but is liable to drift, and the surface is in places too uneven for irrigation.

The types included in the Tripp series are characterized by a loose, friable surface soil, generally fairly well supplied with organic matter; a subsoil heavier in texture than the surface soil; and a porous substratum. These soils lie on low, alluvial terraces, principally along the North Platte River. The topography and soil structure are favorable for irrigation and the land is generally productive.

The Laurel series includes the recent bottom-land soils. A porous subsoil or substratum at shallow depths is characteristic of these soils.

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[PUBLIC RESOLUTION—No. 9.]

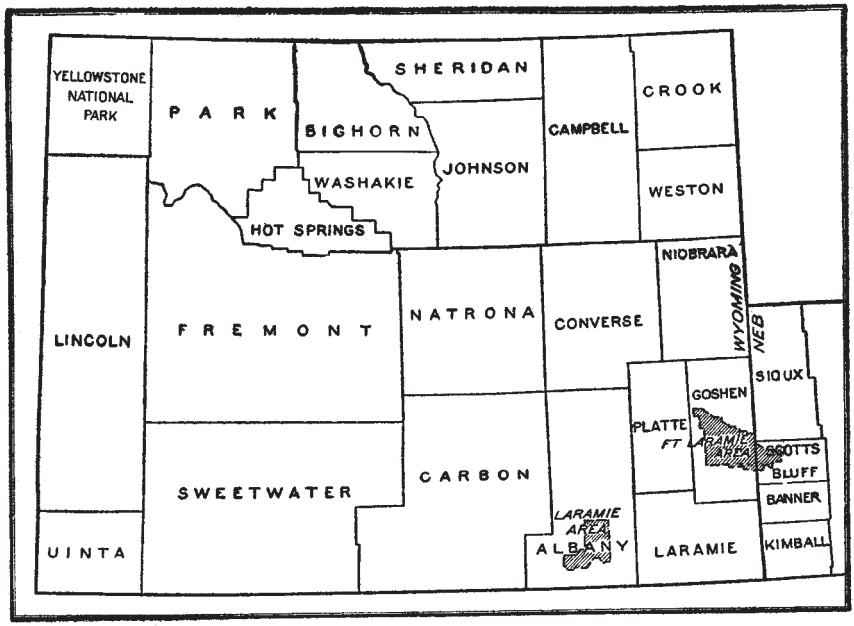
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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

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

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in Wyoming.

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