

U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS.  
IN COOPERATION WITH THE UTAH AGRICULTURAL EXPERIMENT STATION.

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SOIL SURVEY OF THE UINTA RIVER VALLEY  
AREA, UTAH

BY

B. H. HENDRICKSON, OF THE U. S. DEPARTMENT OF AGRICULTURE,  
IN CHARGE, AND D. S. JENNINGS, SCOTT EWING, AND  
E. H. FLANDERS, OF THE UTAH AGRICULTURAL  
EXPERIMENT STATION.

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[Advance Sheets—Field Operations of the Bureau of Soils, 1921.]



WASHINGTON:  
GOVERNMENT PRINTING OFFICE.  
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[PUBLIC RESOLUTION.—No. 9.]

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

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

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

Approved, March 14, 1904.

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

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### MAP.

Soil map, Uinta River Valley sheet, Utah.

# SOIL SURVEY OF THE UINTA RIVER VALLEY AREA, UTAH.

By B. H. HENDRICKSON, of the U. S. Department of Agriculture, in charge, D. S. JENNINGS, SCOTT EWING, and E. H. FLANDERS, of the Utah Agricultural Experiment Station.

## DESCRIPTION OF THE AREA.

The Uinta River Valley area is situated in the northwestern part of Uintah County, in the northeastern part of the State of Utah. The center of the area is about 40 miles west of the Utah-Colorado State line, about 40 miles south of the north boundary of Utah, and about 100 miles due east of Salt Lake City. It lies in the east-central part of the Uinta Basin.

The boundaries of the area are rather irregular. The Uinta Special Meridian bounds the area on the west. The Green River and the Duchesne River constitute the southern boundary, and the northern and eastern boundaries are arbitrarily drawn along township and section lines in such a way as to include practically all lands which are now improved and under irrigation, or which may be brought under irrigation at some future date. Upon the east the area extends to within about 8 to 12 miles west of the crest of Asphalt Ridge, and on the north to the base of the Uinta Mountains.

The area surveyed includes the larger part of the valley of the Uinta River and the valleys of some of its tributary streams. White-rocks Bench, Indian Bench, other smaller benches, the Colorado Park table-land, and bottom lands along the Uinta, Whiterocks, Duchesne and Green Rivers are included. Numerous rocky ridges, mesas, and large areas of rough, broken, dissected, steep, and stony land are within the area. The total area surveyed is 298 square miles, or 190,720 acres.

The Uinta Basin, of which the present area is a part, is a dissected plateau region characterized by areas of rough, eroded, broken lands, many broad, nearly level bench lands, and broad valleys, with smaller inclosed basins along intermittent tributary streams. (Pl. XLV, fig. 1.)

The rough, broken, and steeply dissected lands in the Uinta River Valley area occur mainly in a large body in the northern and eastern parts, extending almost continuously from the foothills of the Uinta Mountains to Colorado Park, and in a large number of smaller areas

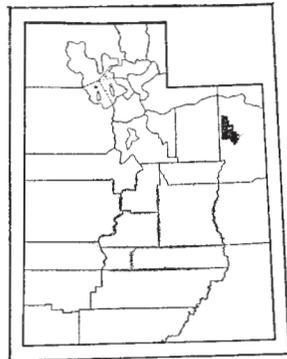


FIG. 49.—Sketch map showing location of the Uinta River Valley area, Utah.

of similar character scattered throughout the survey in the form of small flat-topped mesas, steep rock hills, rough, steep-sided ridges, and less rocky but dissected uplands unsuited for cultivation.

The benches and broad mesas, or table-lands, are prominent physiographic features of the area and are also important agriculturally, as many of them are in a high state of cultivation.

In the northern part of the area, parallel to and about 2 miles east of the Uinta Special Meridian, is the elongated table-land known as Whiterocks Bench. It is  $6\frac{1}{2}$  miles long and averages three-fourths mile wide. It is comparatively level in an east-and-west direction, but has a slope of approximately 110 feet per mile from north to south. The elevation at its northern end is about 6,500 feet above sea level and at the southern end about 5,700 feet. It originates near the foothills of the mountains, and becomes increasingly higher above the intrenched valleys on each side as it extends southward. With steep slopes on its east and south sides, it stands 100 to 200 feet above the adjacent country, but on the west it meets the alluvial land of the Whiterocks River with a much less abrupt slope and a total drop of 25 to 50 feet. This bench is nearly all improved, irrigated farm land.

Another elongated table-land of considerable size enters the area  $2\frac{1}{2}$  miles northeast of Lapoint, extends southward to a point about  $1\frac{1}{2}$  miles east of Lapoint, thence continues in a southeasterly direction for about  $3\frac{1}{2}$  miles, and terminates just over the eastern boundary of the area. The part within the area is 5 miles long by one-half mile wide, is nearly level in a northwest and southeast direction, and slopes about 100 feet per mile southward. Where it enters the area on the north its elevation is about 6,000 feet; at its southern end the elevation is about 5,500 feet. Its rim is marked by a steep slope of 150 to 300 feet height. At the present time this bench is wholly unimproved, owing to the difficulty of reaching it with irrigation water.

Extending southwestward from the foot slopes of the table-land just mentioned is a lower, less well-defined bench, about 3 square miles in extent, which terminates in a narrow low ridge in the vicinity of the Webb School. In general outline it is nearly triangular. Its edge is almost imperceptible on the northwestern side where it joins the alluvial lands of more recent origin, in the vicinity of Lapoint, but on the south and southeast it breaks off abruptly in a steep slope and stands 75 to 150 feet above the lower country in that direction. This bench is largely under cultivation and irrigation.

Indian Bench originates to the north of Leeton, where its surface rises gently from the surrounding alluvial flat of the Uinta River. It widens rapidly and extends southward nearly 8 miles, with an average width of about 1 mile. It terminates in an abrupt rocky scarp 200 or more feet above the level of Montes Creek valley, which borders its western side. On the eastern side the slope is modified by several successive, narrow, considerably eroded, lower bench levels, which combined extend out about a mile from the rim of the bench proper. Indian Bench is nearly flat in an east-and-west direction, has an elevation of about 5,500 feet at Leeton, and about 5,200 feet at its southern end, and a slope from north to south of about 40 feet to the mile. This bench is practically all irrigated farm land.

In the northwest corner of T. 2 S., R. 1 E., a narrow, irregular bench enters the area and extends southeast for 3 miles, until it

narrowing top tapers off into a ridge. This bench is about 1 mile west of Indian Bench and has a similar elevation and general topographic character. Its average width within the area surveyed is about one-fourth mile. It is mostly improved land under irrigation.

West of Fort Duchesne are three smaller benches none of which are improved farm land. Several smaller benches lie in the northern part of the area. Near Tridell are three narrow benches, embracing enough cultivable land to justify improvement; these are utilized to some extent. A small bench extending from Bennett southward for  $1\frac{1}{2}$  miles has been improved in part.

Colorado Park, in the southeastern part of the area, is a triangular-shaped plateau or large table-land situated between the Duchesne and Green Rivers. Its surface is varied. In the western part, and extending down along the Duchesne River for about 5 miles, are broad, flattish benches, becoming considerably eroded farther south. A small, low, prong-shaped lower bench level of about 1 square mile constitutes the southernmost extension of Colorado Park, on the extreme southern tip of which the settlement of Ouray is located. A high, considerably eroded, but flat-topped ridge begins  $1\frac{1}{2}$  miles east of the Duchesne River, at a point about 4 miles downstream from Randlett, and extends parallel to the river to within about a mile of Ouray. East of this prominent ridge are broad undulating slopes reaching to the Green River, and in most places terminating in abrupt inclines. In the central part of Colorado Park is an inclosed basin of considerable size, in the lowest part of which is a lake bed, dry during the greater part of the year. In the eastern part of the plateau the surface is undulating. Along Green River from the Sheppard Ranch northward the rim of the plateau is marked by rocky and precipitous slopes of 200 to 300 feet height. In the northern part there are high table-lands, with undulating to flattish surfaces, which merge into steeper, rough dissected country to the north. The elevation of the plateau varies from 4,655 feet above sea level at Ouray to about 5,200 feet in the northern part. Colorado Park is mostly virgin desert. A few settlers cultivate and irrigate tracts of land, but owing to lack of irrigation water or long distance from source of supply, the park is but little developed at the present time.

The recent-alluvial lands included in the survey are found in the valleys of the Uinta, Whiterocks, Duchesne, and Green Rivers and some of their small tributaries. These are gently sloping to nearly flat lands, the largest area occurring in the valleys of the Uinta and Whiterocks Rivers.

Including the glacial-outwash fan of the Whiterocks River, in the northwestern part of the area, the recent-alluvial soils extend southward in a belt 2 to 4 miles wide through the center of the area, narrowing near Fort Duchesne, and widening again at the lower end of the Dry Gulch Valley near Randlett. Deep Creek and Dry Gulch, important tributaries of the Uinta River, are bordered by narrower belts of alluvial soil, which rapidly widen as the streams approach the river. The recent-alluvial lands along the Duchesne and Green Rivers rarely exceed a mile in width within the area, because the channels of these rivers are bordered rather closely by uplands.

A considerable number of small intermittent stream tributaries flow through narrow valleys. Each has developed a small belt or

strip of sloping alluvial land, which widens as it approaches the larger streams. These lands are largely used for irrigation farming.

The main streams within the area are the Uinta, Whiterocks, Duchesne, and Green Rivers. The Whiterocks River is a large tributary of the Uinta River. The two streams are very similar in character above their junction. Together they furnish almost all the irrigation water used in this area. They also constitute, together with numerous tributaries, a well-ramified system of drainage for the greater part of the area.

The natural drainage conditions of the area as a whole are good. In a few parts of the area, however, the drainage is naturally sluggish namely: (1) In a narrow strip of low land adjoining Whiterocks Bench on its west and south side, and extending southeast for about 3 miles; (2) in a considerable tract of land extending from the upper part of Montes Creek Valley, about  $1\frac{1}{2}$  miles northeast of Altera School, to a point about  $2\frac{1}{2}$  miles north of Leeton; (3) in several local small areas in the flood plains of Duchesne and Green Rivers, owing to natural backwater conditions; and (4) in the dry lake bed and associated smaller low areas of Colorado Park, which have no drainage outlet.

Uintah County was organized in 1880 from parts of Sanpete and Wasatch Counties. In 1917 parts of the county were annexed to Duchesne and Summit Counties, and in 1918 the part of the county situated north of the crest line of the Uinta Mountains was set apart and designated Daggett County.

The part of Uintah County embraced in this survey includes lands of the Uinta and Ouray Indian Reservation, lands owned by white settlers, and large tracts of Government and State lands, parts of which are open to entry.

This part of the county was unsettled until the establishment of the Uinta Indian Reservation, in 1861. About 1871 the headquarters or agency of the reservation was located at Whiterocks. In 1908 or 1909 the agency was moved to Fort Duchesne, which had been established as a military post in 1886. The Ouray Reservation was established about 1881, with headquarters at Ouray. The Uinta and Ouray Indian Reservations were combined in 1886. Military forces remained at Fort Duchesne until the post was made the headquarters of the reservation. There are no soldiers on the reservation at the present time.

Three bands of Ute Indians, the Uinta, Whiteriver, and Uncompahgre bands, numbering about 1,115, occupy the combined reservation, a part of which is included in this survey. The Uinta band came from the southern part of the Territory of Utah in 1865 or 1866. The Whiteriver band came to this reservation in the fall of 1880, having been previously located on the White River, Colo., near the present site of Meeker. The Uncompahgre band was moved to this reservation from Montrose, on the Uncompahgre River in Colorado, about 1881.

The land allotment in severalty to the Indians was made in 1905. In addition, large tracts of suitable land were set apart as Indian grazing land. An extensive gravity-canal system of irrigation was constructed for the watering of Indian-owned lands. At the present time there is an intricate system of Indian canals in the better parts

of the area, as well as numerous canals constructed by white settlers. The Indian lands have the prior water right.

The towns of Lapoint, Moffat, and Randlett are settlements of white people and are local trading centers. Tridell consists of a post office and a few near-by farmhouses. Whiterocks is a small settlement having a considerable Indian population and an Indian school. Ouray is an old trading post on the Green River; it consists of a general store and a few houses. Fort Duchesne is an old Army post, now the headquarters of the Indian reservation. The county seat is Vernal, outside the area, in the north-central part of the county, about 24 miles northeast of Fort Duchesne by road.

There are no railroads within or near the area. Transportation is supplied by automobile stages and motor trucks. Watson, Utah, is about 79 miles southeast of Fort Duchesne, by road through Vernal, and about 65 miles by road through Ouray, but the latter route is closed during part of the year on account of floods. Watson is the northern terminus of the Uintah Railway, a narrow-gauge spur line connecting with the Denver & Rio Grande at Mack, Colo. Rifle, Colo., the terminus of the Rio Grande Junction Railway, is about 80 miles east of Fort Duchesne by road through Vernal. There is very little traffic, however, between these railroad stations and points within the Uinta River Valley area.

Most of the incoming supplies, freight, and express shipments, as well as outgoing products, are carried by motor trucks or wagons from or to Price or Helper, important towns on the main line of the Denver & Rio Grande, 95 to 100 miles southwest of Fort Duchesne by road. Almost all the passenger traffic is handled by automobile stages running between Price and Helper and towns within the Uinta Basin. Automobile trucks of the Post Office Department bring in large quantities of mailable supplies and commodities shipped by parcel post.

Until a few years ago the roads in the area were in a very poor condition. In recent years the reservation management, together with the county and State authorities, have effected considerable improvement of the public roads, so that now they are as a rule in good condition, especially in the better farming sections of the area. The main artery of travel to points east and west is the road known as the Pikes Peak Ocean-to-Ocean Highway, or Victory Highway, which passes through Moffat and about 1 mile north of Fort Duchesne. This route passes through Vernal to Denver and cities to the east, and through Roosevelt, Myton, and Duchesne (towns in the Uinta Basin) to Salt Lake City and western points. It is a well-constructed earth road, with good bridges, and is a favorite route for automobile tourists. Considerable transportation difficulty is experienced during the winter, because of frequent heavy snowfalls in the mountains through which the road passes. Besides the main public roads, the area has many fair earth roads, as well as secondary roads and trails which extend into the mountains, the rough broken country, and the near-by virgin desert lands.

Marketing is a serious problem by reason of long distances from railroad shipping stations and consequent high costs of transportation. Practically the only products reaching outside markets are beef cattle, sheep, wool, and extracted honey. Cattle and sheep are driven over-

land to eastern and western shipping points; wool and honey (the latter put up mostly in 5-gallon cans) are hauled to Price and Helper and shipped to various larger markets. The local towns are markets for hay, feed, cereals, milk, butter, meat, eggs, vegetables, and fruits. The prices obtained for products at local markets as a rule are rather low.

#### CLIMATE.

The climatic conditions in the area are similar in a general way to those in other irrigated farming districts in Utah, most of which are situated about 5,000 feet above sea level.

The winters are severe, with occasional short periods of extremely cold weather. The mean winter temperature is  $16.3^{\circ}$  F. Very little snow falls. The highest recorded temperature for the winter months is  $65^{\circ}$  F. and the lowest is  $-38^{\circ}$  F. The summers are pleasant, with cool nights. The mean summer temperature is  $67.4^{\circ}$  F. The maximum recorded temperature for the summer months is  $107^{\circ}$  F. and the lowest  $27^{\circ}$  F.

According to the records of the Weather Bureau station at Fort Duchesne the average date of the last killing frost in the spring is May 18 and of the first in the fall, September 22. The average growing season is therefore about 127 days in the vicinity of this place. Killing frosts have occurred as late as June 28 and as early as August 31. During the first week in July, 1921, a frost did considerable damage to vegetable gardens and to some of the field crops. As the elevation is from 4,655 feet at Ouray to nearly 7,000 feet in the extreme northern part of the area, the length of the growing season varies a good deal within the area. The season is usually two weeks later in the higher parts of the area than in the lower valleys, and it may be correspondingly shortened in the fall by earlier killing frosts. Owing to the considerable slope of the stream valleys and the absence of air pockets, the air movement as a rule is not restricted in such a manner as to cause unseasonable frosts on cold nights on lower valley lands. The growing season is marked by very pleasant, sunny weather. The temperature rarely rises to over  $100^{\circ}$  F.

Thundershowers, commonly occurring in the afternoons, occasionally sweep across the country, but most of the rain falls in the mountains to the north. High winds are very rare. Very little damage by hailstorms has been reported.

The mean annual precipitation at Fort Duchesne is 7 inches. The extremes in annual rainfall are 4.36 inches for the driest year (1897) and 12.13 inches for the wettest year (1905). The greater part of the rainfall usually occurs in the spring and fall.

Owing to the dry climate, the native vegetation on the uplands consists only of desert brush or shrubs, consisting predominantly of sagebrush, rabbit brush, greasewood, shadscale, and smaller desert shrubs and on certain upland soils of a sparse growth of native grasses, the most important of which is galleta grass (*Hilaria jamesii*). Trees and good pasture lands occur only on the lower lands near a natural supply of water. The rainfall is insufficient for the production of farm crops without irrigation.

During the winter months a heavy snowfall usually occurs in the Uinta Mountains. In the spring months the snow on the southern slopes melts rapidly when warm weather comes, and annual freshets occur late in May to early in June. Gradually melting ice and snow

continue to feed the streams during the earlier part of the summer, and the water from this source, together with that supplied by almost daily showers in the mountains, supplies all the irrigation water used in the area.

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

*Normal monthly, seasonal, and annual temperature and precipitation at Fort Duchesne.*

[Elevation, 4,941 feet.]

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1897).	Total amount for the wettest year (1905).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December .....	16.3	61	-25	0.50	0.10	0.20
January .....	13.5	59	-38	.53	.60	.50
February .....	19.1	65	-36	.46	.10	.60
Winter .....	16.3	65	-38	1.49	.80	1.30
March .....	35.9	82	-12	.67	.75	1.55
April .....	48.0	86	4	.55	.17	.69
May .....	55.8	95	21	.65	.61	.89
Spring .....	46.6	95	-12	1.87	1.53	3.13
June .....	64.4	101	27	.35	.45	.10
July .....	70.6	107	34	.56	.66	.09
August .....	67.1	101	31	.65	.66	.06
Summer .....	67.4	107	27	1.56	1.77	.25
September .....	58.0	94	17	1.10	.08	5.92
October .....	44.8	85	4	.60	.05	.28
November .....	32.6	76	-11	.38	.13	1.25
Fall .....	45.1	94	-11	2.08	.26	7.45
Year .....	44.3	107	-38	7.00	4.36	12.13

#### AGRICULTURE.<sup>1</sup>

The early efforts of the Government to concentrate the Indians within the limits of the reservation and teach them the art of farming marks the beginning of agriculture within this area. The reservation was set apart in 1861 and farming operations begun in the fall of 1866 under the guidance of Thomas Carter. No crops were raised in 1867, but in 1868 approximately 80 acres were planted, but without return, as the growing crops were destroyed by grasshoppers.

The location of this farm, it appears, was in the general vicinity of Whiterocks, probably in the Farm Creek district. At any rate the location was considered an unfortunate one, particularly on account of the altitude, and in the fall of 1868 farms farther down the river (probably near Fort Duchesne) were selected. In 1869 Agent Dodds reports that "110 acres have been cleared and planted largely by Indian labor."<sup>2</sup> The following table is taken from Dodds's report:

<sup>1</sup> This chapter written by Dr. D. S. Jennings, 1924.

<sup>2</sup> Report of the Commission of Indian Affairs, 1869, p. 232.

*Production of crops, Uinta Reservation, 1869.*

Crop.	Yield.		Value at agency.
	Acres.	Bushels.	
Wheat.....	50	1,750	\$10,500
Corn.....	20	1,200	6,000
Potatoes.....	6	1,500	6,000
Turnips.....	20	3,000	6,000
Oats.....	6	240	480
Other vegetables.....	8	-----	1,000
Total.....	110	-----	29,980

Later reports indicate that there was a decline in the general farming operations by the Indians, probably due to their great antipathy for work. At the present time a great deal of the work about Indian farms is done by the squaws, and many of the Indians rent their land, generally under cash leases, to whites.

The reservation was not open to settlement by white men until 1905. Previously to that year, however, some farming had been done by them in the area, particularly near Moffat. Since 1905 many farmers have settled within the Uinta Basin.

Among the leading agricultural industries of the area are the production of alfalfa hay and seed, the growing of small grain, the production of livestock, both cattle and sheep, dairying, beekeeping, and poultry raising, particularly turkeys.

The Uinta River Valley area is especially well adapted to the production of livestock and dairying. This is due not only to the excellent summer pasturage afforded by the Uinta Mountains, but also to the fact that a relatively large acreage of the Mesa and Bennett soils is generally being used as cultivated pasture.

The production of beef cattle has played an important rôle in the development of the Uinta Basin. Conditions at present do not appear so favorable because (1) much of the summer range is being used for dry farming and (2) within the last few years the basin has been recognized as being well adapted to the production of alfalfa seed, thus greatly decreasing the supply of cheap hay. The cattle, except those belonging to the Indians, which are left to pasture within the area or driven into the canyon, are ranged in the Uinta Mountains in the summer, at the close of which many that are marketable are driven directly to the market. In the fall the main herd is taken from the mountains and kept in the fields and pastures until about December, when feeding is begun and continued as a rule until March or April.

Sheep raising is an important branch of the livestock industry. The value of the wool clip in Uintah County<sup>3</sup> in 1909 was reported by the Federal census as slightly more than \$57,000, and 10 years later at nearly nine times that amount. According to the same authority, there were nearly 120,000 sheep owned in the county in 1920. As an average of the yearly number this is probably low, since 1919 was a very dry year—so dry that irrigation streams were

<sup>3</sup> The Uinta River Valley area includes only a small part of Uintah County. The reader should keep this in mind and not apply the figures given for the county to the area surveyed. Probably one-third of the irrigated area of the county lies within the present survey.

lessened with a consequent light hay crop. In addition, a very severe winter followed, which resulted in large losses of livestock.

Sheep raising may be said to be of two types: (1) The large-herd type and (2) the farm flock. In the first group the lambs and wethers are driven directly to market from the summer pastures on the Uinta Mountains, and the main herds are wintered to the south and east of the area. In late winter the herds are culled of old ewes and lambs which are sent into the settlements for feeding. The farm flock varies in size from 25 to about 200. These flocks are kept on the farm most of the time, although of late a plan has developed for combining several of the flocks and ranging them for the summer. Arguments advanced by the keepers of the farm flock are that they keep down weeds and bring in two pay days a year—a wool clip in the spring and a sale of lambs in the fall.

There is no creamery within the area, but since 1915 one has been operated at Neola, which is situated north and west of Fort Duchesne, just outside the area surveyed. At the present time this company has three stations within the area—one at Lapoint, one at Whiterocks, and one at Fort Duchesne. The milk is separated on the farm and delivered to the station by the farmer. Here it is tested and then hauled to the creamery by the company.

Cream also is shipped from the area to another company located at Fort Duchesne, and to a creamery at Vernal. At the present time the following quantities of cream are being produced within the area:

*Quantity of cream received at the principal stations within the Uinta River Valley area.*

Station.	Pounds per week.	Station.	Pounds per week.
Lapoint.....	2,800	Leeton.....	1,300
Fort Duchesne.....	2,500	Bennett.....	800
Whiterocks.....	500		
Randlett.....	700	Total.....	8,600

The creamery company at Neola manufactures butter and cheese, which is placed on the Salt Lake City market or is sold in the coal camps in Carbon County.

Beekeeping has been important in the development of the Uinta Basin, as honey from this section is generally recognized as having exceptional quality. The Utah State Department of Agriculture reports 2,695 colonies of bees in 1924 within the district surveyed. There was an average production of 47 pounds of surplus honey per colony, or a total surplus production of 126,665 pounds.

Poultry production, especially the raising of turkeys, is a very important phase of farming. The dressed turkeys are shipped to market by way of Price. In 1919 the value of poultry products in Uintah County was reported to be nearly \$50,000. The poultryman of the Utah Agricultural Experiment Station states that in 1923 10 carloads of dressed turkeys were shipped from the Uinta Basin. These were sold in New York, Los Angeles, and Omaha and a total of \$65,000 brought back into the basin. Seven of the 10 cars were prepared for the Thanksgiving market. The production of 1924 was only

about 75 per cent that of 1923. The cold, damp weather in the spring interfered with the hatching and raising of the young turkeys.

Until quite recently the Uinta Basin has been a heavy producer of alfalfa hay. At the present time it is recognized as an important section for the production of alfalfa seed. When hay alone is produced on a farm two crops a season are harvested; in addition to this a good fall pasture is obtained. The land is given from two to four irrigations by the flooding method.

Alfalfa seed has been produced in the basin to some extent for many years. However, it was not until 1921 that farmers began producing it as a business. Several cleaning plants have already been built and the necessary machinery installed. Two or three companies have men stationed there to advise the farmers relative to the treatment of the growing crop and to look after the cleaning and marketing of the seed. Within the Uinta River Valley area there were in 1924 approximately 5,000 acres of alfalfa producing seed. The following table, showing the growth of the seed industry in the basin as a whole, is given by a local seed company:

*Production and value of alfalfa seed in the Uinta Basin, 1921 to 1923, inclusive.*

Year.	Production.	Value of crop.
	Pounds.	Dollars.
1921 -----	1, 250, 000	100, 000
1922 -----	3, 000, 000	420, 000
1923 -----	5, 000, 000	775, 000

All small grains do well within the area surveyed. About 5,000 acres were grown in 1921. Vegetables and fruits are grown for local consumption only. Among these products potatoes yield satisfactorily. The smaller fruits, such as currants, gooseberries, and raspberries, do well, and are produced for local consumption. Several orchards are found in the area.

No definite crop rotation is practiced. Alfalfa is allowed to remain five years or longer. When it is plowed up two crops of small grain, as a rule, are grown. These are followed by one year of corn, after which alfalfa is again sown with a grain crop. No fertilizer other than manure is used. Labor is entirely local.

The average size of farms in Uintah County, as reported by the 1920 census, is about 140 acres, of which 60 acres is classed as improved land. There are a number of farms of less than 3 acres and a few holdings of more than 1,000 acres, but about two-thirds of the farms range in size from 20 to 174 acres and farms of 40 to 50 acres are common. Land values range from \$20 to approximately \$100 an acre. These figures, while pertaining to the county as a whole, are fairly representative of local conditions.

#### SOILS.

The arable soils of the Uinta River Valley area are classified into four general groups, namely: (1) Residual soils, or those derived from the weathering of consolidated rocks in place; (2) old valley-filling soils, which are derived from old, unconsolidated, water-laid deposits; (3) recent-alluvial soils, derived from recent stream deposits that

have undergone little if any change by weathering since they were deposited; and (4) wind-laid soils, or those owing their accumulation to wind action. In addition to the above are the miscellaneous types Dunesand and Rough broken and stony land.

The soils are further separated into soil series and soil types. Each soil series consists of soil types that are similar in origin, color, and structure, and differ from one another mainly in the texture or relative coarseness or fineness of their surface soils. The soil type is the unit of soil mapping. The phase is a variation of the type.

The virgin or undisturbed soils of the area that are well drained and lie above stream flood plain levels, all have the characteristic desert profile, the direct result of development under certain climatic conditions. This profile consists of a thin crust, one-eighth to 1 inch in thickness, underlain to a depth of 2 or 3 inches by a loose mulch, composed of small roundish soil aggregates. A more or less compact layer underlies the mulch, which in some places has a horizontal platy structure in the upper part. Below the compact layer is a less compact layer extending downward to varying depths. In addition, a vertical columnar structure develops in heavy desert soils. The desert profile is best developed in old, clayey soils, and least developed in young, sandy soils.

The soil types of the area are described in their virgin or natural condition, because plowing, leveling, cultivating, and irrigating obliterate the natural arrangement of the soil layers in the upper part of the soil section and materially alter the degree of compaction.

Many of the soils of the area which have a pronounced red color or tint show a subdued gray color in the surface inch or two, owing to dehydration of certain iron compounds in the soil by the action of hot dry weather.

All the soils of the area are calcareous. In regions of scant rainfall lime has a tendency to accumulate in the subsoil. In this area the percentage of lime present in the soils and the position of its concentration in the soil profile seem to depend mainly upon the age of the particular soil. Beginning with comparatively even distribution of lime throughout the profile of the younger soils, as in the soils of the Redfield series, concentrations as high as 50 to 60 per cent of lime carbonate occur in the subsoils of certain of the older soils, for example, the Mesa and Bennett soils.

Alkali salts exist to some extent in nearly all the soils of the area. Excepting soils derived from or associated with the Green River shales, the presence of alkali does not appear to have any relation to the chemical composition of the parent rock. This formation is notably high in soluble salts, and near-by areas of soils are somewhat affected by the run-off. Excess alkali in the soils in general is mainly the result of lack of drainage, to overirrigation, or to seepage, either from canals or from higher lying irrigated lands. The alkali conditions of the soils of the area are being carefully studied by the Utah Agricultural Experiment Station, Logan, Utah. The results of this work, together with an alkali map and recommendations, will be published by that station in the form of a bulletin, which may be obtained upon request.

The prevailing type of vegetation on the well-drained uplands consists of desert shrubs, from a few inches to 3 or 4 feet in height, including sagebrush, rabbit brush, greasewood, shadscale, salt sage,

and matchweed, together with a very scant growth of desert grasses. Poorly drained soils support a heavy growth of native grasses, such as salt grass, foxtail, and redtop. In belts along the permanent streams cottonwood trees, buffaloberry, and squawberry bushes, willow bushes, and a good sod of native grasses appear. Juniper covers the foothills of the mountains, and a scattering growth extends down to the vicinity of Whiterocks.

Land values depend upon type of soil, location, improvements, and supply of irrigation water. The most desirable farm land, with good water right, in the alluvial valleys, on soils of the Redfield and Navajo series, for example, sells for \$50 to \$100 an acre. Desirable improved bench-land types, such as certain of the Bennett or Mesa series, are valued at \$40 to \$75 an acre. Good pasture-land types are worth \$10 to \$20 an acre. There is a very wide variation in land values on all types of soils, however, on account of unusually varied conditions.

The residual soils, i. e., those derived through weathering in place from the country rocks—shale and sandstone rocks of Tertiary age—are found principally on the uplands in the eastern part of the area, with scattered small areas elsewhere. They are often shallow and stony, the stone in some places consisting of angular fragments of sandstone, and in others of waterworn quartzite cobbles and boulders derived from a capping of old river-laid gravels from which the finer material has been removed by erosion. They are small in extent and are represented by the soils of the Shavano and Chipeta series.

The Shavano series of soils consists of dull-red or dark-red soils and subsoils, derived from red, or dark-red sandstone and shale. The subsoil is usually finer textured and somewhat more compact in the upper part than the surface soil. Surface and subsoil materials are distinctly calcareous, but there is no conspicuous concentration of lime anywhere in the soil section. The topography is undulating or rolling to slightly dissected. Soils of this series rest on bedrock at depths of 3 to 6 feet. Rock outcrops are numerous. The drainage is good. The content of alkali salts in these soils is very low.

The soils of the Chipeta series are residual from gray, brownish-gray, or yellowish-gray shale. The soils and subsoil are light gray, gray or light brownish gray and generally shallow. They are highly calcareous, but the lime is quite uniformly distributed. The topography is rolling to eroded. The drainage is good.

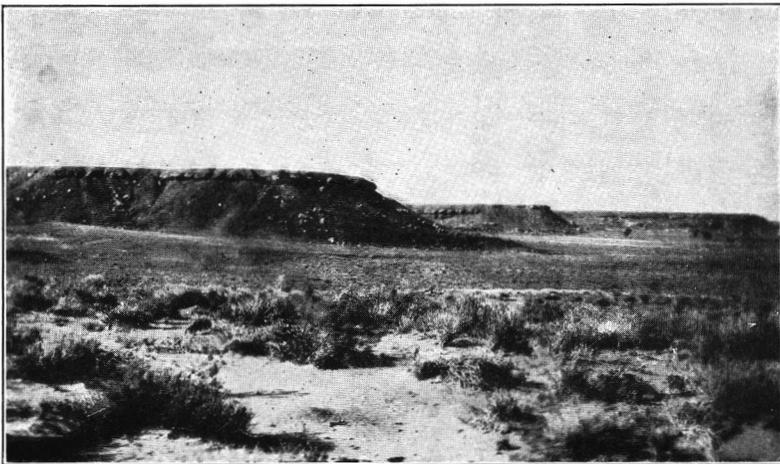
The old valley-filling soils are derived from alluvial-fan and terrace deposits of the streams of the Uinta Mountains. These deposits consist of material coming mainly from quartzite and sedimentary rocks. They have been laid down upon shale and sandstone rocks that underlie the Uinta Basin. A considerable part of these deposits, together with some of the underlying strata, has been removed by erosion. The old valley-filling soils are now confined to the upland mesa or plateau surfaces, with included small areas of stream terraces. These soils have been sensibly modified or altered in profile by weathering. Such modifications are indicated by the formation of compact and heavy subsoils, the concentration of lime at definite horizons, and partial cementation of the subsoil or substratum materials. They may be divided into soils with a gravel substratum and soils without



S. 11456.

**FIG. 1.—VIEW LOOKING EAST ACROSS VALLEY OF UINTA RIVER, 3 MILES SOUTH OF FORT DUCHESNE.**

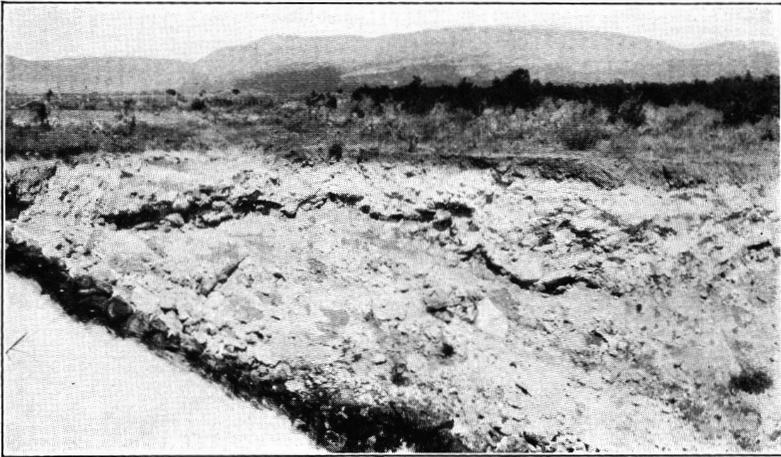
Soils of the Billings series in the foreground. Indian dwelling on right. Escarpment of Rough broken and stony land on left in distance



S. 11455

**FIG. 2.—VIEW OVERLOOKING LOCAL VALLEY OCCUPIED BY SOILS OF THE REDFIELD SERIES.**

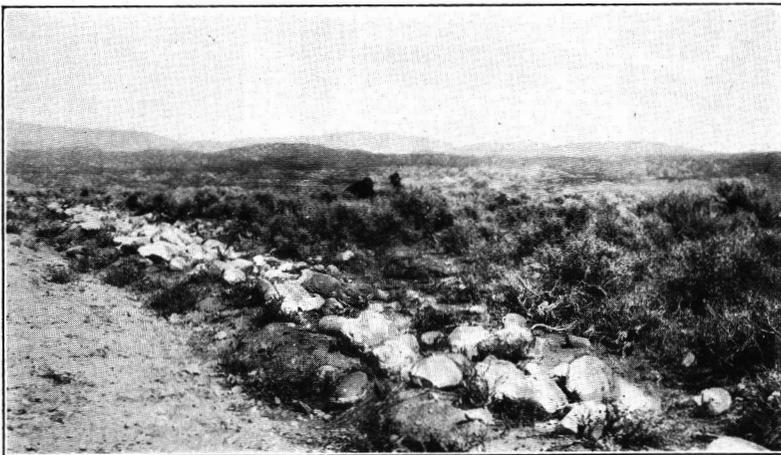
Escarpment in distance is formed by red shales and sandstones from which the materials of these soils are derived.



S. 11482.

**FIG. 1.—EXPOSED SECTION IN MESA FINE SANDY LOAM, ERODED BY SPILLWAY IN IRRIGATION CANAL.**

This shows stratum of lime accumulation and substratum of lime-cemented gravels.



S. 11484.

**FIG. 2.—VIEW LOOKING NORTH ACROSS BENCH OCCUPIED BY THE MESA FINE SANDY LOAM.**

Note typical topography, sagebrush vegetation, and lime-encrusted bowlders and cobbles thrown out by roadside.

a gravel substratum. They are classed in the Mesa, Bennett, Leeton, Moffat, Winslow, Navajo, and Billings series.

The Mesa series includes soils of light reddish brown, or pale-red to rather dull red color, the reddish tints being strongest in the moist soil. The subsoil has a high lime concentration at about 1½ to 3 feet below the surface, is of light-gray or light pinkish gray color, and of marly character. This highly calcareous material is underlain by or mixed with lime-coated gravel, forming a semihardpan, which becomes quite hard when exposed to the air. When saturated, however, the marly material becomes soft and penetrable by plant roots. The gravel substratum in most places appears between 2½ and 3½ feet below the surface. Waterworn gravel occurs on the surface of some areas and is a conspicuous feature on eroded areas. These soils occupy benches and have a prevailingly flattish to slightly undulating topography. The surface drainage is good, but internal drainage is somewhat restricted.

The soils of the Bennett series are closely related to the Mesa soils. They have the same origin and mode of formation, topography, general drainage conditions, native vegetation, and crop adaptations. They differ mainly in color. The soils are red to brownish red, or reddish brown. The deeper subsoil is high in lime, light gray to light pinkish gray in color, marly, and in most areas compact or partly cemented. It is underlain by or mixed with lime-coated gravel. The soils occupy benches and have a flat, or in the coarser textured types, undulating topography. The drainage is usually good.

The soils of the Leeton series are characterized by gray or dark-gray surface soils, without well-developed layers, and a flesh-colored to light pinkish gray marly clay subsoil, underlain by a substratum of lime-coated gravel embedded in marly clay. These are old-alluvial or river-terrace soils that have been altered by recent overwash by the Whiterocks and Uinta Rivers. The water table is high and the soils are moist during normal years, stimulating natural vegetation and causing accumulation of organic matter. The topography is gently sloping to flattish.

The soils of the Moffat series are derived from old alluvial-fan and other stream-laid deposits, modified to some extent by admixture of material from the sandstone and shale of near-by uplands. These soils are deep, fairly homogeneous, and prevailingly red in color. They do not have the gravel substratum of the Mesa and Bennett series, nor is the concentration of lime in the subsoil as great. There is a marked compaction, however, in the upper and lower parts of the soil profile, and a zone of lime carbonate accumulation between depths of 2 and 4½ feet. The soils occupy the upper slopes of the fans and in places the smoother parts of ridges. The topography is sloping and in places undulating. The drainage conditions are good.

The soils of the Winslow series are fine-textured desert-basin or playa soils of dark reddish brown or chocolate-brown color, developing in low, poorly drained basins. The soils have been derived principally from material washed down from adjacent uplands. They are highly calcareous and have a heavy, compact, and impervious subsoil. Only one type, the Winslow clay, is mapped in this area.

The soils of the Navajo series are derived from alluvial-fan material washed from areas of dark reddish brown to chocolate-brown shale.

Both surface soils and subsoils have a chocolate-brown color. The soils are of sufficient age to have developed compaction, but contain only slight indications of a zone of lime accumulation. They are deep soils occupying slopes of smaller valleys. The drainage is usually good.

The Billings series includes types with light-gray, light brownish gray, or light grayish brown, highly calcareous surface soils and subsoil, which have developed a compact and columnar structure but show very little, if any, concentration of lime in the subsoil. These soils occur in the valleys of intermittent streams in the form of alluvial fans and footslopes. They are derived mainly from the same light-gray to gray shale that gives rise to the Chipeta series. In this area the Billings soils contain considerable gypsum.

The recent-alluvial soils of the area occupy stream bottoms and low recent stream terraces and alluvial-fan slopes, the latter predominating. Some of the alluvial-fan areas occupy rather elevated slopes, but in profile the soils and subsoil here are nearly uniform and typically without the zonation due to age and typifying the series last described. In places the soil materials are stratified and the subsoil may consist of varitextured layers alternating without regular order. Unlike the old valley-filling soils, the recent-alluvial soils are in process of accumulation. Surface drainage is less well developed, low-lying areas are subject to overflow, and as a rule the soils have a higher moisture-holding capacity than the old valley-filling soils. These soils are of mixed origin; some consist of materials directly deposited by streams from the Uinta Mountains, some of reworked material derived from the valley-filling soils, and some of wash from residual soils of the adjacent hills. The alluvial group includes the soils of the Redfield, Naples, Ashley, and Green River series.

The soils of the Redfield series are light-red, red, or dull-red in color. The profile is typically uniform, but a slight compaction may develop when the material approaches the age and character of the soils of the related, older Moffat series. Surface soil and subsoil are highly calcareous, the lime being uniformly distributed through the profile. The soil material is in places stratified, but rarely contains gravel. It is derived mainly from red sandstone and shale. These soils occupy sloping to nearly level alluvial fans and stream bottoms. (Pl. XLV, fig. 2.)

The types of the Naples series have light-brown or light reddish brown to pale-red surface soils and subsoil. They differ from the types of the Redfield series only in color, being uniformly calcareous, very slightly compact in the subsurface, and showing no accumulations of lime in the subsoil. The light color range of this series is due to the light color of the parent material.

The soils of the Ashley series are recent-alluvial or first-bottom soils subject to overflow. They are derived from material washed from the sedimentary rocks of the mountains. The surface soils and subsoil are light brown to light grayish brown or somewhat reddish brown. The substratum consists of waterworn gravel and cobblestones. This layer normally appears within the 6-foot section. In the present survey the series is mapped to include some areas of rather pronounced reddish color. Some areas of dark-colored soils

are mapped as phases. Both surface and subsoil materials are decidedly calcareous; the lime, however, is uniformly distributed through the profile.

The soils of the Green River series are derived from sediments washed mainly from light-colored sedimentary rocks and their associated soils. The areas lie in first bottoms and are subject to overflow. Both the soil and subsoil are light-gray or light brownish gray, and both are strongly calcareous, the lime being evenly distributed through the profile. The subsoil is stratified, but contains no compact layers. The areas of these soils have a rather uneven surface, being entrenched by overflow channels. Mounds and irregularities are common in the types of coarser texture.

The wind-laid soil group is of minor importance in the present area, being represented by only one type, correlated with the Sheppard series. This soil has been derived from near-by soils, the material having been blown up into hillocks or low dunes.

The Sheppard series includes types with pale-red to red soils and subsoil. These are loose, deep soils, the surfaces of which have an undulating to hummocky topography typical of wind-blown soils. There is no visible change in structure throughout the soil profile. The surface soil is noncalcareous, or only feebly calcareous, but the subsoil below 12 inches contains a moderate quantity of lime, which is quite uniformly distributed.

The miscellaneous materials include Dunesand of which there are a few small areas, and Rough broken and stony land, covering a little more than one-third of the area surveyed.

The various soil types are described in detail in subsequent pages of this report, their distribution is shown on the accompanying soil map, and their actual and relative extent are given in the table following.

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Rough broken and stony land	66,176	34.7	Mesa fine sand	4,288	2.3
Ashley fine sand	1,344	4.8	Billings clay	3,136	1.9
Red stony phase	5,120		Shallow terrace phase	640	
Stony phase	1,856		Green River silty clay loam	2,752	1.9
Dark phase	704	Swamp phase	1,024		
Ashley fine sandy loam	1,984	4.5	Green River fine sandy loam	3,584	1.9
Dark stony phase	5,184		Bennett loam	3,264	1.7
Stony phase	1,344		Mesa clay loam	2,176	1.5
Redfield fine sand	8,384	Poorly drained phase	334		
Bennett fine sandy loam	3,840	Heavy phase	256		
Heavy phase	3,456	4.3	Billings fine sandy loam	2,432	1.4
Stony phase	512		Gravelly phase	256	
Gravelly phase	448		Winslow clay	2,304	1.2
Shavano fine sand	8,000	4.2	Bennett stony fine sandy loam	1,024	1.1
Mesa fine sandy loam	6,272		Poorly drained phase	1,088	
Stony phase	832	4.0	Green River silt loam	1,856	1.0
Gravelly phase	512		Leeton clay loam	1,856	1.0
Redfield silty clay loam	3,584	3.2	Bennett fine sand, wind-blown phase	1,728	.9
Heavy phase	2,560		Billings stony clay loam	1,664	.9
Redfield fine sandy loam	5,376	2.8	Leeton fine sandy loam	1,408	.7
Navajo clay	5,376		Chipeta clay	512	.3
Naples fine sand	4,224	2.7	Naples fine sandy loam	320	.2
Shallow terrace phase	1,024		Dunesand	320	.2
Redfield loam	1,120	2.4			
Sheppard fine sand	4,698				
Moffat fine sandy loam	3,776	2.4	Total	190,720	
Heavy phase	832				

## SHAVANO FINE SAND.

The Shavano fine sand is a red fine sand of slightly sticky and loamy character throughout soil and subsoil, resting on sandstone of prevalingly red color. In the virgin condition the profile shows (1) a thin desert crust and mulch, with a combined thickness of 2 inches; (2) a slightly compact layer about 3 inches thick; and (3) a less compact layer to an average depth of 3 feet. As mapped in this survey the type includes some areas of rather dark red color and heavy texture.

This type occupies undulating to rolling sandstone ridges and slopes. The surface is hummocky or uneven, broken frequently by rock outcrops. The drainage conditions are excellent, the downward movement of water through the soil being unimpeded and the run-off rapid. This is one of the more extensive types in this area. It is developed principally among the sandstone hills and ridges in the eastern part.

Less than 5 per cent of this soil is under cultivation, because of the unevenness of its surface and its droughty nature. The native vegetation is largely sagebrush and rabbit brush. The type is adapted to alfalfa, sweet clover, and potatoes. Deeper areas are admirably suited to orchard fruits, where climatic conditions are favorable.

The following table gives the results of mechanical analyses of samples representing different layers of the Shavano fine sand:

*Mechanical analyses of Shavano 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.	<i>Per cent.</i>
520901	Crust, 0 to ¼ inch.....	0.4	2.5	5.7	54.7	20.8	6.9	8.8
520902	Mulch, ¼ to 2 inches.....	.6	1.8	4.7	54.4	21.4	7.0	10.5
520903	Subsurface, 2 to 5 inches.....	.6	3.0	7.9	61.7	9.2	5.0	12.5
520904	Subsoil, 5 to 36 inches.....	.0	.8	3.5	65.4	19.2	4.9	6.1

## CHIPETA CLAY.

The surface material of this type, in the virgin condition, consists of a light-gray desert crust of clay texture, three-fourths to 1 inch in thickness, underlain by a loose mulch of the same texture and color to a depth of 3 inches. From 3 to 6 inches is a very compact clay layer, also light gray in color. Scattered clusters of gypsum crystals occur in this layer and in the deeper subsoil. From 6 inches to an average of 18 inches the subsoil is a slightly less compact light-gray clay, below which appears the bedrock, consisting of thin-bedded, gray Green River shales. The lower part of the soil profile normally carries large quantities of small angular shale fragments. As mapped the type includes some minor variations of reddish or pinkish color, resulting from the admixture of material of the Shavano series.

The topography is rolling to dissected. The drainage conditions are good, but the shallowness of the type makes it undesirable for

crop production. It occurs in three isolated areas in the southeastern part of the survey. About 3 miles southeast of Randlett is an area of flattish topography, a variation of the type, which was included because of its small extent.

None of the Chipeta clay is in cultivation. The native vegetation consists of a very sparse growth of shadscale and saltbush.

#### SHEPPARD FINE SAND.

The Sheppard fine sand is a light-red, pinkish-red, or pale-red, loose fine sand to a depth of 72 inches or more. It occurs only on the upland areas in Colorado Park. The topography is undulating or gently rolling, the surface being uneven and billowy.

Drainage is excessive, and the type, having little power to hold water, is droughty. It drifts badly, and is not adapted to cultivation unless protected by windbreaks. None of it has been improved.

The natural vegetation consists of sagebrush, greasewood, rabbit brush, and sparse bunch grass. It furnishes scant pasturage for cattle and sheep.

#### MESA FINE SAND.

The Mesa fine sand, in the virgin condition, to a depth of 5 inches consists of loose, light pinkish brown to light reddish brown fine sand, having an incipient crust and mulch development. From 5 to 15 inches is a slightly compact layer, composed of material of the same texture and color as that above, and this is underlain to a depth of 48 inches by a loose light reddish brown fine sand. The deeper subsoil, below 48 inches in most areas, consists of lime-coated gravel embedded in light pinkish gray compact calcareous material. Below 72 inches the interstitial material varies from a reddish light fine sandy loam to a heavy loam. As mapped some of the areas are rather loamy, and some material as light as fine sandy loam may be included.

The type has a gently sloping to undulating topography. The surface is rather more uneven than in the finer textured types of this series. The drainage is good, as the substratum is usually not compact enough seriously to retard percolation. The water-holding power is, however, rather low.

This type is not extensively developed in this area, being confined to a few bodies in the Colorado Park district near Green River. The native vegetation is cactus, torchweed, greasewood, and some sagebrush. None of the type is in cultivation. This soil is adapted to the production of potatoes, vegetables, alfalfa, and sweet clover. In sheltered positions it is suited to the growing of orchard and small fruits. The principal drawbacks to the cultivation of this type, as it occurs in this area, are its tendency to drift and the difficulty in reaching it with irrigation water. The main areas are 20 miles or more from the source of irrigation water, in a comparatively little developed part of the area. When the facilities for irrigation are increased, it should be utilized to a considerable extent.

The table below gives the results of mechanical analyses of samples of different parts of the profile of the Mesa fine sand:

*Mechanical analyses of Mesa 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.	<i>Per cent.</i>
520909	Soil, 0 to 5 inches .....	0.2	11.8	20.6	60.1	4.1	1.0	2.1
520910	Subsurface, 5 to 15 inches ..	1.2	7.2	13.2	55.2	13.6	4.5	5.1
520911	Subsoil, 15 to 48 inches.....	.5	5.9	11.6	52.4	18.6	5.7	5.1
520912	Subsoil, 48 to 60 inches.....	.2	1.1	1.9	32.4	32.3	24.6	7.5

## MESA FINE SANDY LOAM.

The surface material of the Mesa fine sandy loam, in the virgin condition, consists of a thin crust of light grayish brown fine sandy loam, underlain by a light reddish brown fine sandy loam mulch, the two having a combined thickness of 2 inches. Below this to a depth of 18 inches is a moderately compact light reddish brown fine sandy loam, somewhat more compact in the upper 6 inches than in the lower part. The subsoil is a compact light pinkish gray to nearly white, marly clay, extending to an average depth of 24 inches, where a lime-coated gravel substratum appears. The interstitial material of the gravel substratum to a depth of about 48 inches to 60 inches is like the marly material above it. (Pl. XLVI, fig. 1.) Below 48 inches the interstitial material is a brownish-red loam. The surface soil is rather compact, and noticeably sticky when moist, approaching a loam in physical characteristics. In the more northern part of the area the subsoil has the character of a semihardpan.

This type occupies gently sloping to flattish mesa tops. In places it is undulating, particularly near the edges of the mesas, along the draws, or near the heads of the intermittent streams. The surface is generally smooth and free from irregularities. (Pl. XLVI, fig. 2.) Surface drainage is good, but underdrainage is rather sluggish in the flatter areas.

This type is developed on the southern ends of both the White-rocks and Indian Benches and in the northern and western parts of Colorado Park. The native vegetation consists of rabbit brush, greasewood, some shadscale, sheepsage, matchweed, and a sparse growth of galleta grass. About half of the type is in cultivation. It yields good crops of alfalfa, clover, and small grains, and is considered one of the best bench-land soils of the area. Although the soil is a little shallower than that of the heavier members of the series, it is, because of the somewhat better drainage conditions, less likely under irrigation to suffer from surface accumulations of alkali.

*Mesa fine sandy loam, gravelly phase.*—The gravelly phase closely resembles the typical Mesa fine sandy loam, differing from it mainly in that the upper soil layers carry considerable quantities of water-worn gravel. Also, the marly subsoil and the gravel substratum are, as a rule, closer to the surface.

The surface soil of this phase, in the virgin condition, consists of 2 inches of crust and mulch of light pinkish gray to light reddish brown gravelly fine sandy loam, underlain to a depth of 12 inches by a compact light reddish brown gravelly fine sandy loam. The subsoil, consisting of lime-incrusted gravel in a marly clay matrix, extends to a depth of about 48 inches, below which there is a gradation into

beds of clean gravel, mixed with reddish-brown loam. This rests upon sandstone or shale at a depth of 5 to 10 feet below the surface.

The topography varies from gently undulating or sloping, as on the crests of larger mesas, to eroded and dissected surfaces, particularly on narrower flat-topped ridges, small mesas, and along the rims of the larger mesas. Surface drainage is excellent, and the internal movement of water fairly free.

Only a few small areas of this phase are mapped. They are confined to the southeastern part of the area. Some narrow strips lie along the edges of the larger benches, but these were mapped with larger bodies of adjacent bench-land soil. None of the phase is under cultivation. The native vegetation consists chiefly of cactus, shadscale, and saltsage. In elevated and droughty positions the vegetation is very scant. Most of the type is unsuited to cultivation because of its high content of gravel, uneven topography, and shallowness. Flatter areas of the phase, situated favorably as regards irrigation, are adapted to alfalfa, clover, and grain.

*Mesa fine sandy loam, stony phase.*—The stony phase of the Mesa fine sandy loam also resembles the typical Mesa fine sandy loam, except that large quantities of rounded quartzite cobbles and coarse gravel occur on the surface and throughout the soil section. In the virgin condition it consists of a light reddish brown fine sandy loam crust and mulch to a depth of  $1\frac{1}{2}$  inches, underlain to a depth of 18 inches by a light reddish brown moderately compact very stony fine sandy loam, the upper 6 inches of which is more compact than the lower part. From 18 inches to 60 inches appears the bed of lime-incrusted gravel and cobblestones embedded in light pinkish gray marly clay. Below 60 inches the interstitial marly material is largely displaced by brownish-red loam or fine sandy loam.

This phase occurs south and east of Leeton on the slightly undulating to nearly flat northern end of Indian Bench. The surface is somewhat uneven. Drainage is good. The vegetation consists almost entirely of sagebrush and matchweed. Only about 10 per cent of it is in cultivation, because of its stony character. When cleared of the larger stones the land produces good crops of alfalfa, clover, and small grains.

The table below gives the results of mechanical analyses of samples representing different layers of the typical Mesa fine sandy loam:

*Mechanical analyses of Mesa 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.	<i>Per cent.</i>
520913	Crust, 0 to $\frac{1}{4}$ inch.....	0.9	3.3	4.4	23.3	30.2	19.0	8.9
520914	Mulch, $\frac{1}{4}$ to 2 inches.....	.7	3.4	4.8	34.2	30.1	17.4	9.5
520915	Subsurface, 2 to 18 inches.....	.6	3.0	4.6	32.6	24.0	15.9	19.2
520916	Subsoil, 18 to 32 inches.....	.2	4.4	6.2	21.9	11.0	12.2	44.1

MESA CLAY LOAM.

The surface material of the Mesa clay loam, in the virgin condition, consists of desert crust and mulch 2 inches deep, the material of which is of clay loam texture, of less red color than typical of the series. From 2 inches to 10 inches there appears a moderately compact layer of light reddish brown rather light textured clay loam, and this is under-

lain by less compact material of similar texture extending to an average depth of 24 inches. Below this appears a layer of light pinkish gray to nearly white, compact, marly clay about 18 inches thick. At an average depth of 42 inches the typical layer of lime-coated gravel embedded in marly clay is encountered and this continues without change to the bottom of the 6-foot profile. The illustration, Figure 2, shows the profile of this soil graphically.

The type occurs on flattish mesa tops, which slope gently to the southward. The surface is prevailingly smooth, though marked here and there by slight depressions and small patches of higher land, in which the soil is not as deep as usual and gravel sometimes shows on the surface.

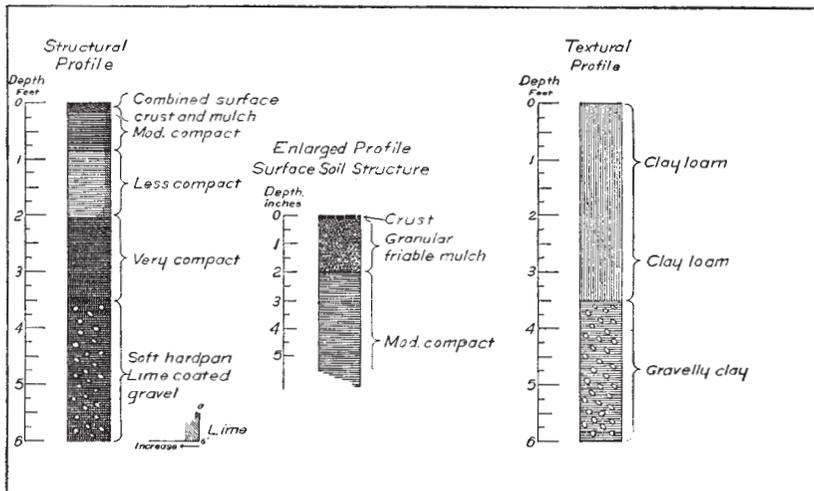


FIG. 50.—Textural and structural profiles of the Mesa clay loam.

The surface drainage conditions are in general good, because of the relatively elevated position of the type. The internal drainage is, however, noticeably sluggish, owing to the compact subsoil. The water-holding capacity of the type as a whole is good, excepting small areas in which the soil is shallow.

This type occurs on a few small mesas in the Tridell district, in an area containing about  $1\frac{3}{4}$  square miles in the northern part of Indian Bench, and in others on the western side of Colorado Park. About 40 per cent of it is cultivated. The native vegetation is mainly shadscale, rabbit brush, and greasewood.

Much of the area on Indian Bench is cultivated and the soil is considered an excellent one for general farming. Sweet clover, alfalfa, and small grains do well. It is also suited to garden crops and potatoes.

The sluggish internal drainage, with excessive irrigation, has caused some injury from surface accumulation of alkali. A few fields have been abandoned for crop production on this account and are at present utilized for pasture.

*Mesa clay loam, poorly drained phase.*—The poorly drained phase of the Mesa clay loam consists of friable, faintly reddish brown clay

loam without development of the crust and mulch layers, extending to a depth of 18 inches, underlain by a sticky, calcareous light pinkish gray clay, which at an average depth of 36 inches rests upon the typical gravel substratum.

The phase occupies poorly drained swales or depressions. It is constantly saturated or in a semimarshy condition during the irrigating season. Only a few small areas are mapped. These lie along the eastern side of Indian Bench.

None of the phase is cultivated, but it is all utilized as pasture. The vegetation is a dense growth of salt grasses, wire grass, redtop, foxtail, and cat-tail rushes.

*Mesa clay loam, heavy phase.*—The Mesa clay loam, heavy phase, is a deeper soil than the typical Mesa clay loam and has prevailing a finer texture. The surface materials consist of a thin crust of light-brown color underlain by a well-developed mulch, about 3 inches thick, of light-brown or light reddish brown color, both crust and mulch having a heavy clay loam texture. From 3 inches to 12 inches appears a light reddish brown compact heavy clay loam; from 12 inches to 36 inches the material is the same but only moderately compact. The subsoil below 36 inches to a depth of 48 inches is a light-gray or light pinkish gray, compact, marly clay. This rests on the typical lime-incrusted gravel embedded in marly clay.

The topography is nearly flat, and the surface smooth. Drainage is only fair, because of slow run-off, and the subsoil is compact enough to impede the movement of water through the soil.

Only two areas of this phase are mapped, both in the western part of Colorado Park. None of this phase is under cultivation, though it is adapted to alfalfa, clover, and small grains, particularly. The water-holding capacity is excellent, and it should prove a desirable soil. The native vegetation is shadscale, greasewood, and rabbit brush.

The following table gives the results of mechanical analyses of samples of different layers of the typical Mesa clay loam:

*Mechanical analyses of Mesa clay 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.	<i>Per cent.</i>
520925	Crust, 0 to ¼ inch.....	0.2	1.0	1.2	11.3	33.4	32.1	20.9
520926	Mulch, ¼ to 2 inches.....	.1	1.0	1.2	13.3	29.9	31.1	23.4
520927	Subsurface, 2 to 24 inches...	.4	2.6	3.0	17.4	33.0	23.5	20.1
520928	Subsoil, 24 to 42 inches.....	.4	1.8	2.6	10.4	5.2	27.2	52.3

BENNETT STONY FINE SANDY LOAM.

The surface material of the Bennett stony fine sandy loam, in the virgin condition, is a light-red to reddish-brown stony fine sandy loam having a crust and mulch structure to a depth of 2 inches. This is underlain by a moderately compact red or dull-red stony fine sandy loam extending to 12 inches, below which is a bed of waterworn lime-coated cobbles and gravel embedded in light pinkish gray, compact, marly clay.

The topography is undulating and the surface rather uneven. Surface drainage generally is good, but internal drainage is rather sluggish.

This type is not extensive within the area. It occurs on the small table-land on which Bennett is situated, and also on the bench 1 mile southeast of Lapoint.

About 30 per cent of the type has been cleared of the larger stones and placed in cultivation. Good crops of clover and alfalfa are obtained. The native vegetation on this type is largely sagebrush and rabbit brush.

*Bennett stony fine sandy loam, poorly drained phase.*—The soil of the poorly drained phase of the Bennett stony fine sandy loam, to a depth of 24 inches, consists of a reddish-brown friable stony fine sandy loam. The entire soil profile is stony, the stones being mainly water-worn quartzite. The subsoil to a depth of 72 inches is a sticky, plastic, light pinkish gray, marly clay mixed with lime-incrusted gravel and cobblestones.

This phase occupies depressed positions, and the drainage is notably poor, the areas being in swampy condition most of the year. It occurs in an area of considerable size around the head of Montes Creek, and in smaller areas 4 miles north of Fort Duchesne, bordering the Uinta River bottoms, and 2 miles south of Lapoint. It is useless for anything but pasture, and is used entirely for grazing. It supports a native growth of salt grass, wire grass, redtop, foxtail, greasewood, inkweed, and a few willow bushes. It as a rule carries excessive quantities of alkali salts.

The results of mechanical analyses of samples of the typical Bennett stony fine sandy loam are given in the following table:

*Mechanical analyses of Bennett stony fine sandy loam.*

[Fine earth.]

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.	<i>Per cent.</i>
520949	Crust, 0 to ¼ inch.....	0.3	2.9	4.7	33.5	27.2	19.7	12.0
520950	Mulch, ¼ to 2 inches.....	.5	3.2	5.2	40.9	29.8	11.5	9.1
520951	Subsurface, 2 to 12 inches.....	1.8	5.6	7.5	35.6	28.0	12.5	8.7
520952	Subsoil, 12 to 48 inches.....	1.8	5.4	7.6	24.5	13.9	16.6	30.3

BENNETT FINE SAND, WIND-BLOWN PHASE.

The Bennett fine sand is not typically developed in this area, but is represented by a wind-blown phase. In the virgin condition the soil consists of a light-red or light brownish red, loose fine sand, 36 inches deep, underlain by a loose fine sandy loam of the same color. Below an average depth of 60 inches appears a compact bed of lime-incrusted gravel and light pinkish gray, marly fine sandy clay. A scattering of very small lime-incrusted quartzite pebbles is commonly found on the surface.

This phase occurs on the Colorado Park table-lands and upper slopes. In general the topography is undulating, and in detail billowy. The characteristic marly subsoil of the Bennett series lies at variable depths, owing to variation in depth of the soil. Small areas of deeper wind-blown soil of the Sheppard series are included, and some areas of a light pinkish brown or pale reddish brown soil belonging to other series are also included because of their small extent.

Both surface drainage and internal drainage are good. The areas are distant from a supply of irrigation water, and none of the type is cultivated at present. The native vegetation consists of sagebrush, greasewood, matchweed, and a sparse growth of galleta grass.

BENNETT FINE SANDY LOAM.

The upper 3 inches of the Bennett fine sandy loam, in the virgin condition, consists of a slightly developed crust and mulch of brownish-red fine sand or fine sandy loam. From 3 inches to 24 inches appears a slightly compact layer of brownish-red fine sandy loam of light texture, becoming more friable with depth. The substratum below 24 inches consists of lime-coated gravel and light-gray or light pinkish gray marly material, rather compact or in some places of loosely cemented hardpan. Below 60 inches the interstitial material changes from the marly material to a loose reddish-brown loam or fine sandy loam.

This type occupies the tops of table-lands or mesas, and also higher slopes extending to an elevation above 6,500 feet on the northern end of Whiterocks Bench. In places erosion has removed some of the soil, bringing the subsoil near the surface. The drainage is excellent. The surface is fairly smooth to slightly uneven and locally slightly modified by hillocks of wind-blown material. The water-holding power is only moderate, making frequent irrigation necessary.

The larger part of Whiterocks Bench is covered with this type of soil. Smaller areas lie in the southeastern part of Colorado Park. A long, narrow strip, occupying a lower and more recent stream terrace, runs through Fort Duchesne, paralleling the course of the Uinta River.

About half of the total area of this type is under cultivation. Good crops of alfalfa, sweet clover, and small grains are obtained, almost all of the acreage in cultivation being devoted to the production of these crops. This soil is easily worked and productive. Very little trouble is experienced with alkali. The large body of the type on Whiterocks Bench is situated close to irrigation-water supply, and is practically all under cultivation. The native vegetation is largely sagebrush, rabbit brush, and a scattering growth of galleta grass. Above 6,000 feet juniper trees and sagebrush predominate.

*Bennett fine sandy loam, stony phase.*—The Bennett fine sandy loam, stony phase, in the virgin condition, has a crust of light-brown or light reddish brown fine sandy loam, and a mulch of reddish-brown fine sandy loam, the two having a thickness of 2 inches. A moderately compact layer of red fine sandy loam extends from 2 to 8 inches, below which a fairly open and friable red fine sandy loam extends to a depth of 24 inches. A very stony and gravelly substratum underlies this, the stones being embedded in hard marly material, light pinkish gray in color. Waterworn cobblestones and large gravel are plentifully scattered over the surface, and are very abundant throughout the soil profile.

The topography is fairly level, though in detail the surface tends to be uneven, being in places marked by small low ridges. The surface drainage is good, but the internal drainage is only fair.

This phase, which is inextensive, occupies part of the table-land southeast of Lapoint, and a lower stream terrace about  $2\frac{1}{2}$  miles southeast of Bennett. On account of its stony nature only small areas are cultivated—in all, about 25 per cent of the total area. When cleared of stones, the soil produces good alfalfa, clover, and small grains. The native vegetation is principally sagebrush and greasewood.

*Bennett fine sandy loam, gravelly phase.*—The soil of the gravelly phase of the Bennett fine sandy loam in virgin areas consists of a thin crust and mulch of a red or a brownish-red gravelly fine sandy loam, 2 inches thick, underlain to a depth of 12 inches by a rather compact, red gravelly fine sandy loam. This rests upon a bed consisting of lime-coated gravel embedded in light pinkish gray marly clay, extending to a depth of about 48 inches. A gravel substratum extends to bedrock, appearing at 5 to 10 feet below the surface.

This is an unimportant soil occupying eroded rims or edges of large mesas and the tops of small eroded ridges. The topography is undulating to rather rolling and in most places uneven and irregular in detail. The surface drainage is excellent.

Small isolated areas of this phase occur in various parts of the area surveyed. In an area occupying a low terrace position 3 miles northwest of Randlett, the concentration of lime in the subsoil is not as marked as is typical.

About 5 per cent of this phase is sowed in alfalfa and clover. The rest is virgin land, part of which is used for pasture. The native vegetation is shadscale, saltsage, and galleta grass.

*Bennett fine sandy loam, heavy phase.*—The surface material of the Bennett fine sandy loam, heavy phase, consists, in virgin areas, of a reddish-brown or dull-red fine sandy loam crust, about one-fourth inch thick, underlain by a mulch to a depth of 2 inches of similar color and texture. This is underlain by a compact red or brownish-red fine sandy loam, grading at about 8 inches into less compact material of the same character, which continues to a depth of 18 inches. The subsoil below this consists of compact, light pinkish gray, marly material, which extends to 32 inches before the lime-coated gravel substratum is encountered. This layer is in places partly cemented, especially in the areas on higher elevations. Below an average depth of 60 inches the interstitial marly material is supplanted by a brownish-red loam. The soil is sticky when wet, is of somewhat heavier texture than the typical Bennett fine sandy loam, and tends to pack and clod under cultivation.

This phase is a moderately level table-land soil, with a total extent of about 5 square miles. The surface as a rule is smooth, becoming slightly irregular toward the edges or rims of the mesas. Drainage in general is good, though the internal movement of water is restricted and in places sluggish. The soil has fairly good water-holding capacity, except in shallow or eroded spots.

The high mesa  $1\frac{1}{2}$  miles east of Lapoint, which is covered with this phase, is unimproved at present because of the difficulty in reaching it with irrigation water. Other areas lying about 2 miles southeast and 3 miles south of Lapoint are largely developed. On the west side of the Uinta River, about 1 mile above the mouth of Dry Gulch, is a lower terracelike area; this also is under cultivation.

This heavy phase is a desirable soil, well adapted to the general crops of the region. It returns good yields of alfalfa, sweet clover, wheat, oats, and potatoes. Vegetables do well. Small fruits are raised successfully in small quantities.

The table below gives the results of mechanical analyses of samples of the different layers of the typical Bennett fine sandy loam:

*Mechanical analyses of Bennett fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
520935	Crust and mulch, 0 to 3 inches	<i>Per cent.</i> 0.6	<i>Per cent.</i> 3.0	<i>Per cent.</i> 4.6	<i>Per cent.</i> 47.4	<i>Per cent.</i> 30.4	<i>Per cent.</i> 6.2	<i>Per cent.</i> 7.9
520936	Subsurface, 3 to 24 inches	1.0	3.4	4.8	41.0	30.2	8.2	11.5
520937	Subsoil, 24 to 60 inches	.8	3.1	4.1	29.4	30.0	15.0	17.7

BENNETT LOAM.

The Bennett loam, in the virgin condition, consists of 2 inches of desert crust and mulch of light reddish brown to red loam, underlain to a depth of 10 inches by a moderately compact red or brownish-red loam of rather light gritty texture. From 10 inches to 24 inches the material is of the same character but less compact. From 24 inches to 42 inches the material is a light-gray or light pinkish gray compact marly clay; below this it consists of lime-coated gravel embedded in marly clay.

This type occupies table-lands, with a prevailingly flat and fairly smooth surface. In places, especially near the edges of the mesas, the surface becomes slightly undulating. The surface drainage is good, but the internal drainage is sluggish, owing to the compact subsoil. The water-holding capacity is good.

The Bennett loam occurs in the west-central part of the area. It occupies the main part of Indian Bench, and the narrow bench lying on the west, as well as lower benches west of Fort Duchesne. About 60 per cent of the type is cultivated. It produces good crops of wheat, oats, sweet clover, and alfalfa. Some of the flatter areas are likely to become saturated unless care is taken in irrigating. Crops have been ruined by the rise of alkali where excessive quantities of water have been used.

This type is suited to the production of the general farming crops, as well as vegetables and small fruits. It is considered a very desirable soil, and where favorably situated as regards irrigation has been largely developed. The natural vegetation is rabbit brush, greasewood, shadscale, matchweed, and some galleta grass.

LEETON FINE SANDY LOAM.

The Leeton fine sandy loam consists of a friable gray or dark-gray fine sandy loam, with a depth of 15 inches, underlain by a light pinkish gray, sticky, plastic, highly calcareous subsoil. This extends to a depth of 36 inches, more or less, where it rests upon beds of lime-coated gravel embedded in material like that above. When moist the surface soil is noticeably sticky and loamy.

The topography is nearly flat and in most places smooth, though it may be somewhat irregular where floods, which sometimes cover parts of this type during the spring freshets, have left erosions. Both surface drainage and internal drainage are poor, owing to the low position of the areas and to the plastic subsoil.

This soil occupies a considerable tract north of Leeton, but only a small part, about 5 per cent of the total, is cultivated. It produces excellent crops of vegetables, small grains, and sweet clover. The native vegetation consists of cottonwood trees, buffalo and squawberry bushes, willow bushes, and a dense growth of salt grass, wire grass, foxtail, reedtop, and other grasses. It furnishes excellent pasturage for beef cattle, horses, and sheep.

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

*Mechanical analyses of Leeton 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.	<i>Per cent.</i>
5209142	Soil, 0 to 15 inches .....	0.0	0.9	2.8	39.6	31.2	13.1	12.3
5209143	Subsoil, 15 to 36 inches .....	.0	1.2	3.0	36.9	27.7	26.2	5.0

#### LEETON CLAY LOAM.

The Leeton clay loam consists of 12 inches of dull-gray to dark-gray, friable clay loam, underlain to a depth of 36 inches by a sticky, plastic, flesh-colored, marly clay, which becomes light pinkish gray in color on drying. The substratum consists of lime-coated gravel embedded in marly clay. This type is similar to the Leeton fine sandy loam in all essentials, except that it has a heavier texture.

The more important areas of this type are in the vicinity of Leeton and south of the southern end of Whiterocks Bench.

The type supports an excellent growth of grasses and is used entirely for pasture. The drainage is very poor, but the type does not show signs of alkali accumulation, probably because of its nearness to permanent streams and frequent flooding by water from the mountains. Where artificial drainage can be installed economically, this type should prove highly productive for such crops as corn, wheat, and oats.

The results of mechanical analyses of samples of the soil and subsoil of the Leeton clay loam are given in the following table:

*Mechanical analyses of Leeton clay 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.	<i>Per cent.</i>
5209144	Soil, 0 to 12 inches .....	0.0	1.6	1.6	16.5	27.4	27.2	25.7
5209145	Subsoil, 12 to 36 inches .....	.0	1.4	2.6	23.0	17.4	14.9	40.7

#### MOFFAT FINE SANDY LOAM.

The surface soil of the Moffat fine sandy loam, in the virgin condition, consists of a desert crust and mulch of light-red to red fine sandy loam, underlain to a depth of 15 inches by light-red to red

compact fine sandy loam of rather light texture. From 15 inches to 72 inches appears a light-red moderately compact fine sandy loam, containing scattered white specks and streaks. Accumulations of lime are present in the subsoil to a depth of about 48 inches.

This type occupies slopes and undulating rounded hills or low ridges. The surface is sloping and fairly even to slightly undulating. The drainage is good, and the water movement within the soil is unrestricted.

There are about 5 square miles of soil of this type. It occurs in the higher reaches of the smaller intermittent stream valleys east of Moffat and Fort Duchesne. In addition, several sizable areas lie on the divide east, west, and south of the old lake bed in Colorado Park. In these areas the surface in places is billowy, the result of wind action.

The native vegetation consists of sagebrush, shadscale, matchweed, rabbit brush, greasewood, and some galleta grass. About 20 per cent of this type is in cultivation at present. Most of it is situated far from water supply and has not been extensively developed. It is a desirable soil, fairly retentive of moisture, and in most places easily prepared for irrigation. Alfalfa, sweet clover, vegetables, melons, and small fruits are the principal crops grown. The yields of these are profitable.

*Moffat fine sandy loam, heavy phase.*—The heavy phase of the Moffat fine sandy loam, in the virgin condition, consists to a depth of 3 inches of a desert crust and mulch of red fine sandy loam, underlain to a depth of 20 inches by a red compact fine sandy loam of somewhat heavier texture and more loamy character than the typical Moffat fine sandy loam. From 20 to 72 inches it is a moderately compact red or light-red fine sandy loam, having a zone of lime accumulation to a depth of 48 inches consisting of scattered white specks and streaks of chalky lime material.

This phase occupies slopes in the upper parts of small valleys. The surface is sloping and fairly smooth. Drainage conditions are satisfactory. The soil retains moisture well.

The phase is not extensive, occurring mainly in the valley east of Moffat. About 5 per cent of it is under cultivation. Grain and alfalfa are grown. The soil is suited to a wide range of crops, however, including vegetables and fruits. The native vegetation is shadscale, rabbit brush, and sagebrush.

The table below gives the results of mechanical analyses of samples representing the different layers of the typical Moffat fine sandy loam:

*Mechanical analyses of Moffat 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.	<i>Per cent.</i>
520963	Crust, 0 to ¼ inch .....	1.1	3.4	6.0	36.2	36.0	6.9	10.3
520964	Mulch, ¼ to 3 inches.....	.6	2.8	5.7	39.6	32.1	7.8	11.9
520965	Subsurface, 3 to 15 inches...	.5	3.0	6.8	42.6	27.7	8.7	10.7
520966	Subsoil, 15 to 48 inches.....	.4	4.3	9.3	48.9	15.0	10.3	11.8
520967	Subsoil, 48 to 72 inches.....	.6	2.7	4.0	40.5	28.6	11.8	11.8

## WINSLOW CLAY.

The surface horizons of this type consist of a one-fourth to one-half inch desert crust of reddish-brown to dark reddish brown fine sandy loam to clay, underlain by a desert mulch of the same material to a depth of 3 inches. A very compact horizon of chocolate-brown clay underlies this to a depth of 15 inches, below which the material to 72 inches or more becomes slightly less compact with increasing depth. A columnar structure is well developed in this material.

The Winslow clay occupies flat or nearly flat desert basins. The drainage is very poor; in fact, there is no drainage outlet for the main body of this type in the center of Colorado Park. Internal water movement downward through the soil is slow.

This type is confined to several areas in Colorado Park. No attempt has been made to cultivate it, and until artificial drainage shall have been provided it would be useless to attempt to grow crops upon it.

The native vegetation consists of two species of saltbush (*Atriplex* sp.), with a scattering growth of small shadscale plants around the edges of the areas. There is no grass whatever.

The following table gives the results of mechanical analyses of samples of the Winslow clay:

*Mechanical analyses of Winslow clay.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
520972	Crust, 0 to ¼ inch .....	0.8	5.3	6.6	38.7	17.2	18.2	13.4
520973	Mulch, ¼ to 2 inches .....	.6	4.5	7.4	43.0	13.9	15.8	14.8
520974	Subsurface, 2 to 15 inches ---	.4	3.0	4.9	28.2	13.6	18.7	31.2
520975	Subsoil, 15 to 72 inches .....	.2	3.2	5.0	25.4	13.2	18.8	34.1

## NAVAJO CLAY.

The Navajo clay, in virgin areas, consists of a desert crust and mulch, about 2 inches thick, of dark reddish brown clay loam or clay, underlain to a depth of 15 inches by compact clay of the same color. Below this to 72 inches is a moderately compact chocolate-brown clay, sometimes containing a few small whitish specks or streaks of limy material. Vertical columnar structure is quite well developed in this material.

The Navajo clay occupies sloping alluvial fans which flatten out considerably on lower slopes. (Pl. XLVII, fig. 1.) The surface is fairly smooth. The surface drainage is good, though the internal water movement is somewhat sluggish, and as a result some of the lower flatter areas are sometimes waterlogged.

This type is best developed in the valley east of Whiterocks Bench. A large body lies southwest of Lapoint. An area extends along the east side of the Uinta River, and another occurs in lower Dry Gulch valley.

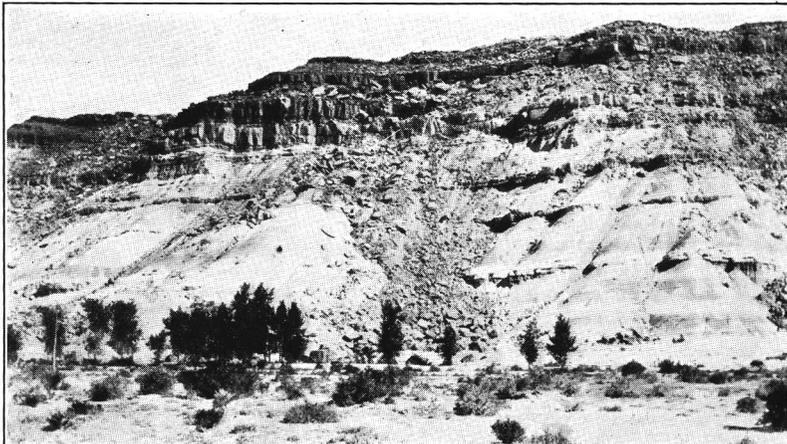
About half of this type is in cultivation. It is a strong general farming soil, particularly well adapted to alfalfa, clover, and small grains. Some corn is grown. The native vegetation consists of greasewood and rabbit brush.



S. 11486.

**FIG. 1.—VIEW OVERLOOKING SMALL INTERMITTENT STREAM VALLEY OCCUPIED BY THE NAVAJO CLAY.**

Note native vegetation of scattering sage on slopes and greasewood in vicinity of the meandering stream channel.



S. 11487.

**FIG. 2.—ERODED ESCARPMENT OF SANDSTONE AND SHALE NEAR RANDLETT.**

Steep rocky slopes of this character are included in Rough broken and stony land.



The results of mechanical analyses of samples of the various layers of the Navajo clay are given in the following table:

*Mechanical analyses of Navajo clay.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
520976	Crust, 0 to ¼ inch.....	0.2	0.2	0.4	7.4	17.0	38.0	36.9
520977	Mulch, ¼ to 2 inches.....	.0	.2	.4	7.0	16.0	37.6	38.8
520978	Subsurface, 2 to 15 inches..	.2	.2	.2	2.8	11.2	38.8	46.7
520979	Subsoil, 15 to 72 inches.....	.0	.2	.2	2.6	8.6	34.6	53.8

BILLINGS STONY CLAY LOAM.

The Billings stony clay loam, in virgin areas, consists typically of 2 inches of light brownish gray, gritty stony clay loam, having the typical desert crust and mulch structure, underlain to a depth of 15 inches by a compact light brownish gray, gritty, clay loam, which continues only moderately compact to a depth of 72 inches or more. The type is somewhat variable and may include some areas of lighter textured soil.

This type occurs only in the extreme southwest corner of the area, on the slopes of the shale uplands north of Duchesne River. These uplands were formerly covered by old gravelly and stony river-laid materials, vestiges of which in the form of a mantle of waterworn cobble and gravel now cover the hilltops and slopes. A thin layer or scattering of the gravel and cobbles is scattered over the areas of this soil type. They do not occur mixed with the soil below the surface. In places there are traces of reddish-brown deposits upon the true Billings soil. These deposits are remnants of old river-laid sediments, most of which have been removed by erosion.

This type is developed on the slopes of upland ridges. The surface is undulating and rather irregular. The areas are well drained.

This type is not in cultivation. Some of it is high in alkali salts. The native vegetation consists of a scanty growth of greasewood, shadscale, and sheepsage.

BILLINGS FINE SANDY LOAM.

The surface layer of the Billings fine sandy loam, in the virgin condition, consists of 3 inches of desert crust and mulch of light brownish gray fine sandy loam. Under this there is a moderately compact light brownish gray fine sandy loam extending to 12 inches, below which the subsoil material to a depth of 72 inches has the same color and texture but is only slightly compact. The soil is rather sticky when moist, and in places approaches a loam in texture.

This Billings fine sandy loam occupies alluvial fans and footslopes. The surface is undulating and sloping. Drainage, both surface and internal, is satisfactory. A large body of this type lies in Dry Gulch valley near Independence School and extends up the tributary valleys. Another area lies along the southern slope of the rocky scarp east of Randlett.

About 30 per cent of this type is in cultivation. Good crops of small grain, alfalfa, potatoes, and corn are grown. The native vege-

tation consists of greasewood, rabbit brush, shadscale, and scattered galleta grass.

*Billings fine sandy loam, gravelly phase.*—The gravelly phase of the Billings fine sandy loam occurs only on the low river terrace west of Randlett. It differs from other Billings soils in its low position, its gravel content, and in resting on a gravel substratum.

The soil consists of light-gray or light brownish gray, gravelly, fine sandy loam, having a crust and mulch structure and extending to a depth of about 2 inches, underlain to 8 inches by a compact light brownish gray gravelly fine sandy loam or loam. From 8 inches to 18 inches appears a loose gravelly fine sandy loam of the same color as the soil, resting upon a bed of waterworn gravel. Gravel occurs in abundance on the surface and throughout the soil section.

The gravelly phase is confined to one area. The surface in general is flat and smooth, but at the edge of the terrace it is more or less eroded. Drainage conditions are good, except in some small low spots. The large quantities of gravel in the soil and subsoil, together with its shallowness, make this a rather undesirable soil. On a few less gravelly spots small fields of alfalfa and sweet clover are cropped. The vegetation is greasewood, shadscale, and some galleta grass.

The following table gives the results of mechanical analyses of samples of the typical Billings fine sandy loam:

*Mechanical analyses of Billings 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.	<i>Per cent.</i>
520984	Crust, 0 to ½ inch.....	0.1	0.4	0.9	31.0	33.1	22.8	11.7
520985	Mulch, ½ to 3 inches.....	.1	.4	1.1	41.2	32.5	12.9	11.8
520986	Subsurface, 3 to 12 inches..	.0	.4	1.0	36.2	35.3	19.0	8.1
520987	Subsoil, 12 to 72 inches.....	.0	.9	2.6	40.0	25.0	19.8	11.6

#### BILLINGS CLAY.

The Billings clay, in the virgin condition, consists of a desert crust and mulch of light-gray or light brownish gray clay, with a depth of 2 inches, underlain to 15 inches by a compact layer of clay of the same color. From 15 inches to 72 inches the subsoil is a moderately compact clay, light gray in color, without noticeable lime concentrations, although the entire soil profile is highly calcareous.

This type occurs mainly on the footslopes of the shale uplands west of Randlett. It has a gently sloping, smooth surface. Drainage is good, except in the lower and flatter areas.

About 20 per cent of this type is under cultivation. It produces good yields of alfalfa, clover, and small grains and is well adapted to these crops. In the flatter areas alkali tends to accumulate at the surface, unless irrigation is carefully done. There are now some abandoned fields on this type, and a few areas badly affected by alkali. The native vegetation consists of greasewood, rabbit brush, shadscale, and inkweed and other desert weeds.

*Billings clay, shallow terrace phase.*—The shallow terrace phase of the Billings clay occurs in one area on the river terrace 2 miles west of Randlett. In the virgin condition it consists of 2 inches of desert crust and mulch of light-gray clay, underlain to a depth of 15 inches

by a light-gray compact clay. From 15 inches to 36 inches there is a layer of moderately compact material similar in all respects except structure to the material above. Below this appears a substratum of waterworn gravel. Its terrace position gives this phase a flat topography and a fairly smooth surface. Drainage conditions are fair.

Grain, alfalfa, and sweet clover are grown. Part of the phase is used for irrigated pasture by the Indians, who own most of it. Some spots show surface concentrations of alkali due to use of too much irrigation water. The native vegetation consists of greasewood, rabbit brush, with some inkweed and salt grass in the lower places.

The table below gives the results of mechanical analyses of samples taken from the profile of the typical Billings clay:

*Mechanical analyses of Billings clay.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
520992	Crust, 0 to ¼ inch -----	1.0	0.8	0.8	10.1	21.5	20.3	45.5
520993	Mulch, ¼ to 2 inches -----	1.4	1.4	1.0	9.6	22.0	34.5	30.2
520994	Subsurface, 2 to 15 inches --	.4	1.2	.9	7.9	16.8	34.7	38.0
520995	Subsoil 15 to 72 inches -----	.7	1.9	1.2	15.4	19.6	30.8	30.4

REDFIELD FINE SAND.

The surface soil of the Redfield fine sand, in the virgin condition, consists of a faint development of crust and mulch, 2 inches thick, of pale-red to deep-red fine sand, underlain by a slightly compact red fine sand to a depth of 12 inches. The material of the subsoil, from 12 to 72 inches, is predominantly an open-structured red fine sandy-loam, but in many places may consist of strata of loam, silt loam, clay loam, and clay texture.

This type occupies slightly undulating alluvial-fan slopes. The surface is fairly smooth. Except in a few localities drainage conditions are good. In the imperfectly drained areas there has been some concentration of alkali.

This soil is admirably adapted to orchard fruits, small fruits, and the deeper rooted crops that prefer well-drained, warm, deep soils of sandy texture. About 75 per cent of the type is in cultivation. It is used at present in the production of alfalfa, clover, potatoes, melons, and garden vegetables.

The native vegetation is sagebrush, rabbit brush, greasewood, and some galleta grass.

The results of mechanical analyses of samples of the different layers of the Redfield fine sand are given in the following table:

*Mechanical analyses of Redfield 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.	<i>Per cent.</i>
5209102	Crust, 0 to ½ inch -----	0.4	3.3	5.8	51.2	28.8	5.3	5.0
5209103	Mulch, ½ to 1½ inches -----	.6	2.6	4.6	47.9	33.5	4.7	6.0
5209104	Subsurface, 1½ to 12 inches --	.7	4.8	8.5	51.9	17.2	7.2	9.8
5209105	Subsoil, 12 to 72 inches -----	.8	3.8	4.4	34.1	31.6	15.2	10.1

## REDFIELD FINE SANDY LOAM.

The surface soil of the Redfield fine sandy loam consists, in the virgin condition, of a surface crust and mulch layer, about 2 inches thick, of light-red or red fine sandy loam, underlain to a depth of 12 inches by a red fine sandy loam, slightly compact, and resembling a loam in character when moist. To a depth of 72 inches the subsoil is prevailingly an open-structured red loam, though, as in the type just described, it may consist of strata material of different textures.

This type occupies alluvial-fan slopes. It is fairly smooth and easily prepared for irrigation. Both surface and internal drainage are good. The water-holding capacity is excellent as a rule.

This is a widely distributed and important soil type. About 80 per cent of it is in cultivation. It is a strong soil, highly prized for general farm crops, fruits, and vegetables, and probably the best soil in the area for tree fruits, including apples, pears, peaches, and plums. The native vegetation consists of sagebrush, greasewood, rabbit brush, shadscale, and galleta grass.

The table below gives the results of mechanical analyses of samples of layers of the Redfield fine sandy loam:

*Mechanical analyses of Redfield 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.	<i>Per cent.</i>
5209106	Crust, 0 to ¼ inch .....	0.3	0.6	1.1	31.0	31.4	24.0	11.6
5209107	Mulch, ¼ to 2 inches .....	.1	.4	.8	20.4	31.7	29.4	17.3
5209108	Subsurface, 2 to 12 inches .....	.0	.4	.6	26.4	32.4	34.3	5.9
5209109	Subsoil, 12 to 72 inches .....	.2	.4	.2	10.6	27.8	49.1	11.7

## REDFIELD LOAM.

The surface soil of the Redfield loam, in virgin areas, to a depth of 2 inches, consists of a crust and mulch of light-red to red color. This is underlain by a slightly compact layer of light-red to red loam extending to a depth of 12 inches. From this depth to 72 inches the material is friable and pervious, prevailingly red in color, and stratified. The surface soil is rather sticky when wet and appears heavier than it really is. West of Lapoint a large area of this soil tends to have a light reddish brown color or dull-reddish cast, where it is mixed somewhat with material of the Navajo series.

Areas of this type are mapped in various parts of the survey. The total area is 5,120 acres. The type occupies the lower footslopes and alluvial fans and has a smooth, gently sloping surface, and both surface drainage and underdrainage are good. The water-holding capacity is excellent.

The Redfield loam is an excellent general farming soil. About 80 per cent of it is under cultivation, the crops grown including alfalfa, clover, small grains, potatoes, corn, the usual garden crops, and orchard and small fruits. The natural vegetation on this type consists of tall rabbit brush, greasewood, sagebrush, torchweed, and some galleta grass.

The following table gives the results of mechanical analyses of samples of the layers composing the profile of the Redfield loam:

*Mechanical analyses of Redfield 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.	<i>Per cent.</i>
5209110	Crust, 0 to ½ inch.....	0.2	0.2	3.4	3.7	25.8	33.8	35.9
5209111	Mulch, ½ to 2 inches.....	.0	.0	.0	5.0	17.8	48.8	28.3
5209112	Subsurface, 2 to 12 inches..	.2	.8	1.8	22.4	15.8	44.3	14.6
5209113	Subsoil, 12 to 72 inches.....	.1	.6	1.6	35.5	17.6	27.4	17.1

## REDFIELD SILTY CLAY LOAM.

In the virgin condition the surface soil of the Redfield silty clay loam consists of 3 inches of a light-red to red crust and mulch of clay or clay loam texture, underlain by a slightly compact light-red to red silty clay loam which extends to a depth of 15 inches. From 15 inches to 72 inches the subsoil consists predominantly of friable red silt loam or clay. Less stratification appears in this material than in the subsoil of the coarser textured members of this series.

This type occupies lower alluvial-fan slopes and valley bottoms. The surface is very gently sloping and prevalingly smooth. Drainage is fair to good, except in a few lower flatter areas.

This type is of moderate extent. It is developed in various parts of the area. About 75 per cent of it is cultivated. It is a strong soil and very productive when properly tilled and irrigated. Excellent yields of wheat, oats, alfalfa, and sweet clover hay and seed are obtained. The native vegetation consists of a vigorous growth of sagebrush, greasewood, and rabbit brush.

*Redfield silty clay loam, heavy phase.*—In virgin areas the heavy phase of the Redfield silty clay loam consists of 3 inches of desert crust and mulch of red or rarely light reddish brown material, underlain to a depth of 20 inches by a slightly compact red silty clay loam, below which to a depth of 72 inches there appears a red clay of friable structure. The surface soil material is somewhat heavier than the typical Redfield silty clay loam, approaching a silty clay in texture.

This phase is developed on the lower gently sloping to flatter parts of alluvial valleys. The surface is smooth and nearly level. Drainage is on the whole fairly good.

This phase occupies good-sized areas 3 miles west of Lapoint and in western Colorado Park. Small areas occur in other parts of the survey. The better drained areas of this soil give very good yields of grain, alfalfa, and clover, to which crops it is best adapted. About 50 per cent of its area is in cultivation. The natural vegetation is sagebrush, greasewood, and rabbit brush.

The table below gives the results of mechanical analyses of samples of the typical Redfield silty clay loam:

*Mechanical analyses of Redfield silty clay 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.	<i>Per cent.</i>
5209114	Crust, 0 to ½ inch.....	0.2	0.3	0.2	4.0	20.5	42.5	32.2
5209115	Mulch, ¼ to 3 inches.....	.3	.2	.1	1.7	12.4	44.4	40.8
5209116	Subsurface, 3 to 15 inches..	.1	.1	.1	2.6	18.4	56.5	22.5
5209117	Subsoil, 15 to 72 inches.....	.1	.1	.1	4.0	28.0	54.0	13.7

## NAPLES FINE SAND.

In virgin areas the surface soil of this type consists of light reddish brown to pale-red fine sand having a feebly developed crust and mulch structure to a depth of about 2 inches. Below this a slightly compact light reddish brown fine sand is encountered, extending to 12 inches. The underlying subsoil is usually of the same material, loose, friable, and open structured, but in some places stratified materials of variable texture appear. Although relatively low in silt and clay, the soil is slightly loamy when moist.

This type occupies alluvial-fan slopes of slightly undulating topography. It is thoroughly drained, but holds water fairly well.

The Naples fine sand occurs in small areas in the alluvial valleys east and southeast of Moffat and on slopes in the Colorado Park district. About 25 per cent of it is in cultivation. It produces good yields of alfalfa and clover. It requires frequent irrigation, but on the whole is a very desirable soil, adapted to the production of leguminous forage crops, vegetables, and fruits. The native vegetation is shadscale, rabbit brush, and sagebrush.

*Naples fine sand, shallow terrace phase.*—The Naples fine sand, shallow terrace phase, occurs only on the terrace of the Duchesne River, on which the town of Randlett is situated. It differs from the characteristic soils of the Naples series in that it has a substratum of loose waterworn gravel within the 6-foot profile. The material also varies in color and includes grayish soils approaching in character the Green River soils. In the virgin condition it consists of a slightly developed crust and mulch of light reddish brown fine sand to a depth of 2 inches, underlain by a slightly compact light reddish brown fine sand to a depth of 12 inches. Below this and extending to 24 inches the material is a loose light-red or light reddish brown fine sand or fine sandy loam, resting on a bed of waterworn gravel.

The phase is confined to one area at Randlett. It occupies two different general terrace levels, both of which lie above normal overflow. The topography is nearly flat. The surface is somewhat uneven, and broken by occasional gravel bars, particularly at lower levels, where the type is of more recent origin. The drainage is naturally good on the higher level and fair to poor on the lower level.

About 50 per cent of the phase is now under cultivation, but until lately almost all of it had been farmed. Accumulation of alkali in the surface soil, the result of the use of too much irrigation water, together with seepage and unsatisfactory drainage conditions, has caused abandonment of parts of the land. Good small grain, alfalfa, corn, and garden crops are grown. The soil is well adapted to alfalfa and sweet clover, potatoes, and vegetables. The native vegetation consists of greasewood, rabbit brush, and desert weeds.

The table below gives the results of mechanical analyses of samples of the typical Naples fine sand.

*Mechanical analyses of Naples 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.	<i>Per cent.</i>
5209122	Crust, 0 to ¼ inch.....	0.0	1.8	4.1	53.0	30.7	4.6	5.8
5209123	Mulch, ¼ to 3 inches.....	.7	2.9	5.6	56.2	24.9	4.8	4.9
5209124	Subsurface, 3 to 12 inches....	.0	.5	1.8	47.4	37.5	6.1	6.8
5209125	Subsoil, 12 to 72 inches.....	.0	1.0	2.4	47.4	30.0	10.6	8.8

## NAPLES FINE SANDY LOAM.

The surface 2 inches of the Naples fine sandy loam, in the virgin condition, consists of a desert crust and mulch of light-brown or light reddish brown fine sandy loam or sandy loam, underlain to a depth of 15 inches by a slightly compact light reddish brown fine sandy loam. Below this to a depth of 72 inches the material is similar, but of loose, open structure. It is rarely stratified.

This type is confined to a few small bodies in Colorado Park. It occupies alluvial-fan slopes and has a gently sloping, fairly smooth surface. The surface and internal drainage conditions are good, and the soil is retentive of moisture.

Not over 10 per cent of this type is under cultivation. It is used for the production of general farm crops. In adaptation this soil type is similar to the Redfield loam. The native vegetation is greasewood, rabbitbrush, and shadscale.

The results of mechanical analyses of samples representing layers of the Naples fine sandy loam are given in the following table:

*Mechanical analyses of Naples 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.	<i>Per cent.</i>
5209130	Crust, 0 to ¼ inch.....	1.4	7.0	5.6	31.6	31.1	14.8	8.6
5209131	Mulch, ¼ to 2 inches.....	3.8	10.8	9.4	36.2	19.3	10.7	9.9
5209132	Subsurface, 2 to 15 inches....	1.6	4.6	4.6	36.4	20.6	12.6	19.8
5209133	Subsoil, 15 to 72 inches.....	1.0	8.0	8.4	54.4	8.6	6.3	13.3

## ASHLEY FINE SAND.

The Ashley fine sand consists of 18 inches of light brown or light reddish brown to grayish-brown, loose, friable fine sand of loamy character, underlain to an average depth of 36 inches by a layer of yellowish-brown or light-reddish stratified material, resting upon a substratum of waterworn gravel. The soil contains considerable organic matter and appears brown when wet. The subsoil is somewhat variable in color but in most areas is lighter and contains less organic matter than the surface soil.

This type occurs on prevaillingly flat recent flood plains along permanent streams. The surface is uneven, entrenched in many places by channels, and cut by strips of gravelly wash. Surface drainage is good. The water table is high in normal years, and the soil usually is moist. This type is practically free from alkali.

The Ashley fine sand occurs mainly in a long, narrow strip in the first bottom of the Uinta River, extending for several miles north of Fort Duchesne. A few patches, constituting about 3 per cent of the total area of this type, are cultivated. They are highly productive and require but little irrigation water. Corn, potatoes, small grain, and garden products do well. This type, however, being subject to overflow by swiftly running water, is used principally for pasture. It supports a variety of wild grasses, with large cottonwood trees and willows along the stream.

*Ashley fine sand, stony phase.*—The Ashley fine sand, stony phase, consists of a shallow layer of sand, fine sand, and fine sandy loam of light-brown color, underlain by gravel beds. The type lacks uniformity and is interrupted by bars and strips of gravelly wash. It is first-bottom land, annually inundated, rough and uneven, and of little value except for pasture. As mapped it includes narrow strips of Riverwash and stony overflow channels. It extends in a narrow belt along the Uinta River, up as far as a point opposite Leeton. The vegetation is the same as on the typical Ashley fine sand, but the sod growth is poorer.

*Ashley fine sand, red stony phase.*—The Ashley fine sand, red stony phase, in virgin areas consists of red or dull-red to pronounced reddish brown fine sand or fine sandy loam to a depth of 3 inches, underlain to a depth of 12 inches by a slightly compact layer of similar material. The surface is covered with gravel, cobblestones, and glacial boulders of quartzite, which also are present in large quantities in the soil and subsoil. Below 12 inches appears a mass of cobblestones embedded in red, loose fine sand or fine sandy loam.

This phase occupies the greater part of the outwash fan extending from the mouth of Whiterocks Canyon southward to a point about 6 miles southeast of the town of Whiterocks. It is deeply trenched by the present stream channels, and has a rough, irregular, ridgy surface, marked by gravel bars. It is not adapted to agriculture, because of the presence of large quantities of stone. A few small, less stony tracts have been cleared and are used for alfalfa and small grains. These form about 5 per cent of the total area of the phase. The native vegetation consists of juniper trees and sagebrush and a scanty growth of grasses.

*Ashley fine sand, dark phase.*—The Ashley fine sand, dark phase, consists of 24 inches of dark reddish brown or dark grayish brown friable fine sand, underlain by a substratum of waterworn gravel. No lime accumulations occur in the soil profile, nor is there any noticeable compaction of the soil material.

This phase is situated in the flood plains of the Whiterocks and Uinta Rivers. The greater part of it is subject to overflow. The topography in general is flat, but in detail is uneven and broken to irregular, owing to the fact that it occupies the bottoms of streams of braided channel habit and includes numerous shallow high-water channels and gravelly washes. The drainage is fairly good, but the water table lies close to the surface.

This is not an extensive soil. A fair-sized area is located 3 to 4 miles east of Bennett. About 5 per cent of the phase is in cultivation, part of this consisting of a more loamy, better drained variation which was not mapped separately because of its small extent. It yields excellent crops of grain, corn, and vegetables. The native

vegetation consists of cottonwood trees, brush, and grasses. It is used principally for pasture.

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

*Mechanical analyses of Ashley 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.	<i>Per cent.</i>
5209134	Soil, 0 to 18 inches.....	0.0	1.4	5.2	50.2	25.8	12.6	4.8
5209135	Subsoil, 18 to 36 inches.....	.2	.2	.2	52.1	39.6	6.8	1.0

ASHLEY FINE SANDY LOAM.

The Ashley fine sandy loam consists of red to reddish-brown friable fine sandy loam, with a depth of 6 inches, underlain by a slightly compact layer of red or reddish-brown fine sandy loam to a depth of 15 inches. Below this is a mass of cobblestones and gravel, the interstitial soil material being loose, red fine sandy loam. The soil material of this type is redder than the typical Ashley soil, and is somewhat better drained.

This type occupies the gentler side slopes of alluvial fans, and has an undulating to fairly even surface. Surface drainage and internal drainage are good. Occasional bars of gravel and cobblestones traverse the surface.

The Ashley fine sandy loam occurs chiefly in an elongated area adjoining the upper half of Whiterocks Bench on the west. Another body is located on the west side of the main channel of the Uinta River, in the vicinity of Leeton. About 60 per cent of this type is in cultivation. It produces alfalfa, clover, small grains, and some garden vegetables. While not an extensive type, it lies above overflow, is well situated as regards irrigation water supply, and is well adapted to the production of alfalfa and sweet clover, grains, vegetables, and small fruits.

The native vegetation consists of sagebrush, greasewood, matchweed, and some galleta grass.

*Ashley fine sandy loam, stony phase.*—The Ashley fine sandy loam, stony phase, consists of 3 inches of grayish-brown friable fine sandy loam, underlain to a depth of 12 inches by a grayish-brown, slightly compact fine sandy loam, which rests upon a mass of cobblestones and large gravel. Both surface soil and subsoil are very stony, the stones consisting chiefly of quartzite. In some parts of the type, as around the settlement of Whiterocks, the cobblestones and boulders are partly coated with a lime, but as a rule there is little evidence of lime accumulation.

The phase occupies the lower and less well drained parts of the glacial-outwash fan. It is not subject to ordinary overflows and has fairly good drainage. Small, poorly drained areas occur along the edges of the fan, where this phase joins the dark-colored phases of the Ashley soils.

About 10 per cent of the phase is under cultivation. Some small fields near Whiterocks have been cleared of surface stones and are used for corn, alfalfa, and small grains. The soil is not well adapted for

farming because of its stony nature. The native vegetation consists of juniper trees, sagebrush, bunch grasses, and foxtail. The grasses grow only in lower, poorly drained parts.

*Ashley fine sandy loam, dark stony phase.*—The dark stony phase of the Ashley fine sandy loam consists of a grayish-brown or dark reddish brown stony fine sandy loam, about 8 inches deep, underlain by gravel beds. Areas of this description lie close to stream channels and are subject to rapid currents during the spring floods. They include narrow strips of gravelly Riverwash and are cut by the channels of overflow streams that are barren of vegetation.

Land of this phase is not cultivated and is of little value except for pasture. The vegetation consists largely of cottonwood trees, and various bushy growths. In a few low spots there is a sod of native grasses.

The table below gives the results of mechanical analyses of samples of surface and subsurface layers of the typical Ashley fine sandy loam:

*Mechanical analyses of Ashley 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.	<i>Per cent.</i>
5209148	Surface, 0 to 6 inches.....	0.6	3.0	4.4	42.3	30.0	9.7	10.0
5209149	Subsurface, 6 to 15 inches...	.2	1.2	2.4	39.8	32.2	10.2	14.1

GREEN RIVER FINE SANDY LOAM.

The Green River fine sandy loam, as mapped in this survey, consists of undifferentiated areas of light-gray, light brownish gray, or brownish-gray fine sand, fine sandy loam, very fine sand, and very fine sandy loam extending to a depth of 72 inches. On account of the predominance of the fine sandy loam and the small extent of materials of the other textures, only one distinction was made on the map. The soil material varies considerably in the 6-foot section. It is usually stratified with layers of sandy alluvial material of varying thickness, and rarely with silt and silty clay. Gravel is not commonly found in this type, excepting in the Duchesne River bottom, close to the present channel, where beds occur in the subsoil within the 6-foot depth.

The type is developed chiefly along the Duchesne and Green Rivers, usually adjacent to the main or low-water channels. It occupies a flattish flood plain, but the surface is hummocky and marked by mounds or low sand ridges, small winding abandoned channels, and low places. The drainage, both general and internal, is good, as the type stands from 5 feet to 15 feet above the low-water level of the streams.

Less than 5 per cent of this type is under cultivation. It is a deep soil and is adapted to sweet clover, small grain, vegetables, and in higher positions less subject to overflow, to alfalfa. It supports a vigorous growth of cottonwood trees and bushes, and in the more open spaces a fairly good growth of grasses. It is utilized almost entirely for grazing beef cattle.

## GREEN RIVER SILT LOAM.

The Green River silt loam consists of 18 inches of a light-gray or brownish-gray to olive-drab friable silt loam, underlain to a depth of 72 inches by friable, open-structured, light brownish gray silt loam, loam, or fine sandy loam, or by interstratified deposits of like textures. The subsoil on the average is somewhat coarser than the surface soil.

This type occupies the smoother, flatter parts of the flood plains of the Duchesne and Green Rivers. The surface is nearly level and even. Drainage is fair, but the water table is rather high during the greater part of the year, and the type is subject to overflow during flood periods.

The Green River silt loam is inextensive and occurs principally in the back valley section of the Green River south of Sheppard Ranch. None of it is cultivated. It supports the same type of vegetation as the Green River fine sandy loam, but has a denser sod and consequently is better pasture land. It is given over entirely to cattle range.

The results of mechanical analyses of samples of the soil and subsoil of the Green River silt loam are given in the following table:

*Mechanical analyses of Green River 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.	<i>Per cent.</i>
5209138	Soil, 0 to 18 inches.....	0.3	0.3	0.4	2.0	23.8	70.1	3.1
5209139	Subsoil, 18 to 72 inches.....	.0	.2	1.2	28.8	47.5	21.8	0.4

## GREEN RIVER SILTY CLAY LOAM.

The Green River silty clay loam consists typically of 15 inches of light grayish brown, brownish-gray, or olive-drab friable silty clay loam, underlain to a depth of 72 inches by light grayish brown, friable, stratified material of prevaillingly coarser texture, though including clay loam, silt loam, and very fine sandy loam materials. As mapped the type is of rather variable texture and may include some materials either lighter or heavier than silty clay loam.

The type occupies low, flat areas in the flood plains of the Duchesne and Green Rivers and is subject to overflow. Drainage is very poor. In most places the ground-water level remains close to the surface throughout the year.

Only about 5 per cent of this type is under cultivation. This is situated on a better drained area. The soil is adapted to small grains and leguminous forage crops. The larger areas support an excellent growth of native grasses, including salt grass, redtop, and foxtail.

*Green River silty clay loam, swamp phase.*—The swamp phase of the Green River silty clay loam, which like the typical soil is rather variable in texture, consists predominantly of dark brownish gray or drab silty clay loam and silty clay material occupying lagoons and low marshy basins. These are overflowed during periods of high water, and some of them are covered by shallow water throughout the summer. The type supports a native vegetation of grasses and rushes,

with some willow in places. Under present conditions of drainage it has no agricultural value except for grazing.

#### DUNESAND.

Three areas of Dunesand are found in the lowlands along the margin of the flood plain of the Duchesne River. The material consists of light-gray sands and fine sands which have been worked by wind action into small elongated dunes from 5 to 15 feet in height. In some cases the dunes appear to have a clay base. The material has been derived from water-laid sediments, originating from gray sandstones and shales. The dunes support a scanty growth of desert shrubs and are essentially nonagricultural.

#### ROUGH BROKEN AND STONY LAND.

The Rough broken and stony land constitutes the most extensive type of material within the area. It represents nonagricultural land in the mapping of which no attempt was made to separate lands that are too steeply rolling or too rough for farming from lands too stony for cultivation.

The general grouping of Rough broken and stony land embraces broad stretches of uplands which have been dissected by intermittent streams to such an extent that the soil material has been reduced to a thin layer, or has been washed away. Weathering and erosion is rapidly going on in these areas, the soil material being deposited on adjacent alluvial fans or being carried away into larger streams. Small bodies of soil, broken by frequent outcrops, are scattered over these rough and rocky areas. Steeply rolling land, unsuited to irrigation farming, has been included in this grouping. The patches of arable soil included in these areas are usually rather thin, rough in topography, small in extent, and inaccessible to water for irrigation. Steep-sided valleys, canyons, and abrupt rockyscarps, 50 to 250 feet in height, with numerous small mesas, rocky, steep-sided ridges, and areas of thoroughly dissected upland are included in this class of material. (Pl. XLVII, fig. 2.)

The native vegetation on Rough broken and stony land is sparse and stunted, consisting of various desert shrubs and grasses, but the type has some value for grazing.

#### IRRIGATION.

The Uinta and Whiterocks Rivers supply almost all the irrigation water used in the area of this survey. Deep Creek, a tributary to the Uinta, also is drawn on for a very small flow, and a little of the water of the Duchesne River is diverted within the area and used on lands west of Randlett.

The construction of canals for irrigation began under the direction of Government engineers for the purpose of providing water for irrigating Indian lands. A number of large canals have been constructed, which divert the water supply of the streams at suitable places along the stream courses. Through these the water is carried into smaller canals and ditches and finally into laterals for distribution over the fields. In addition, the white settlers have formed irrigation companies and built canals to supply their own lands. The Indians have

the prior right, so that in dry seasons there is sometimes insufficient water for all. Some litigation in regard to the rights of users of irrigation water in the area is in progress at the present time (1921).

The corrugation or furrow system of irrigating is used entirely in this area. The shallow U-shaped or V-shaped parallel furrows run up and down the slope, excepting on the steeper surfaces, where the soil is likely to wash, in which case they run at an angle more or less transverse to the direction of steepest slope. The irrigation water, carried into the fields in the laterals, is distributed through smaller ditches or leads into the furrows. When crops are well started, there is little danger of erosion. Economical use of water is rarely obtained, because, as a rule, fields are not properly leveled. It is therefore difficult to obtain uniform distribution of water over the surface of the fields. A good deal of waste water runs off during irrigation, collecting at the roadsides, sometimes flooding parts of the roads, and finds its way to low places. This has caused alkali concentrations at the surface in some places. Four or five applications of water usually are given during the season. Under the conditions existing the duty of water is low.

#### SUMMARY.

The Uinta River Valley area is located in the northeastern part of the State of Utah, in the east-central part of the Uinta Basin. The area lies just south of the base of the Uinta Mountains, and includes parts of the valleys of the Uinta and Duchesne Rivers and adjacent alluvial valleys, several prominent table-lands or mesas, and considerable rough broken and stony land. The area surveyed is 298 square miles.

The natural drainage is good in the greater part of the area. The general trend or direction of drainage is southerly. All the drainage waters flow finally into the Green River, a tributary of the Colorado River.

The area was first opened for settlement by the Government after the Uinta Indian Reservation was established in 1861. The white settlers in the area have come in during the last 25 years—most of them recently.

The nearest railroad connections are 75 to 100 miles distant by road from Fort Duchesne. Passenger and freight traffic is handled by automobile stages, motor trucks, and wagons.

The mean annual rainfall is 7 inches, which is not sufficient for dry farming. The summers are pleasant, the winters rather severe. The average length of growing season is about 127 days, with a rather wide variation within the area, owing to differences in elevation. The rainfall is greater at the higher elevations, but the season is shorter.

In the Uinta Mountains to the north the precipitation is heavy, and rainfall usually is of almost daily occurrence during the growing season. Streams from the mountains furnish the sole source of irrigation water for the area.

Twenty-eight types of soil, twenty phases, and two types of miscellaneous materials, are mapped. The most extensive and important agricultural types are members of the Mesa, Bennett, Redfield,

Billings, and Navajo series. The dominant types of the area are red, brownish-red, or light reddish brown fine sands, fine sandy loams, loams, silt loams, silty clay loams, and clay loams.

Gravity canals supply the water for irrigation. The furrow system of irrigation is generally employed, the topography of most of the soils of the area being too sloping for the application of the flooding system. The duty of water is low.

The alkali conditions in this area are being carefully investigated by the Utah Agricultural Experiment Station, and the results of this investigation will appear in a separate report of that station.







Areas surveyed in Utah, shown by shading.

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