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

SOIL SURVEY OF THE ASHLEY VALLEY, UTAH.

BY

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[Advance Sheets—Field Operations of the Bureau of Soils, 1920.]

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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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Soil map, Ashley Valley sheet, Utah.

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DESCRIPTION OF THE AREA.

The Ashley Valley area occupies the central part of Uintah County, which is situated in the northeastern part of the State of Utah. The area is about 20 miles west of the Utah-Colorado State line, about 40 miles south of the northern boundary of the State, and about 125 miles east of Salt Lake City.

The boundaries of the area are irregular. Green River passes along the eastern and southern sides of the area, and the remaining boundaries have been drawn to include all land now under irrigation and land which it is reasonable to expect may be brought under irrigation at some future time, either by the extension of the present canal systems or construction of new ones. The area covers about 150 square miles, or 96,000 acres.

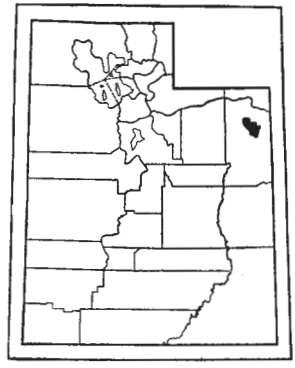


FIG. 28.—Sketch map showing location of the Ashley Valley area, Utah.

The Ashley Valley area includes all the agricultural land within the valley of Ashley Creek, known as Ashley Valley, and, in addition, the mesa lands between Ashley Creek and Green River, small areas of alluvial soils along Green River, and an area of land of uneven topography south of Ashley Valley. The agricultural lands of the region are terminated on the north by the lower slopes of the Uinta Range of mountains, and on the west and southwest by Asphalt Ridge and associated ridges and mesas.

The lower slopes of the Uinta Mountains consist of strata of sedimentary rocks that dip sharply to the south and southeast and disappear beneath the lower alluvial soils of the Ashley Valley, or beneath masses of shales that form the outlying mesas.

Ashley Valley lies between Asphalt Ridge on the west and the mesa just east of Ashley Creek, and extends from the base of the Uinta Mountains on the north to a semidetached spur of Asphalt Ridge that extends to the channel of Green River, about 7 miles southwest of Jensen.

Ashley Creek, which traverses the area from northwest to southeast, meanders through a narrow flood plain, parts of which are often overflowed during the spring floods. Between the creek and the base of the Uinta Mountains the surface slopes uniformly to the level of the flood plain, and is traversed at intervals by the channels of intermittent drainage courses. West of Ashley Creek the country consists

of a series of rolling ridges and isolated mesas, traversed by numerous well-defined drainage ways. Throughout the greater part of T. 4 S., R. 21 E., the surface is only moderately rolling. Along the foot of Asphalt Ridge and along the terrace slopes above the flood plain of Ashley Creek the topography becomes too rough for cultivation and irrigation. This part of the valley lies from 50 to 75 feet above the flood plain of Ashley Creek, and rises toward Asphalt Ridge at the rate of about 70 feet per mile. Throughout the northern half of T. 5 S., Rs. 21 and 22 E., the ridges become more prominent, but the greater part of the land is under cultivation or is capable of being farmed. In the southern part of these townships erosion by the local drainage has been severe, producing a very uneven surface, and leaving only an occasional small isolated mesa with a uniform surface.

East of Ashley Creek and extending nearly to Green River, nearly horizontal beds of dark-colored shale give rise to a series of mesas that extend from the base of the Uinta Mountains southward to a point about west of the town of Jensen. From a distance these mesas appear as an elevated plain, sloping gently to the southward, and separated from the lower lands by eroded terrace slopes. In detail this region consists, however, of a series of small flat-topped mesas, which are separated by steeply sloping sides, and by lower lying areas of varying extent where the local drainage courses have developed a more or less uneven topography. This mesa region lies from 100 to 300 feet above the alluvial lands along Ashley Creek, and from 200 to 500 feet above the flood plain of Green River.

Throughout the part of T. 6 S., R. 22 E., included in the survey, most of the land is too uneven for irrigation, consisting for the most part of a prominent ridge extending from the base of Asphalt Ridge southeastward to Green River. The agricultural land in this part of the area is confined to a relatively narrow body of soil along the north bank of Green River, and to three or four small benches on the northern and eastern sides of the ridge.

Ashley Creek is a permanent stream, which rises in lakes near the summit of the Uinta Mountains. For a distance of about 6 miles after it enters the area the channel is rather shallow, and with it are associated a number of smaller channels which carry water only during floods. During the spring months, when the melting of snow in the mountains becomes rapid, the stream often carries a large volume of water, and the lands along its course in the northern part of the area are frequently overflowed and more or less eroded, and the location of the channel may be changed for short distances. During the summer season the flow of the creek is small but continuous. Before the diversion of water for irrigation, the flow sank into the gravels within a short distance below the mouth of the canyon. South of a point about due east of Vernal the stream has cut a deep, tortuous channel through the flood plain, that is usually of sufficient capacity to carry the entire flow of the stream. Ashley Creek furnishes the water for irrigating the land within Ashley Valley and part of the irrigable lands along Green River near Alhandra.

Brush Creek, which also rises in the higher part of the Uinta Mountains, traverses a narrow, winding, depressed alluvial valley cut through the shales in the eastern part of the survey. This creek enters the area several miles east and a little north of Vernal, and

flows in a southerly direction to its junction with Green River, about 3 miles north of Jensen. Brush Creek is a permanent stream and its flow is diverted for the irrigation of land in the vicinity of the town of Jensen.

Green River, whose channel forms the eastern and southern limits of the area, rises on the western slopes of the Wind River Mountains, in Wyoming, and flows southward to its junction with the Colorado River, some 150 miles south of the area. Within the area of this survey this stream has a meandering, slightly depressed channel, which is bordered by narrow strips of alluvial soil. At the normal and low-water stages of the stream the water is several feet below the level of the adjacent lands, but during the periods of flood local areas of the bottom lands are subject to overflow. Some of these bodies have no surface drainage outlet and remain wet and swampy throughout the year. Although this stream carries a considerable volume of water at all times, the conditions are not favorable for a gravity diversion of water for small irrigation projects. One small pumping plant in the extreme southern part of the area lifts water for the irrigation of a small area of land adjacent to the stream. This is the only utilization of the waters of Green River for irrigation in this area.

The city of Vernal has an elevation of about 5,266 feet above sea level, and the elevations of the lands in Ashley Valley range from 5,000 to 5,700 feet. In the mesa region east of Vernal the maximum elevation is about 5,500 feet. The lower lands along Green River have an elevation of about 4,700 feet above sea level.

Uintah County was organized in 1880 from parts of Wasatch and Sanpete Counties. In 1917 the western portion of Uintah County was annexed to Duchesne County and all of that part of the county north of the crest of the Uinta Mountains was taken to form Daggett County.

Settlement in this region was begun by a few settlers who located the town of Ashley, about 1½ miles northeast of the present site of Maeser. The Indians gave the settlers considerable trouble, so a small detachment of soldiers was maintained for several years at a post known as Fort Thornburg, about 2 miles west of the settlement of Ashley, at the mouth of the canyon of Ashley Creek. At that time mail and supplies were brought into the valley by teaming over the Uinta Mountains from Fort Bridger in Wyoming. Vernal was established about 1888, and the town of Ashley was abandoned shortly afterwards.

Vernal, the county seat of Uintah County, is located in the west-central part of the area and has a population of 1,309 (1920 census). Maeser is a small settlement a few miles northwest of Vernal, and Naples and Jensen are similar settlements to the southeast. Jensen is situated on the west bank of Green River.

There are no railroads within the area. Watson, Utah, the northern terminus of the Uintah Railway (narrow gauge), about 55 miles southeast of Vernal, is the nearest railroad connection, and from that point the greater part of the freight and express into the valley has in the recent past been transported by automobile trucks. Price and Helper are stations on the main line of the Denver & Rio Grande Railroad, about 135 miles southwest of Vernal. A considerable part of the commodities received by the local merchants is

shipped by parcel post through Price, and a large part of the passenger traffic into and out of the valley is by automobile stage through Helper and Price, by the way of Roosevelt.

Within the Ashley Valley good earth roads are maintained along most of the section lines, and a few wagon roads lead northward into the Uinta Mountains. A fair stage road leads from Vernal to Watson, and the Pikes Peak Auto Highway crosses Green River at Jensen. Highways extend westward to Heber, Salt Lake City, and other points. Aside from these main lines of travel, roads that are often but little better than trails lead to various parts of the adjacent territory.

Owing to the distance from railroad transportation, only a few local products can profitably be marketed. Cattle and sheep are driven overland to railway points for shipment to Salt Lake City or to eastern markets.

CLIMATE.

The mean annual temperature at Vernal, according to official records of the Weather Bureau for a period of 19 years, is 45.9° F. During the summer months, which normally include about 75 per cent of the growing season, the average temperature is a little over 69° F. Summer temperatures of over 100° are very rare, and the nights are always cool. The winters are cold and often severe, and during protracted cold spells the temperatures may range from 12° to 25° below zero. Winterkilling of peach, apricot, and plum trees is not uncommon, and in seasons of unusually low temperatures many of the trees in the area may be very severely affected.

The average date of the last killing frost in the spring is May 17, and that of the first in the fall, September 25. Killing frosts have occurred as late as the middle of June and as early in the fall as August 24. Late spring frosts in the lower lands along Ashley and Brush Creeks, and along Green River, occasionally do some damage to the early fruits and vegetables, but in the more elevated parts such damage is exceedingly rare.

Violent winds are almost unknown. Strong westerly winds occur during the spring months; in the heated season these winds are often of short duration and accompany or precede the summer afternoon or evening showers. Hail storms are very rare. Thunderstorms are of almost daily occurrence during the summer season in the mountains just north of the area, and occasionally they sweep across the area in an easterly direction.

The mean annual precipitation at Vernal is 8.59 inches, with extremes of a little less than 6 inches and somewhat more than 14 inches. This rainfall is not sufficient to allow dry farming and serves to support only a thin growth of salt sage, shad scale, and greasewood. The summer showers are more often detrimental than beneficial to the crops, as they frequently come during the harvesting of alfalfa and grains. The snowfall in the Uinta Mountains is moderately heavy but somewhat variable, depending upon the season. The larger part of this thaws and runs off rapidly during the spring months and is responsible for the heavy floods that occasionally sweep down Ashley and Brush Creeks. In sheltered places the snow remains until well into the summer and contributes to the stream flow, and some snow remains on the higher peaks throughout the

year. Showers are of almost daily occurrence in some part of the range during the summer months, and these storms are a factor in maintaining the flow of the creeks from which the irrigation water is obtained. Very rarely the mountain rainfall and snow are scanty, and there is a subsequent shortage of irrigation water.

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

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

[Elevation, 5,266 feet.]

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1901).	Total amount for the wettest year (1906).
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	17.9	55	−18	0.56	0.48	1.72
January	18.9	56	−21	.66	.71	.96
February	23.4	60	−25	.62	1.36	.29
Winter	20.1	60	−25	1.84	2.55	2.97
March	36.0	79	− 5	.82	.31	1.11
April	48.7	83	12	.67	.33	1.52
May	56.8	90	19	.85	.86	2.55
Spring	47.1	90	−5	2.34	1.50	5.18
June	66.5	99	24	.38	.21	.25
July	71.7	102	34	.68	.21	1.18
August	69.8	99	34	.65	.73	1.02
Summer	69.3	102	24	1.71	1.15	2.45
September	60.1	94	20	1.18	.04	1.00
October	47.0	85	11	.86	.42	.39
November	34.4	68	− 5	.66	.27	2.77
Fall	47.1	94	− 5	2.70	.73	4.16
Year	45.9	102	−25	8.59	5.93	14.76

AGRICULTURE.

Agriculture in the Ashley Valley began with the digging of a small ditch in the spring of 1874 to irrigate land on the Dodd ranch. A second ditch was dug within a year by two or three settlers who took up ranches near Dodd's ranch and formed the settlement of Ashley. Little more was done until the fall of 1877, when settlers came in from Salt Lake City. In the spring of 1878 three town sites were laid out, one at Incline (now Jensen), one at Vernal (formerly called Ashley Center), and one at Dry Fork, which is just outside the area to the northwest. During this year (1878) irrigation ditches were built to serve the lands in the neighborhood of each town site. Before the close of the summer of 1880 three large canals—the Central, Ashley Upper, and Rock Point—had been built. In 1882 there were about 400 people within the area.

From the first the settlers found it necessary, on account of their isolation and the bad roads, to make the communities self-supporting.

The first crops grown were corn, wheat, and potatoes. By 1890 several hundred fruit trees had been planted and some fruit was produced within the area. Then, as well as now, there was no immediate cash crop, livestock and animal products being the source of cash income.

The Ashley Valley area is well adapted to the production of livestock, dairying, and poultry raising. 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 soils is generally being used for cultivated pasturage.

A creamery has been in operation at Vernal for about 20 years. Until recently the products made were cheese and butter, which were shipped to the gilsonite mines and to the Rangeley oil field. At the present time this creamery is shipping a ton of sweet cream a week to Denver through Craig.

According to the 1920 census, the dairy products of Uintah County in 1919, exclusive of home use, were valued at a little less than $70,000, and there were over 1,800 dairy cows in the county.[1] There are about 15 silos within the Ashley Valley area.

Sheep raising is an important branch of livestock production in this valley. The value of the wool clip in Uintah County in 1909 was reported by the census as slightly more than $57,000, and 10 years later it had increased to nearly nine times that amount. Lambs and wethers are driven to market directly from the summer pasturage on the Uinta Mountains, while the main herds are wintered to the south and east of the area surveyed. The herds are culled in late winter of the old ewes and lambs, which are sent into the settlements for feeding. There were nearly 120,000 sheep owned in Uintah County in January, 1920, according to the census. This number is probably low as an average, since 1919 was a very dry year—so dry that irrigation streams were decreased and the hay crop was consequently light. In addition a very severe winter followed, which resulted in large losses of livestock.

Cattle raising is second in importance only to sheep raising. The cattle are ranged in the Uinta Mountains in the summer, at the close of which many that are marketable are driven directly to the markets. The main herd is taken from the mountains in the fall and kept in fields and pastures until about December, when feeding is commenced and continued, as a rule, until March or April. There were nearly 25,000 head of cattle within the county in January, 1920. However, many cattle were lost during the following spring.

Poultry production, especially the raising of turkeys, is a very important industry and is practiced to a considerable extent within the area. The turkeys are shipped dressed to the market by way of Price. The value of poultry products in Uintah County in 1919 was reported by the census as nearly $50,000.

Beekeeping has been important in the development of the entire Uinta Basin and especially the Ashley Valley area. Honey from this district is generally recognized as being of exceptional quality. The State Department of Agriculture reports there were 2,046 colonies of bees, spring count, in the Ashley Valley proper in 1922. They

[1] The Ashley Valley area includes only a small part of the total area of Uintah County. However, the irrigated land in the area surveyed constitutes probably about one-third of the land under irrigation in the county.

produced 143,220 pounds of surplus honey. Extra winter protection is necessary for bees in the Ashley Valley.

Small grains occupied about 8,500 acres within the area in 1920, of which over 90 per cent was spring planted. The acreage is about equally divided between wheat and oats. The average yield of wheat is about 18 bushels and of oats about 25 bushels. Grain is irrigated by the furrow method, ordinarily two irrigations to the season after it is above ground. An irrigation is sometimes applied to germinate the seed. New land is generally planted to small grain. Alfalfa was growing on about 8,000 acres in 1920. It is generally consumed by stock within the area. As a rule two crops are harvested each season, and in addition there is usually good fall pasturage. From two to four irrigations by the flooding method are made during the summer. Some alfalfa and sweet clover seed is produced in the Ashley Valley. On fields intended for seed the first crop is cut for hay in the early part of July. The seed is not harvested until September and the yield is often reduced by frost.

Vegetables and fruits are grown for local consumption only. The average yield of potatoes per acre in 1920 was 138 bushels, for 1910 the average was 164 bushels, and for 1900 it was 179 bushels.

Apples, peaches, pears, plums, prunes, apricots, and cherries all do well, except for some winterkilling of the more delicate kinds, as do the smaller fruits, such as currants, strawberries, and raspberries. However, the market for fruit is as yet only local.

No definite rotation is practiced. Alfalfa is allowed to remain 5 years or longer; when it is plowed up two crops of grain are grown, as a rule, 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, and more than 80 per cent of the farms are operated by the owners.

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, 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 $30 to about $125 an acre, with an average of about $70.

SOILS.

The soils of the Ashley Valley area have been developed under desert conditions and are treeless, with the exception of the lower lying areas of recent-alluvial soils, near the larger stream channels, which in places support a growth of brush and small trees. The rainfall has not been sufficient to leach and remove the lime and other soluble materials, and in the areas of the older soil accumulations a part of the lime in the original soil material has been converted into lime carbonate and has accumulated in the subsoils. The surface soils, except in the recently laid alluvial deposits, in many places contain enough carbonate to effervesce in acid, but in others they may be entirely free from lime; the subsoil on the contrary, always contains a horizon of lime carbonate in concentrated form. The depth at which this layer appears varies with the texture of the soil.

The freshly laid alluvial deposits contain no carbonate accumulations in either soil or subsoil.

Coincident with the tendency to superficial leaching and concentration of the lime in the deeper part in the areas of older soils, certain other characteristics have been developed in the soil profile. These are common in virgin areas of older soil and occur locally even in areas of recent accumulation. They usually consist of a thin, compact, and slightly cracked crust, a fraction of an inch in thickness, underlain as a rule by a thin layer of loose flocculated material ranging in thickness from one-fourth inch to 2 or 3 inches. This is generally underlain either directly by a layer of compact soil material, more or less columnar in structure, or by material unmodified in structure, below which the compact zone occurs. This compact stratum generally contains a slight to pronounced accumulation of lime with feeble to well-developed cementation of the soil particles, while in the deeper part of the 6-foot profile the zone of lime accumulation and compaction gradually gives way to unmodified or only slightly modified material of lower lime content and more friable structure.

These characteristics of structure, which appear to be incident to the development of soils in desert areas, are apparent only in areas in which the soil has been undisturbed for some time. Moreover, they are not everywhere well developed, the degree or stage of development varying with variations in soil texture, drainage, rapidity of erosion or accumulation of soil material, age of material, and probably other factors the influence of which is as yet unknown.

The soils of the area include (1) those derived from freshly laid alluvium that has not been changed by weathering since it was laid down; (2) those derived from old-alluvial deposits that have been changed very greatly from their initial condition, the change consisting mainly in oxidation, the accumulation of small quantities of organic matter, the development, usually, of a desert profile as described above, and the accumulation of a zone of carbonate in the subsoil; and (3) those derived from material accumulated by the decay and disintegration of rocks (sandstone and shales) in place, and the further development of soil features like those evolved on the old-alluvial deposits.

The residual soils are formed by the weathering in place of consolidated sedimentary rocks. They are represented by the Shavano soil series.

The Shavano series consists of types having light reddish brown or pale-reddish surface soils, underlain by a more compact and usually heavier textured subsoil, similar to the surface soil in color, or a trifle lighter. In the vicinity of areas of Rough broken land the sandstone bedrock may be encountered within 6 feet of the surface. The material is calcareous, the lime content being fairly uniform through the soil profile, but with some accumulation in the subsoil. This series occupies knolls and gently rolling ridges in the western part of the area. The drainage is good. The Shavano series is derived from grayish to buff-colored sandstones. Locally these are massive, but in places they are shaly in structure and have calcareous coatings along the cleavage planes. One type, the Shavano fine sandy loam, is mapped in this area.

Of the soils derived from transported materials, those of the old valley-filling group are the most extensive. These are classed in the Mesa and Billings series. The soils of this group form a mantle of

varying thickness over the shale and sandstone rocks or their residual products, and represent old-alluvial sediments in which weathering has given rise to chemical and physical changes since deposition.

The types of the Mesa series have pale-red or light reddish brown to reddish-brown surface soils, the reddish color as a rule being pronounced. The upper part of the subsoil is reddish brown to pale red, while the deeper part is light gray or, in places, nearly white owing to excessive accumulations of lime. The upper subsoil is prevailingly heavier textured than the surface material and is usually very compact. The gray deeper subsoil carries large quantities of waterworn cobblestones and gravel, derived from sedimentary rocks. In a few localities, the compact lower subsoil is underlain within 6 feet of the surface by brown materials of lighter texture and more friable structure. The surface soil locally carries appreciable quantities of waterworn cobblestones and gravel, especially upon the steeper slopes of the ridges and along the edges of the mesas. The coarse materials consist of well-rounded fragments of sandstone and quartzite. The material of this series is highly calcareous throughout, and in the subsoil a large part of the lime accumulation is in the form of gypsum. The Mesa series includes the greater part of the land in Ashley Valley south of Maeser and Vernal, and occurs also in the mesa region east of Ashley Creek. West of Ashley Creek the types of this series occupy gently rolling ridges, mesas, and old-alluvial fans, while to the east of the creek they occupy the tops of the mesas and have a smooth to gently rolling topography. The surface drainage is good, but the internal movement of moisture is restricted by the heavy and compact subsoil material which in places constitutes a rather soft or feebly cemented lime-carbonate hardpan. The Mesa series is derived from old-alluvial sediments that were deposited over the eroded shales of the region by former streams. Much of this material has been removed through erosion. Occasional remnants indicate that at one time it covered the greater part of the area, except possibly some of the higher ridges and mesas in the eastern and southern portions. Three types of the Mesa series are mapped in this area, the Mesa fine sandy loam with a gravelly phase, the Mesa very fine sandy loam, and the Mesa clay loam.

The types of the Billings series have light grayish brown to light-gray or medium-gray surface soils; the color of the subsoil is usually similar to that of the surface soil, or it may be olive drab when moist. Both the surface soils and subsoil are calcareous, usually with slight concentrations of lime in the subsoil. This series is free from gravel, except small quantities on the surface in places where it has been washed down from the adjacent higher slopes. The subsoil is somewhat more compact than the surface material, and shows a columnar structure where exposed in erosion channels or excavations. In a few places it contains streaks or layers of lighter textured materials. The Billings series consists of old-alluvial fan and footslope material, derived mainly from the erosion of the Mancos shales, which has been slightly modified through weathering. This series occupies rather extensive old-alluvial fans throughout the area, and also narrow areas along many of the smaller intermittent streams in the eastern part of the area. The surface is uniform, except for the presence of narrow, rather deep channels of intermittent streams. Drainage is generally fairly well developed. The Billings very fine

sandy loam and the Billings clay with a phase are the only types of this series developed in the present survey.

The recent-alluvial soils of the area include the soils within the flood plains of Ashley and Brush Creeks and Green River, as well as narrow areas lying along the smaller intermittent streams. Soils of this group also occur on some of the larger alluvial fans that lie between the mesas and the lower lands. Within the Ashley Creek drainage the recent-alluvial materials have been derived entirely from sedimentary and metamorphosed sedimentary rocks consisting of quartzite, sandstone, and shale. Along Green River, and on some of the mesas in the eastern part of the area, the material has been derived largely from sedimentary rocks, but in part from igneous rocks. Locally the recent-alluvial soils are subject to overflow. The soils of this group are correlated with the Naples, Green River, and Redfield series.

The Naples series consists of types with pale-red or light reddish brown to pronounced reddish brown surface soils underlain by a subsoil of similar color, although the subsoil locally becomes more grayish in the vicinity of soils of the Mesa series. The subsoil is permeable, but prevailingly heavier in texture than the surface soil, though without well-developed compaction or columnar structures. Both the surface and subsoil are calcareous and there is a tendency toward concentration of lime in the subsoil, but this is less pronounced than in the Mesa and Billings series, and there is no cementation. As a general rule the types of this series are free from gravel, but a phase of one member carries large quantities of water-worn gravel and cobblestones derived from sedimentary rocks, and within local areas beds of the same materials are found in the subsoil. In the mesa region east of Ashley Creek the soils of this series are underlain locally at shallow depths by beds of shale or some of its weathered products, and the structure and color of the surface soil are affected in places by this condition. The topography varies from smooth and moderately sloping to gently rolling and dissected. In general the Naples series occupies somewhat lower topographic positions than the types of the Mesa series, but individual areas occur on the higher ridges occupied largely by the Mesa soils. The Naples series is most extensively developed in the western and central parts of the area from near Vernal southward. The drainage is generally good. This series is composed of moderately old alluvial sediments laid down as alluvial fans on beds of shale. The materials do not appear to have been greatly modified through weathering, and the series apparently occupies a position intermediate between the older Mesa series and the younger alluvial soils along Ashley Creek. The soils have undergone but little erosion and are not now subject to the action of any destructive agencies.

Included with this series as mapped in this survey are local areas of soils in which the subsoil material appears to consist mainly of material of the Billings soils, over which the Naples material has been superimposed. In these areas the surface soils are identical in color, texture, and structure with those of the typical Naples soils, but the subsoil is heavy textured, compact, and of an olive-drab or grayish-brown color, with occasional mottlings of reddish or brownish hue. In other local areas, included with this series as a shallow phase, the typical surface soils of the Naples series are underlain at depths of 12

to 36 inches by beds of shale, or by an olive-drab clay derived from the decomposition of shales.

Four types of the Naples series and two phases have been mapped in this area. They are the Naples fine sand, fine sandy loam, with a gravelly phase, the loam, with a shallow phase, and the clay loam.

The Ashley series comprises types with brown to light-brown surface soils, underlain by a porous subsoil of a similar color. In some localities a slight reddish hue appears, owing to an admixture of sediments derived from adjacent areas of Mesa and Naples soils. The subsoil varies greatly in texture, but is predominantly lighter than the surface soil. Locally it consists of beds of waterworn gravel and sand. Both the surface soil and subsoil are calcareous. The lime is quite uniformly distributed through the profile, and the subsoil is without compaction or cementation. This series is confined to the flood plains and low terraces of Ashley Creek. Along the upper part of Ashley Creek the surface is flat to moderately rolling and is traversed by a number of small lateral channels. The lower part of the flood plain, southward from a point about due east of Vernal, is flat, and the stream occupies a depressed and well-defined channel. During the period of the spring floods local areas are subject to overflow, resulting in some erosion or in accession of sediments. Aside from the brief flooding in these localities, the drainage is generally good. These soils consist of materials derived through the erosion of the sedimentary rocks in the Uinta Mountains. In this survey local areas of soils of gray color have been included with this series under a phase designation. If more extensive these areas would have been classed in a distinct soil series. Two types and two phases of the Ashley series have been mapped in this survey, the Ashley gravelly fine sand, fine sandy loam, with a loamy phase, and a poorly drained phase of the clay loam type, the typical Ashley clay loam not being developed in this area.

The surface soils of the types included in the Green River series are light brown to light grayish brown or gray in color, though as mapped in this area some material of rather pronounced brownish or reddish color is included. The subsoil, which resembles the surface soil in color, is variable in texture, though prevailingly heavier than the surface material. It is without compaction, cementation, or development of structural horizons. Both the surface soils and subsoil are calcareous, the lime being uniformly distributed. The surface is flat to very slightly undulating. This series is confined to a long strip adjacent to the channel of Green River. Some of the areas are free from overflow and are well drained, but others are subject to occasional floods, and some are swampy throughout the year. This series has been derived from sediments eroded from a wide range of igneous, metamorphic, and sedimentary rocks within the watershed of the river, but materials from sedimentary rocks predominated. Three types of the series are mapped—the Green River very fine sandy loam, loam, and clay.

The types of the Redfield series have permeable and friable, light-red to deep-red or dark-red surface soils. The subsoil has about the same color, but is slightly heavier in texture than the surface soil and is without cementation or accumulation of lime. This series occupies moderately sloping alluvial fans. The drainage is generally good. Both the surface soil and subsoil are calcareous, the lime

being uniformly distributed. This series consists of recent-alluvial deposits, derived largely from the erosion of areas of dark-red sedimentary rocks and to some extent from adjacent areas of Rough broken land and Rough stony land. In this survey local areas of soils are included which differ from the typical Redfield soils in that the material is somewhat older and has developed a rather pronounced compaction and columnar structure in the subsoil. These areas have been mapped as a compact-subsoil phase; but if they were more extensive they would have been classed in a distinct series of soils. Two types and one phase are developed in this area, the Redfield fine sandy loam, with a compact-subsoil phase, and the Redfield clay loam.

In addition to the foregoing series of agricultural soils, there are extensive areas of nonagricultural lands that have been classified as Rough broken land and Rough stony land.

The soil types of the Ashley Valley area 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 below.

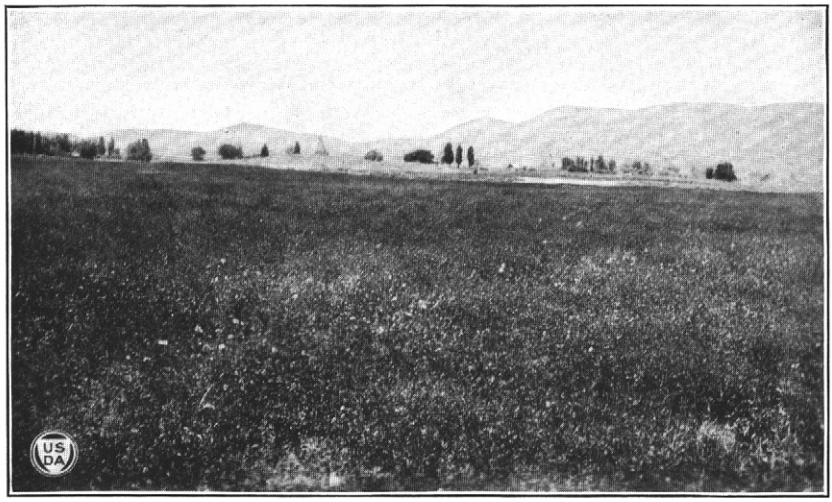
Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Rough broken land	29,952	31.2	Redfield fine sandy loam	384	1.8
Billings clay	12,224	12.8	Compact-subsoil phase	1,344	
Residual phase	128		Green River clay	1,600	1.7
Rough stony land	11,520	12.0	Naples fine sand	1,280	1.3
Naples loam	7,872	9.1	Mesa clay loam	1,216	1.3
Shallow phase	832		Green River very fine sandy loam	1,024	1.1
Mesa very fine sandy loam	8,000	8.3	Shavano fine sandy loam	704	.7
Mesa fine sandy loam	5,184	6.0	Naples clay loam	704	.7
Gravelly phase	576		Ashley clay loam, poorly drained phase	640	.7
Naples fine sandy loam	3,904	5.5	Green River loam	576	.6
Gravelly phase	1,344		Redfield clay loam	384	.4
Ahsley fine sandy loam	1,152	2.7	Billings very fine sandy loam	320	.3
Loamy phase	1,408				
Ashley gravelly fine sand	1,728	1.8	Total	96,000	

SHAVANO FINE SANDY LOAM.

The surface soil of the Shavano fine sandy loam consists of 8 to 12 inches of a light reddish brown to pale-red, porous, friable, fine sandy loam carrying little organic matter. The subsoil generally is a light reddish brown or a grayish-brown to pinkish-colored, very calcareous, compact material of heavier texture extending to a depth of 36 inches or more. This is underlain by bedrock of light-colored, compact, fine-grained sandstone, which is separated in most places by distinct bedding planes that usually carry a thin coating of calcareous material. The texture of the surface soil is somewhat variable, being rather heavy in places and approaching a loam, and the color of the subsoil varies locally to a light grayish brown because of the high accumulation of lime. This type is free from gravel. Both the soil and subsoil are calcareous, but the lime is generally concentrated in the subsoil.

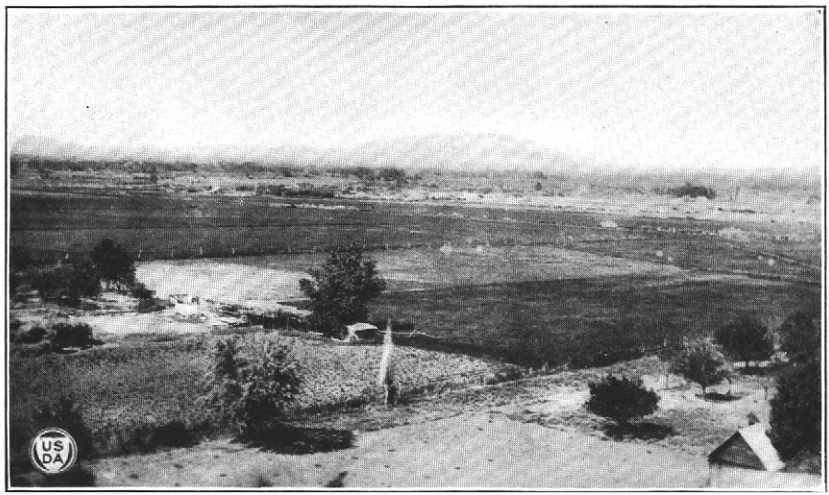
This type occurs in a few small areas about 3 miles south and southwest of Vernal, on a series of ridges extending in a northeasterly



S. 10822

FIG. 1.—ALFALFA ON SOILS OF THE MESA SERIES.

Asphalt Ridge in the background.



S. 10833

FIG. 2.—FARM LAND ON THE BILLINGS CLAY.

Picture taken from a point about 2 miles southeast of Stanaker Canyon. Alfalfa in the foreground. Asphalt Ridge in distance.

direction from the base of Asphalt Ridge. The topography is rather sharply rolling, and the ridges are divided by well-developed stream depressions. The drainage is excellent, and the soil is free from alkali.

The native vegetation consists mainly of a low growth of white sage. A considerable part of this type is under cultivation, largely to small grains and alfalfa. This soil is less desirable for farming than most of the soils in the area, because the uneven topography makes the distribution of water difficult, and the occurrence of bedrock at shallow depths not only restricts the zone of root development but interferes with the internal movement of water. Where the subsoil and topographic features are favorable, this type is adapted to a wide range of crops.

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

Mechanical analyses of Shavano fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
520851	Soil	0.1	2.8	7.2	40.2	25.2	13.0	11.5
520852	Subsoil	.2	1.8	4.3	26.6	29.2	17.2	20.7

MESA FINE SANDY LOAM.

The surface soil of the Mesa fine sandy loam consists of 8 to 14 inches of a light reddish brown fine sandy loam of friable structure and low content of organic matter. This is underlain by a darker or more reddish colored compact material of heavier texture extending to a depth of 18 to 40 inches. The deeper subsoil is a compact, very calcareous, light-gray material, which generally carries a large quantity of waterworn cobblestones and coarse gravel and in most places extends to a depth of 6 feet or more. Gravel is not abundant in the surface soil of this type and is found only near areas of the gravelly phase or in very narrow strips along the steeper sides of the ridges and mesas. Both the surface soil and subsoil are calcareous. In many of the areas along the west side of Ashley Creek the texture of the surface soil is somewhat coarser, and locally there is a thin surface accumulation of small waterworn gravel. In a few places the calcareous compact subsoil does not extend to a depth of 6 feet. but is underlain at a depth of about 5 feet by brownish materials that range in texture from rather coarse sandy loam to heavy loam.

There are three small areas of the Mesa fine sandy loam in the mesa region east of Ashley Creek. These occupy the smooth gently sloping tops of small isolated mesas lying 50 to 75 feet or more above the adjacent soils. The main distribution of this type is to the south and southeast of Vernal on the long ridges and benches that extend from near the base of Asphalt Ridge eastward toward Ashley Creek. In this region a large part of the type occupies the broad tops of gently sloping ridges, but the areas farthest southeast occur on small terraces just above the flood plain of Ashley Creek. Here the surface is smooth to gently rolling, and the limits of each terrace are sharply

defined by abruptly sloping sides. Except on these terraces and on the mesas east of Ashley Creek, there is no line of sharp demarcation between this type and the adjacent types of soil.

The surface drainage is good, and the internal drainage is adequate for the normal rainfall. The compact subsoil greatly retards the movement of moisture, and under irrigation unfavorable moisture conditions have developed within local areas.

The Mesa soils overlie beds of compact shale that have a gradual slope in a southeasterly direction. As the subsoil above the shale becomes saturated with the excess of irrigation water, the outer edges of the mesas occasionally break away and form narrow areas of landslide material. This condition is developing in one or two places in this type just west of Ashley Creek in T. 4 S., R. 22 E.

Under virgin conditions the Mesa fine sandy loam is treeless and supports only a scanty growth of native shrubs. Practically all of the type is under irrigation, the bodies east of Ashley Creek being about the only ones that are not farmed. This soil is devoted largely to alfalfa (Pl. X, fig. 1) and the small grains; it is also well adapted to the growing of small fruits and vegetables.

Mesa fine sandy loam, gravelly phase.—The surface soil of the gravelly phase of the Mesa fine sandy loam consists of 10 to 14 inches of a light reddish brown friable fine sandy loam of low organic content. It carries a large quantity of waterworn cobblestones and coarse gravel derived from sedimentary rocks and consisting largely of dark-colored quartzite. Some sandstone and limestone gravel may also be present. Locally the coarse material is so abundant that it is necessary to clear the land of cobblestones before it can be cultivated. The subsoil consists of a very compact light-gray to nearly white calcareous clay loam extending to a depth of 30 inches or more, but rarely to a depth of 6 feet. When wet this material is sticky or putty-like. It is underlain by a bed of waterworn cobblestones and gravel. The surface soil is subject to minor variations in texture and structure.

The gravelly phase occurs largely in the western part of the area, just below the High Line Canal, and in small bodies south of Vernal at a considerably lower elevation than the greater part of the phase. Most of this soil occupies gently to sharply rolling ridges and benches that extend downward from the Rough broken land along the base of Asphalt Ridge, while the outlying areas occupy small knolls and benches. Areas of the phase are distinguishable in the field because of their elevation above the adjacent soils and by reason of their more uneven topography. The surface drainage is excellent, but the internal drainage is restricted by the partly cemented gravelly substratum.

This phase is derived entirely from sedimentary material deposited by former streams, and the occurrence of the lower detached bodies indicates that at one time there was a rather wide distribution of such material, much of which has been removed by erosion.

The native vegetation consists of white sage and smaller species of the sage and saltbush families. With the exception of one area, all of this phase below the Ashley Upper Canal is under irrigation, but between that canal and the High Line Canal only a part is irrigated. The large proportion of cobblestones and gravel in this phase makes it less desirable than many of the other soils in the area, but this

objection is offset to a considerable extent by the fact that it lies at a higher elevation and has excellent surface drainage and air drainage. Small grains and alfalfa are the principal crops. Small family orchards are maintained in a number of places. This soil is adapted to the growing of fruits and vegetables for local comsumption.

The results of mechanical analyses of samples of the soil, subsurface, and subsoil of the typical Mesa fine sandy loam are given in the table below:

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.*	*Per cent.*
520817	Soil	1.9	2.3	2.4	25.4	37.2	27.8	3.0
520818	Subsurface	.5	3.0	2.8	19.2	29.5	25.3	19.6
520819	Subsoil	.4	1.5	2.0	18.6	38.8	26.9	11.9

MESA VERY FINE SANDY LOAM.

The surface soil of the Mesa very fine sandy loam consists of 8 to 12 inches of a light reddish brown to dark reddish brown friable very fine sandy loam of low organic matter content. This is underlain by a reddish brown to a dark reddish brown material of very fine sandy loam or heavier texture and of compact structure, extending to depths of 24 to 54 inches. This horizon usually becomes more grayish near the bottom of the section, and grades into a very calcareous fine-textured material that contains considerable quantities of waterworn cobblestones and gravel, extending normally to a depth of 6 feet or more. Large waterworn cobblestones and small gravel occur in places on the surface, but are not abundant, except in narrow strips along the outer slopes of the ridges and locally in the vicinity of the gravelly soils of this or other series. Locally the gray compact deeper subsoil does not extend to a depth of 6 feet, and in such places the material of the lower 12 or 18 inches of the 6-foot profile is brownish, permeable, and of loamy texture. A considerable part of this type is of rather heavy texture, verging upon a loam or clay loam, and the boundary between the Mesa very fine sandy loam and the Mesa clay loam is obscure in places.

The chief development of the Mesa very fine sandy loam is in the vicinity of Vernal, extending southward into T. 5 S., R. 21 E. A number of outlying bodies occur in Ts. 4 and 5 S., R. 22 E., and a few occupy the flat tops of mesas east of Ashley Creek in the northern and eastern parts of the area. The greater part of the type occurs on long, gently sloping and rolling ridges. With the exception of narrow strips along some of the minor stream ways, all of this soil has a topography favorable for irrigation and cultivation.

The surface drainage is excellent, but that of the subsoil is deficient, with the result that local areas now have unfavorable moisture conditions owing to the retention of waste irrigation water in the subsoil.

The smaller areas in the vicinity of Ashley Creek support a dense growth of sagebrush, brush, and cottonwoods, but most of the type originally supported a scant growth of desert shrubs. Since irrigation has been extended to cover this soil, the native forms of vegeta-

tion have been replaced very largely by either greasewood, sagebrush, or rabbit bush, depending upon the local moisture and alkali conditions.

With the exception of the areas east of Ashley Creek, all of this type is or has been at some time under cultivation, but at present many fields are used only for pasture because of excessive moisture. Accumulation of alkali has played some part in the abandonment of fields, but this factor has operated only locally.

Alfalfa and small grains are practically the only crops grown upon this type. Vegetables and fruits are grown for home consumption, and usually return satisfactory yields.

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

Mechanical analyses of Mesa very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
520845, 520858	Soil	0.4	1.5	2.4	18.9	44.2	20.0	12.5
520846, 520859	Subsoil	.4	1.8	2.4	18.7	37.5	22.1	17.0

MESA CLAY LOAM.

The surface soil of the Mesa clay loam consists of 10 to 12 inches of light reddish brown to darker reddish brown clay loam. This is underlain by a darker colored compact material of lighter or heavier texture extending to depths of 24 to 30 inches. With increasing depth this layer assumes a lighter tint, and passes into a bed of compact, very calcareous, light-colored, fine-textured material carrying cobblestones and gravel. Waterworn gravel rarely appears on the surface, and the upper subsoil is entirely free of gravel.

This type occurs mainly in a few small bodies in T. 4 S., R. 21 E. Two small areas lie in the northern part of T. 5 S., R. 22 E. The drainage conditions are generally good. The surface is uniform to gently undulating, and some of the areas are traversed by small drainage courses.

The Mesa clay loam is devoted almost entirely to small grains and alfalfa. Vegetables and fruits are grown to some extent, but do not do as well as on soils of lighter texture.

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

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.*	*Per cent.*
520856	Soil	0.5	1.2	1.2	10.0	33.5	26.2	27.4
520857	Subsoil	.3	2.2	2.9	22.4	36.0	11.2	25.0

BILLINGS VERY FINE SANDY LOAM.

The surface soil of the Billings very fine sandy loam consists of 8 to 14 inches of light grayish brown or in places pale-yellowish, friable

very fine sandy loam. The subsoil is a grayish-brown to olive-drab compact material of fine texture. Both the surface soil and subsoil are calcareous, usually with a light accumulation of lime in the subsoil. Some small gravel occurs in the western part of the one area of this type, but none is found along the eastern boundary.

The surface soil of this type assumes a slightly reddish tint where it passes into adjoining soils of other series, and the boundaries beween it and adjacent types are not always definite. The subsoil is prevailingly heavy and compact, but in the extreme western part of the type there is considerable local variation in both texture and structure. Gravel and bowlders occur in the subsoil, often in pockets of considerable size, and lenses of sandy materials are not uncommon.

This type occurs in a single body in the extreme western part of the area in sections 18 and 19, T. 4 S., R. 21 E., where it occupies a broad alluvial fan that slopes noticeably to the east. The greater part of the surface is uniform, but in places it is traversed by the channels of small intermittent stream ways, and occasionally the surface undergoes slight erosion by the waters gathered by those streams. The drainage conditions are excellent, and it is not likely that this type will ever suffer from an accumulation of water.

Small growths of desert shrubs form the bulk of the native vegetation, with sagebrush and occasional greasewood along the banks of the small water courses.

A considerable part of this type lies above the irrigation canals and is not under cultivation. Owing to conditions that govern the height at which water may be diverted from Ashley Creek, the higher parts of the type can only be supplied with irrigation water by pumping. That part of the type lying below the canals is devoted to small grains and alfalfa. It is also adapted to the growing of fruits and many of the vegetables.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the Billings very fine sandy loam:

Mechanical analyses of Billings very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
520826	Soil	0.4	0.9	1.0	17.6	50.5	20.9	8.9
520827	Subsoil	.4	1.2	1.5	17.8	46.6	23.7	8.9

BILLINGS CLAY.

The Billings clay is a light grayish brown to a light-gray or gray compact clay, 6 feet or more in depth, though the subsoil is often an olive drab as freshly exposed and in a wet condition. Locally the surface soil is somewhat lighter textured and less compact than typical, and the subsoil in places contains strata that carry appreciable quantities of very fine sand. Crystals of gypsum of varying size are conspicuous in places on the surface and through the surface soil and subsoil. Fragments of a dark-colored sandstone and quartzite also are present locally on the surface, particularly in areas lying near the higher mesas and ridges. The material of this type is slightly com-

pact, and, when deeply eroded by streams, the soil stands in vertical walls and apparently suffers little erosion by rains.

The Billings clay occurs west of Vernal, and is extensively distributed throughout the region east of Ashley Creek and along Green River. Small areas also occur in T. 5 S., R. 22 E. East of Ashley Creek it appears in bodies of varying size on gently sloping alluvial fans below the mesas, or as narrow areas of alluvial soil along the smaller drainage courses. The largest area occupies a sloping plain about 2 miles northwest of Jensen, which has been formed by the merging of a number of alluvial fans. The areas west of Vernal have a uniform surface that slopes moderately to the east.

A small area about 3 miles north of Vernal, which has been included with this type, differs from the typical Billings clay in its somewhat darker or browner color and lighter texture. Here the surface soil is subject to considerable local variation, as it is frequently covered by thin overwashes of lighter textured materials eroded and transported from the areas of Rough stony land just to the north. The surface of this variation is smooth to moderately rolling and slopes gently to the south.

Owing to the heavy texture of the surface soil of this type, the larger part of the rainfall runs over the surface and into the small drainage channels, but under cultivation the drainage through the subsoil is usually sufficient to care for the irrigation water that passes downward. The drainage in the areas east of Ashley Creek is materially favored by the topographic conditions, as practically all of the areas terminate in steep vertical banks, rising from 6 to 30 feet above the lower lands.

West of Vernal, east of Ashley Creek and Stanaker Draw, and on the higher slopes northwest of Jensen, considerable areas of this type are devoted to grains and alfalfa. (Pl. X, fig. 2.) The other areas are not yet supplied with irrigation water and are not under cultivation. On the areas farmed there is but little probability of any extensive damage by accumulation of alkali, or by the development of a high water table. In the areas lying between Ashley and Brush Creeks, and not now under cultivation, the physical features are not as favorable, and should that district be supplied with irrigation water, unfavorable alkali and moisture conditions may develop.

Billings clay, residual phase.—The surface soil of the residual phase of the Billings clay is a light grayish brown or light yellowish brown to slaty-brown clay extending to a depth of 24 inches or more. The subsoil is a very compact clay, light brown to dark brown or often olive drab in color, which may extend to a depth of 6 feet or more, but is commonly underlain within 6 feet of the surface by beds of more or less decomposed shale. When dry the surface soil is usually cracked and the upper few inches of the soil may assume a finely granular structure.

This phase of the Billings clay represents an inclusion of material of residual origin from shale. If it were of greater extent and importance, this soil would be mapped under a distinct series, probably the Chipeta series, which is represented in earlier surveys in western Colorado. In color and character the surface and subsoil materials are much like those of the Billings series.

This phase occurs in two small areas in the central part of T. 4 S., R. 22 E. The surface is moderately sloping to gently rolling. The

surface drainage is good, but the heavy compact subsoil and the underlying shale greatly retard the movement of moisture.

The soil contains some alkali, and under irrigation the accumulation of alkali would probably become serious, owing to the presence of soluble salts in the underlying shales.

The native vegetation is confined largely to scanty growths of salt sage and other forms of desert shrubs. None of this phase is under irrigation or cultivation, as it lies entirely beyond the present irrigation systems of the area. Under irrigation, its successful cultivation would depend upon the behavior of the alkali. Under favorable conditions of irrigation, cultivation, and freedom from alkali it would probably be found adapted to sugar beets and the small grains. Alfalfa would probably do fairly well on the deeper parts of this phase, but it is doubtful whether the stand would be as permanent as on some of the deeper soils in the area.

The table below gives the results of mechanical analyses of samples of the soil and subsoil 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.*	*Per cent.*
520801	Soil	0.0	0.4	0.6	6.4	20.0	22.1	50.6
520802	Subsoil	.0	.2	.3	5.5	11.5	42.4	40.4

NAPLES FINE SAND.

The surface soil of the Naples fine sand consists of 12 to 24 inches of pale reddish brown to light reddish brown, porous friable fine sand of loamy character, approaching a fine sandy loam, and it may include some fine sandy loam areas. The subsoil is light reddish brown in color and somewhat variable in texture, consisting largely of varying strata of fine sandy loam and loam, with occasional thin lenses of light-brown fine sand. The subsoil is porous, but usually has a slightly compact structure. Both the surface soil and subsoil are calcareous, but the lime is not accumulated as concretions or as a medium of cementation. This type is free from gravel. Locally the surface material is somewhat lighter in texture than typical and some of it has been subject to slight transportation by the wind, and in one small area lying northwest of Vernal the surface soil approaches an incoherent sand in texture.

The Naples fine sand occurs mainly in T. 4 S., R. 21 E. The surface has a gradual slope in an easterly direction and is smooth to moderately rolling. The northern boundary of the larger body is defined by a gentle slope to the level of the adjacent soils, but other boundaries of the type are not indicated by any topographic change. The drainage conditions are excellent, both in the surface soil and subsoil.

The principal vegetation on virgin land is a fairly dense growth of white sage. The larger body of this type is devoted to alfalfa. Small grains do not, as a rule, do as well as on the heavier soils in the area. This soil is especially adapted to the growing of small fruits and vegetables.

The average results of mechanical analyses of samples of the soil and subsoil of the Naples fine sand are shown in the following table:

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.*	*Per cent.*
520809, 520820...	Soil.....	0.1	2.0	3.7	50.7	33.4	5.4	4.7
520810, 520821...	Subsoil.....	.0	.9	2.6	39.6	32.9	14.4	9.6

NAPLES FINE SANDY LOAM.

The surface soil of the Naples fine sandy loam consists typically of 6 to 12 inches of light reddish brown, porous, friable fine sandy loam. The texture of the subsoil is somewhat variable. In the areas south and west of Vernal, the upper subsoil is usually a light reddish brown, rather compact clay loam, but in places it is a rather light-textured loam. East and southeast of Vernal the subsoil is usually a clay loam to a depth of 24 or 36 inches and underlain by beds of waterworn gravel. The latter, so far as is known, extend downward to the dark-colored shale, which, in the only exposure observed, is from 15 to 25 feet below the surface. In the area of the type east of Vernal, along the township line, the surface soil is underlain directly by extensive gravel beds. The gravel is coarse, and largely of a dark-colored quartzite, and occasional fragments carry a thick coating of calcareous material on their lower surfaces.

The Naples fine sandy loam is rather widely distributed in small areas in the region west of Ashley Creek. In the western part of the area the topography is moderately to sharply rolling, and a number of the bodies grade into areas of Rough broken land. In its central distribution the type has a uniform surface traversed by a few small drainage channels. One of the more southern areas occupies the top of a small mesa, while the others occur near the edges of terraces that rise to the west of Ashley Creek. Several of the outlying areas of this type are differentiated from the adjacent soils by slight changes in topography, but throughout its central distribution there are no features to set it apart from the surrounding types.

The drainage conditions are generally good, but in places there is an excess moisture due largely to an accumulation of waste irrigation water from higher lying fields.

The vegetation was originally a thin growth of low desert shrubs, but sagebrush, greasewood, and various grasses have since appeared, owing to changes in the moisture conditions through irrigation.

A large part of the Naples fine sandy loam is either under cultivation or has been abandoned after a period of irrigation. There remain only a few areas of virgin soil, which have not been supplied with irrigation water. Alfalfa and small grains are practically the only crops now grown. This type is also adapted to the growing of fruits and vegetables.

Naples fine sandy loam, gravelly phase.—The surface soil of the Naples fine sandy loam, gravelly phase, is a very gravelly light reddish brown fine sandy loam, 12 to 18 inches deep. The subsoil may carry either more or less gravel than the surface soil, and in places

it is little more than a bed of waterworn gravel. The finer material in the subsoil is usually a light reddish brown fine sandy loam, but strata and lenses of fine sand occur locally. Both the surface soil and subsoil are porous and calcareous.

This phase occurs mainly in narrow irregular areas just above the edges of the terraces along the flood plain of Ashley Creek, and in a number of areas in the vicinity of Green River. One area occupies the top of a small mesa in the central part of T. 5 S., R. 22 E., and a very narrow body lies just west of Ashley Creek in the same township. The surface is level to moderately sloping, and the drainage is good.

The native vegetation is generally a low growth of desert shrubs, and locally some white sage is found on the eastern areas. None of the areas in T. 5 S., R. 22 E., are under cultivation. That east of Vernal is devoted largely to small grains and alfalfa. This soil should also be well adapted to small fruits and a variety of vegetables.

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

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.*	*Per cent.*
520811	Soil	0.0	2.0	3.0	30.0	42.1	12.2	10.7
520812	Upper subsoil	.2	1.8	3.0	32.8	37.2	12.6	12.3
520813	Lower subsoil	.2	1.4	1.9	15.5	32.1	8.7	40.0

NAPLES LOAM.

The surface soil of the Naples loam is a light reddish brown to light-brown, rather sticky loam, 10 to 12 inches deep. This is typically underlain by either a clay loam or a clay which is compact, of a reddish-brown color, and generally extends to a depth of 6 feet. Fine waterworn gravel occurs on the surface in the more eastern bodies, but is found only in very small quantities in the western areas of the type. Where the heavy subsoil does not extend to a depth of 6 feet, it is commonly underlain by beds of gravel. In places the substratum consists of brownish, light-textured material similar to that underlying the deeper subsoil of the Mesa series.

In a local variation the subsoil below 10 to 12 inches is an olive-drab compact clay, extending to a depth of 6 feet or more, which represents underlying material of the Billings series. Both the surface soil and subsoil are calcareous, and the variation is free from gravel.

In the areas of Naples loam between Ashley and Brush Creeks, shale or the products from the weathering of shale may appear within 6 feet of the surface, and the presence of these materials results in a somewhat lighter color and a more compact structure of the surface soil in places.

Both the surface soil and subsoil of this type are calcareous, and the color of the subsoil is locally somewhat grayish because of the accumulation of considerable quantities of lime.

The Naples loam is rather widely distributed west of Ashley Creek, and a number of small areas occur east of that stream. The topography is moderately rolling, and the boundaries of the areas farthest south and east are rather sharply defined by surrounding areas of Rough broken land.

The surface-drainage conditions are good, and those of the subsoil are good in most places. East of Ashley Creek, and locally in some of the southern bodies, the presence of shale at relatively shallow depths greatly retards the movement of moisture. Should that part of the area be placed under irrigation, unfavorable alkali and moisture conditions may develop.

The native vegetation is a rather thin growth of desert shrubs. Practically all of the type in T. 4 S., R. 22 E., is under cultivation. East of Ashley Creek a part of one area of this type is under irrigation, but the remaining bodies have not yet been reached by any of the canals and are still in a virgin condition. In T. 5 S., R. 22 E., all of this type west of Ashley Creek is under the canal systems, but only a part has been placed under cultivation. The type is devoted largely to small grains and alfalfa. It is also adapted to the production of fruits and many vegetables, which are grown to some extent.

Naples loam, shallow phase.—The shallow phase of the Naples loam consists of the usual light reddish brown surface soil of the Naples loam, underlain at depths of 12 to 36 inches by either a compact olive-drab clay, which is residual from the underlying shale or by beds of slightly weathered shale. This phase occurs in a number of irregular areas from 2 to 3 miles west and southwest of the settlement of Naples.

The phase occupies moderately to sharply rolling ridges that are separated by rather deeply cut stream channels. The drainage conditions are usually good, but in the most southern area—in section 11, T. 5 S., R. 21 E.—the subsoil has become water-logged, owing to the compact layer, and conditions in the western part of that area have become unfavorable for the growth of cultivated crops. Where the drainage conditions are favorable this phase is adapted to alfalfa and small grains.

The results of mechanical analyses of samples of the soil, upper subsoil, and lower subsoil of the typical Naples loam are given in the table below:

Mechanical analyses of Naples loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
520814	Soil	0.4	1.0	1.2	12.3	35.8	30.9	18.7
520815	Upper subsoil	.0	.2	.2	3.3	21.5	40.7	34.2
520816	Lower subsoil	.0	.3	1.0	15.4	44.2	20.4	18.8

NAPLES CLAY LOAM.

The surface soil of the Naples clay loam consists of 8 to 16 inches of a light reddish brown, rather heavy clay loam. In its typical development, the subsoil is reddish brown to dark reddish brown in color, compact in structure, and somewhat variable in texture.

Practically no gravel is found. Both the surface soil and subsoil are calcareous.

As mapped in this survey the surface soil departs somewhat from the typical color, owing, in part at least, to unfavorable drainage conditions, and within local areas it may assume a grayish-brown or dark grayish brown tint. In such areas the subsoil also is usually lighter colored than normal. The texture of the subsoil as a rule is heavier and the structure more compact than the surface soil, but in some of the more elevated western areas the subsoil contains strata and lenses of loam and fine sandy loam. Another variation occurs about 1 mile east and a little north of Maeser. Here the deeper subsoil is olive drab to gray in color, compact in structure, and heavy in texture. This represents material of the Billings series, over which the Naples material has been superimposed.

This type is confined mainly to long strips near small intermittent stream courses in the region west of Ashley Creek. The drainage conditions range from good to locally deficient, and in small areas semiswampy conditions exist for a large part of the time.

The native vegetation was originally a low growth of shrubs, but since the development of irrigation on this and adjacent types of soil, sagebrush, greasewood, and grasses have appeared in several localities.

Practically all of this type has been under cultivation at some time, but considerable areas have been abandoned because of the accumulation of seepage water. Where drainage conditions are satisfactory, alfalfa and the small grains are the principal crops.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Naples clay loam:

Mechanical analyses of Naples 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.*	*Per cent.*
520807	Soil	0.0	0.3	0.4	9.2	21.1	41.4	27.5
520808	Subsoil	.0	.3	.6	22.7	46.0	20.5	10.0

ASHLEY GRAVELLY FINE SAND.

The surface soil of the Ashley gravelly fine sand consists typically of 12 to 20 inches of light-brown friable fine sand that carries a large proportion of waterworn gravel and small bowlders. The fine-earth material is comparatively loamy and the type as mapped may include some areas of fine sandy loam. Fine gravel is present locally, but only in small quantities. The subsoil consists of a mass of small bowlders, with sand as the interstitial material. This type is separated from the fine sandy loam of the series on the basis of the slightly lighter texture and the gravel content of the surface soil. The distribution of the coaser material is very irregular, and throughout the type there are small patches that are gravel free. The gravel subsoil, however, is a constant feature. Both the surface soil and subsoil are calcareous.

The surface of this type is usually characterized by a series of low hummocky ridges, with intervening depressions lying roughly parallel to the course of Ashley Creek. Along the stream the soil generally forms a vertical bank or cut, from 4 to 8 feet high. The type is subject to occasional overflows, and often suffers more or less erosion at such times. Between periods of overflow the drainage conditions are good.

This type occurs in the narrow flood plain of Ashley Creek and constitutes the larger part of the recent-alluvial soils deposited by that stream, their area extending from the northwestern corner of the area, in a southeasterly direction for a distance of about 8 miles.

Over a large part of the type the native vegetation consists of dense growths of cottonwood, willow, and underbrush; white sage and smaller shrubs are common on the more elevated bodies. All of this type is reached by irrigation canals, but probably not over 50 per cent of it is under cultivation. This condition is due in part to the large quantities of stone present, and in part to the very heavy growth of native vegetation. It requires considerable work to remove the stones and clear away the vegetation to fit the land for cultivation.

Alfalfa and the small grains are the only important crops grown at the present time. The soil is porous, friable, and well drained, and aside from a slightly greater danger of late spring frosts than in the more elevated soils of the area, it is well adapted to fruits and a wide range of garden crops.

The results of mechanical analyses of samples of the soil and subsoil of the Ashley gravelly fine sand are shown in the following table:

Mechanical analyses of Ashley gravelly fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
520805	Soil	0.6	2.3	2.4	26.4	55.0	11.2	2.1
520806	Subsoil	.2	.9	2.0	43.2	35.6	11.3	7.0

ASHLEY FINE SANDY LOAM.

The surface soil of the Ashley fine sandy loam consists of 12 to 18 inches of a friable, porous, brown to light-brown fine sandy loam. In a few localities the fine sandy loam may extend to a depth of 6 feet, but usually the subsoil is lighter textured than the surface material, and consists either of beds of coarse gravel and bowlders, or strata of sandy loam and fine sandy loam. The color of the fine material is predominantly a light brown. Owing to the irregularity of the distribution of the cobbles and gravel and variation in texture of the surface materials, this type includes patches of the gravelly fine sand of the series. These are too small to be shown on the map.

The surface is flat to undulating and is cut by shallow abandoned stream courses. The soil is occasionally subject to overflow, but seldom suffers any severe erosion or sedimentation. The drainage is good and the soil is free from alkali. This type occurs within the flood plain of Ashley Creek and within the relatively low flat area of alluvial soils between Ashley Creek and Stanaker Draw.

The native vegetation consists of willow, cottonwood, and other tree and brushy growths, including sagebrush. Very little of this type has been cleared and placed under cultivation, although irrigation water is available for all of it. The lack of development is primarily due to the very heavy growth of native vegetation. This type is adapted to alfalfa, fruits, small grains, and vegetables.

Ashley fine sandy loam, loamy phase.—The loamy phase of the Ashley fine sandy loam consists of 12 to 18 inches of light-brown to brown fine sandy loam of rather heavy loam texture, underlain by fine sand, fine sandy loam, or beds of gravel. As a rule there is no gravel in the surface soil.

There are a number of local differences in the texture, structure, and color of the soil and subsoil of this phase, that become more apparent as the phase is followed southward along Ashley Creek. The color of the surface soil gradually assumes a somewhat darker shade, and at the southern extremity of the soil area a reddish-brown tint is not uncommon. From north to south, there is a gradual replacement of the sands and gravel in the subsoil by darker colored and somewhat heavier textured sediments, in the main loam and occasionally heavier. In T. 4 S., R. 22 E., the surface soil is grayish brown in places, with mottlings of a darker color from the presence of organic matter. In the southern extension of this phase, local areas too small to show on the map are dark gray, owing to deficient drainage.

The surface of this phase is level to gently undulating, but broken locally by abandoned channels of Ashley Creek. The drainage conditions range from good to poor. The larger part of this phase has an elevation above the creek that is sufficient to afford good drainage for the normal rainfall, but the soil is not everywhere able to remove the waste irrigation waters received from the higher lands.

The more northerly areas of this phase support a dense growth of trees and underbrush; to the south a heavy growth of brush occurs on uncleared areas. A considerable part of this land is under cultivation to alfalfa and small grains, for which it is adapted where drainage conditions are favorable, but the water-logging of the soil following irrigation has led to the abandonment of some areas. This land occupies a position considerably lower than most of the soils of the area, and there is a slightly greater danger of late spring frosts.

The following table shows the results of mechanical analyses of samples of the soil and subsoil 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.*	*Per cent.*
520832	Soil	1.0	1.3	1.2	30.2	40.4	16.3	9.7
520833	Subsoil	.2	1.0	2.0	38.8	38.2	13.0	6.8

ASHLEY CLAY LOAM, POORLY DRAINED PHASE.

The Ashley clay loam is represented in this survey only by a poorly drained phase, the typical Ashley clay loam not being developed. The surface soil of this phase is a dark-gray clay loam, black when

wet, extending to a depth of 8 to 12 inches. The subsoil is a compact grayish-brown clay that may extend to a depth of 6 feet, but in places is underlain by beds of waterworn cobblestone and gravel at depths of 36 to 60 inches. Some stones are present in the surface soil.

This phase really represents material of darker color and more poorly established drainage than the typical Ashley soils, with which it has been included owing to its small extent. If of greater extent and importance, it would have been recognized as a member of a different soil series.

This phase has a gently undulating surface. The drainage is very deficient and a large part of the land once cultivated has been abandoned and is now used only for pasture. The extreme western end of the area of this phase is under cultivation and is devoted to alfalfa and small grain.

GREEN RIVER VERY FINE SANDY LOAM.

The surface soil of the Green River very fine sandy loam consists of a light grayish brown, light-textured very fine sandy loam from 12 to 18 inches in depth. The subsoil is usually variable, consisting of comparatively thin strata of sand, fine sand, fine sandy loam, and very fine sandy loam, without regular order of arrangement and very rarely including heavier textured materials. Both the surface soil and subsoil are calcareous, the lime being uniformly distributed through the soil profile. As mapped the type includes small areas of fine sandy loam texture. The Green River very fine sandy loam occurs in a few long narrow areas paralleling the course of Green River. The two most northerly areas form smooth rounded knolls slightly elevated above the adjacent lands. The drainage conditions are good, but for a short period in spring, when Green River is at its flood stage, parts of the type may be subject to overflow.

The native vegetation consists largely of cottonwood, willow, and underbrush, and in places this growth is very dense. None of this type is under cultivation. When cleared, protected from overflow, and irrigated this soil should be well adapted to the growing of alfalfa, fruits, and a variety of vegetables.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the type.

Mechanical analyses of Green River very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
520847	Soil	0.2	0.6	0.6	16.4	52.0	20.4	9.7
520848	Subsoil	.0	.2	.1	20.3	58.5	13.9	6.9

GREEN RIVER LOAM.

The surface soil of the Green River loam consists typically of 10 to 15 inches of light grayish brown to light brownish gray, rather light textured loam. This is underlain to a depth of 6 feet or more by a compact light grayish brown clay loam or clay. Both the surface soil and subsoil are calcareous.

As mapped in this survey, this type includes a number of variations in both texture and color. Where it adjoins areas of the Green River clay or the Billings clay, the boundaries between the types are very indefinite, the types merging through imperceptible gradations of both color and texture in the soil and subsoil. Other areas occur in which the surface soil is of silty texture, and much of the material of this type is of too pronounced reddish brown color to be typical.

The Green River loam occurs in four narrow bodies along or near the channel of Green River in Ts. 4 and 5 S., R. 23 E. The surface is smooth. The drainage is generally good, except during floods in the river.

This type is devoted mainly to alfalfa, but is adapted also to the growing of small grains.

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

Mechanical analyses of Green River loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
520862	Soil	0.4	1.1	0.6	7.4	36.2	38.1	16.3
520863	Subsoil	.2	.9	.6	5.3	27.5	34.2	31.2

GREEN RIVER CLAY.

The surface soil of the Green River clay is a grayish-brown to rather dark brownish gray clay, about 12 inches deep, marked in places by streaks of a darker color from local accumulations of organic matter. The subsoil is somewhat variable, but generally consists of grayish-brown compact clay. In the large body of the type occurring about 1½ miles southwest of Jensen, there is a fairly persistent layer of grayish-brown coarse-textured sandy loam below 36 inches. Gravel is absent from this type. Both the surface soil and subsoil are slightly to strongly calcareous.

This type occupies a number of low-lying areas along Green River from the vicinity of Jensen to the point at which the river leaves the survey. The surface is level. All of this type is subject to overflow, and the drainage conditions are very poor. In places the land is slightly depressed and retains waste irrigation water and the flood water from Green River throughout the year. Such areas are indicated on the soil map by the fresh-water marsh symbol. Grasses, cat-tails, and rushes form the native vegetation.

None of this type is under cultivation, and aside from some grazing during the summer months, it is of no agricultural value. Reclamation is not impossible, but the small extent of the individual areas would hardly justify the construction and maintenance of the necessary levees and drains.

REDFIELD FINE SANDY LOAM.

The surface soil of the Redfield fine sandy loam consists typically of 8 to 12 inches of a red fine sandy loam. The subsoil to a depth of 6 feet or more is a red light-textured fine sandy loam which locally includes strata of either heavier or lighter textured material

of similar color, and without well-developed compaction or structural horizons. In the vicinity of areas of the Redfield clay loam a red clay subsoil is sometimes encountered. In the southern extension of this type the color is more a reddish brown than red, and water-worn gravel is encountered locally at a depth of about 36 inches. In some of the included areas the surface soil is of heavier texture than typical, approaching a loam. Both the surface soil and subsoil are calcareous, the lime usually being distributed uniformly.

This type occupies part of a broad slope in the northern part of T. 4 S., R. 21 E. The surface is smooth and only moderately sloping. Drainage courses with deeply cut channels afford good drainage.

In the northern areas the native vegetation consists mainly of desert shrubs, with sagebrush along the water courses. In the southern areas the growth of brush in places is very heavy. A considerable part of this type is under cultivation to small grains and alfalfa. Fruits and garden crops should also do well on this soil.

Redfield fine sandy loam, compact-subsoil phase.—The color of both surface soil and subsoil of the compact-subsoil phase varies from that of the typical fine sandy loam in that it is darker in some places and lighter in others. The phase represents a somewhat more advanced stage of development, and the profile of the surface soil and subsoil includes zones of compaction due to the action of weathering agencies. Otherwise the material of this phase is similar to that of the type.

The phase is of considerably greater extent than the typical Redfield fine sandy loam. It occupies fairly large areas in the extreme northern part of the survey, and between Stanaker Draw and Ashley Creek.

REDFIELD CLAY LOAM.

The Redfield clay loam consists typically of 6 feet or more of red to dark-red compact clay loam. Both the surface soil and subsoil are calcareous. The material is uniform in structure and without horizons of lime accumulation. Gravel is absent in this type. Some variations in texture are included which grade into lighter and heavier textured materials.

This type occurs in two small areas along Stanaker Draw in the northern part of the survey. The surface is generally smooth and slopes gently to the south, but along the western line of T. 4 S., R. 22 E., it is somewhat eroded and cut by a number of meandering channels of former water courses. The lower part of this type is subject to occasional overflows from Stanaker Draw, but as a rule the drainage is good.

On the lower land there is a heavy growth of trees and underbrush, but on the more elevated land the native vegetation consists of a scattering growth of desert shrubs. The more southerly of the two areas is not yet under cultivation, but the larger part of the northern body is used in growing grain and alfalfa, both of which give excellent returns.

ROUGH BROKEN LAND.

Rough broken land covers those parts of the area which are non-agricultural because the topography is so uneven or steep that the land can not be placed under cultivation. It includes the narrow, steep

to precipitous slopes or terrace fronts between the numerous mesas, the steeply sloping areas below areas of Rough stony land, and extensive areas where the erosion of the soils has been sufficient to make the surface too uneven for cultivation. West of Ashley Creek the steep terrace slopes are prevailingly gravelly and light textured, as are also the several areas occurring along the western boundary of the survey. East of Ashley Creek the Rough broken land is composed largely of eroded areas of shale, or of clay derived from shale.

The land is not suited to cultivation and has only a low value for grazing.

ROUGH STONY LAND.

Rough stony land includes areas of rough or eroded unfavorable topography which in addition contain enough rock outcrop or fragmental rock to prevent successful cultivation. This type of material extends in an irregular belt around the northern and southwestern sides of the area. It consists of extensive areas of sandstone and shale formations having at most only a shallow covering of soil. It has no agricultural value except for grazing.

IRRIGATION AND ALKALI.

Water for irrigation is drawn almost entirely from Ashley and Brush Creeks. Water from Green River is used on only one farm, where it is raised to the land by pumping. In Ashley Creek the flow is very irregular from season to season. During the spring, when the snow upon Uinta Mountains is melting rapidly, large volumes of water pass down the stream and into Green River; during the late summer season the flow is so small that there is not sufficient water to supply all the lands reached by the present canals. It is said that conditions are favorable for storage in a number of localities in the upper parts of the watershed. A few small attempts have been made to hold back some of the water, but no serious and well-planned work has been carried on. Brush Creek has a discharge similar to that of Ashley Creek, and so far the volume has been sufficient to irrigate the lands under the present canals. The depressed channel and low fall of Green River make it impossible to divert the water except at a cost out of proportion to the small area of land to be served, and it appears that irrigation from this source will be restricted to such areas as may be supplied by individually owned pumping plants.

Irrigation began in this area about the year 1879, when the first settlers along Ashley Creek constructed small canals to water the adjacent lands. As the settlement in the valley increased, canals were constructed to carry the waters of the stream to the higher lands, first on the northern side of the valley, and later to those around Vernal and farther south. The irrigation season begins about the middle of April and closes about the latter part of September.

The check and border systems of irrigation are not used in this area. The fields are leveled to some extent, and later the surface is gone over with a marker that forms small parallel furrows down or across the slope, depending upon the grade of the slope. Water is led to the heads of these furrows by small laterals, and the distribution over the field is obtained by changing the flow at the proper

time. In general, the practices followed in the irrigation of land are extremely wasteful of water, as the quantities commonly applied are larger than can be taken care of by either the soil or the crop. The fields are seldom leveled so carefully that the best distribution results, and much water is wasted either by passing through the subsoil or over the surface. Water-logging has followed in many areas and drainage is necessary at the present time in a number of localities to remove waste irrigation water. The area of water-logged soils will increase if the present methods of irrigation are continued.

Some alkali was originally present in the soils of the area before irrigation was begun, being most extensively distributed in soils derived from the Mancos shales. At the present time the accumulation of alkali is evident in the soils of the Mesa, Naples, and Billings series, and its concentration seems to be rather intimately associated with the water-logged areas of soil in those types. Some alkali has always been present in some of the soils along Green River, and locally the amount is too large for the growth of cultivated crops.

The alkali conditions in the soils of this area are being investigated by the Utah Agricultural Experiment Station at Logan, Utah, and the result of that study will be published by that station in the form of a bulletin for public distribution.

SUMMARY.

The Ashley Valley area is in Uintah County in the northeastern part of Utah. It has an extent of 150 square miles, or 96,000 acres.

The area lies just south of the Uinta Mountains and consists of the bottom lands and moderately rolling valley of Ashley Creek, which is surrounded by extensive areas of rolling and broken country and the narrow terraces and flood plains along Brush Creek and Green River. In the Ashley Valley, outside the flood plains immediately adjacent to these streams, the land is a series of gently rolling ridges and numerous intermittent stream ways that extend toward Ashley Creek. The region between Ashley Creek and Green River consists of small elevated mesas surrounded by extensive areas of moderately rolling to severely eroded lands of lower elevation.

Elevation ranges from about 4,700 feet to nearly 6,000 feet above sea level.

The natural drainage of the area is good, except in a few places along Green River and Ashley Creek. The entire drainage of the area flows into Green River, one of the main tributaries of the Colorado River.

The area was first settled about 40 years ago with the establishment of the old town of Ashley, about 1½ miles northeast of Maeser. Agriculture was at first confined to the soils along Ashley Creek, and later spread to the lands in the vicinity and to the south of Vernal.

Railroad connections are from 50 to 135 miles from Vernal, and passenger and freight traffic are handled by automobiles and by motor trucks. Good wagon roads extend to all parts of the area.

The climate is characterized by a low annual rainfall, cool summers, and severe winters. Maximum temperatures of 100° F. are very rare, and the winter temperatures often drop to 20° or more below zero. The average length of the growing season is from May 17 to September 25. The average annual rainfall is 8.59 inches. The precipitation

is much heavier in the Uinta Mountains. The rains and snows in this range supply the water used for irrigation of the lands in the area.

Agriculture in the Ashley Valley area is mainly of the self-sustaining type, owing to the distance to railroads. Wheat, oats, and alfalfa are the principal field crops. Vegetables and fruits are grown for home use. The livestock industry is the main source of cash income. Sheep and cattle are grazed in the mountains in large numbers through the summer, the marketable animals are driven to market in the fall, and the rest are fed in the valley through the winter. Dairy products are marketed through the local creamery. Poultry raising and beekeeping are of considerable importance.

Nineteen types of soils, with seven phases, have been mapped in this area. The most important are of the Mesa, Naples, Ashley, Billings, and Green River series. A number of other soil series have been recognized, but they are of small extent.

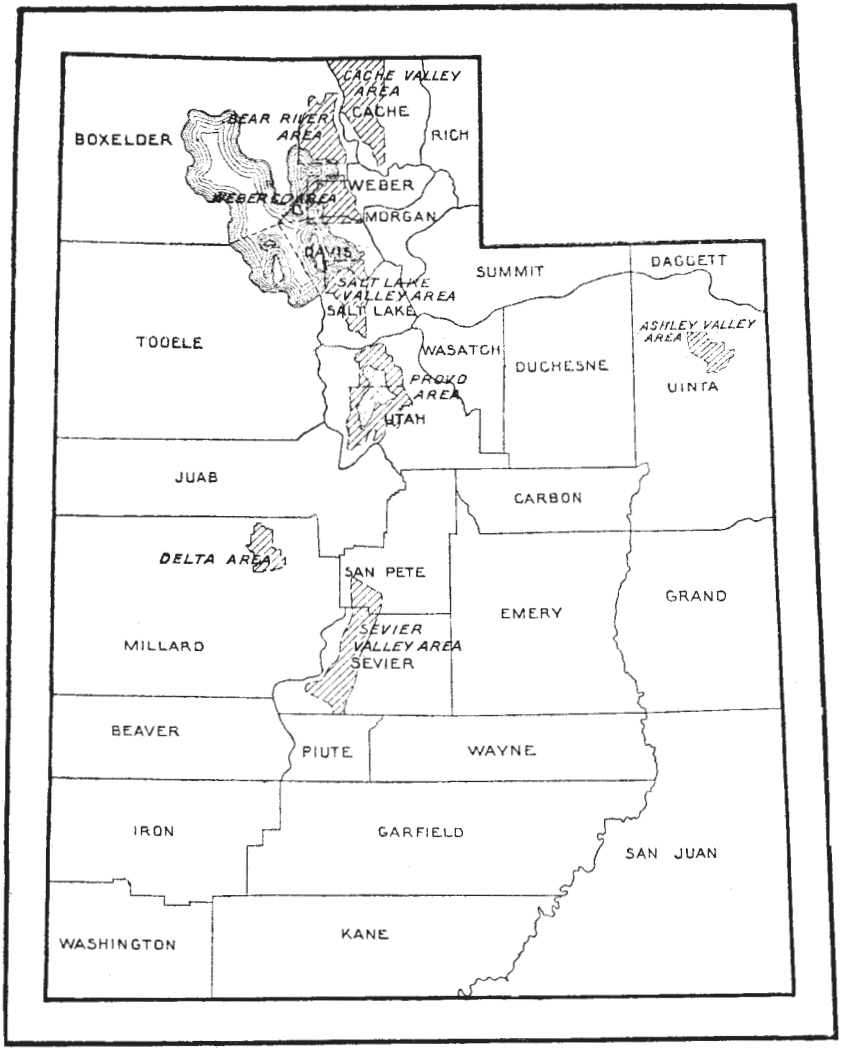
Most of the soils in the area consist of reddish-brown to brown fine sandy loams, very fine sandy loams, and clay loams. Fine sands, loams, and clays are also mapped. In many types the subsoils consist of beds of a very compact calcareous fine-textured material with cobbles and gravel, but some of the types have permeable or porous subsoils. The natural drainage conditions are good, except in restricted areas.

The soils are derived largely from slightly modified old-alluvial sediments laid down by former streams. Throughout Ashley Valley considerable quantities of these old sedimentary materials have been removed, giving rise to the local topography of low rolling ridges and mesalike areas, and have been replaced in part by the recent-alluvial deposits within the flood plain of Ashley Creek. The soil materials within Ashley Valley have been washed from sedimentary rocks, while those along Green River and on some of the mesas have been derived from both sedimentary and igneous rocks, the former predominating. Residual soils form but a small part of the area. These are derived entirely from sandstone and shale.

Irrigation water is obtained by diverting the flows of Ashley and Brush Creeks, and by pumping from Green River. The fields are irrigated by flooding, and much of the water is wasted. Water is abundant in the spring and early summer months, but later a rotation in the use of water is necessary in order that all the land may be irrigated. Storage in the Uinta Mountains would result in a more constant supply of water.

While the area surveyed is as a whole well drained, the use of excessive quantities of irrigation water has resulted in a high water table and in the water-logging of numerous soil areas of varying extent. The damage from waste irrigation water, with accompanying accumulation of alkali salts, is gradually increasing.

Alkali conditions in the soils of this area are under investigation by the Utah Agricultural Experiment Station, and the results of this work will be published in a bulletin to be issued by that station.



Areas surveyed in Utah, shown by shading.

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