U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF SOILS
IN COOPERATION WITH THE SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

SOIL SURVEY OF GRANT COUNTY SOUTH DAKOTA

BY

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[Advance Sheets—Field Operations of the Bureau of Soils, 1922]

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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, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]

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SOIL SURVEY OF GRANT COUNTY, SOUTH DAKOTA

By W. I. WATKINS, of the U. S. Department of Agriculture, in Charge, and W. H. PIERRE, of the South Dakota Agricultural Experiment Station

DESCRIPTION OF THE AREA

Grant County is in the northeastern part of South Dakota. The eastern boundary consists of the South Dakota and Minnesota State line. Roberts County bounds it on the north, Day and Codington Counties on the west, and Codington and Deuel Counties on the south. The county has an area of 685 square miles, or 438,400 acres.

Physiographically, Grant County falls into two general divisions, "the hills" and "the valley," the latter occupying about half of the eastern part of the county[1] and containing the stream channels of Whetstone and Yellow Bank Rivers and their tributaries. The hills, which form the western limit of the valley, are morainal, of the Minnesota lobe of the Wisconsin glaciation. These hills begin about 4 miles north of Marvin and extend across the county in a southeasterly direction, just east of Marvin, west of Twin Brooks, east of Labolt, and west of Revillo, and then south to the county line. The valley slopes gradually to the east. The following elevations[2] of three points across the valley will give an idea of the degree of its slope: Twin Brooks, 1,253 feet; Milbank, 1,141 feet; and Big Stone City, 967 feet. The low-water mark on Big Stone Lake, just east of Big Stone City, has an elevation of 962 feet, which is said to be one of the lowest points in the State. The topography of the valley varies from flat to undulating or slightly rolling.

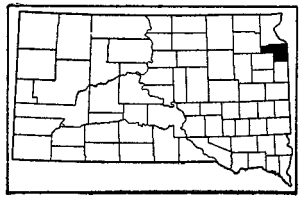

FIG. 49.—Sketch map showing location of Grant County, South Dakota

A practically flat strip of country about 7 miles wide lies immediately east of the hills, and east of this the topography becomes slightly undulating to undulating, the more undulating areas occurring along the streams. The area at the junction of sections 4, 5, 8, and 9, in T. 120, N., R. 47 W., is rolling. A chain of well-defined hills, in which Big Tom Hill is the most prominent point, extends in a southeasterly direction from section 13, south of Lake Albert, to section 9, T. 119 N., R. 46 W., near the State line. The northern end of this hill belt is broader than but not so prominent as the southern end. This belt can be traced very easily on the soil map by noting the areas occupied by Pierce fine sandy loam and the rolling stony phase of Barnes loam. The descent to the old river channel

[1] Throughout this report the term "the valley" refers to this eastern part of the county.

[2] Gannett, Dictionary of Altitudes.

occupied by Big Stone Lake is abrupt, ranging between 50 and 75 feet.

The hills, as they are commonly called, include two groups, the hills proper and those hills which occur in the Sioux River drainage basin, an intermorainal area lying between the Minnesota and Dakota lobes of the Wisconsin glaciation. The latter lobe just touches the southwestern corner of the county. The topography of this basin varies from the flat benches along the streams to the rolling condition in Mazeppa Township.

The hills proper occur as a belt extending across the center of the county, the northern end of which has a width of 6 miles and the southern end a width of 12 or 15 miles. The ascent from the valley to the hills varies greatly, it being very slight near Revillo and Labolt and more pronounced to the north. Marvin is located at an elevation of 1,654 feet, which is 401 feet higher than Twin Brooks, most of this difference occurring within 2 miles of Marvin. To the north of Marvin the ascent is more abrupt. Boating Lake has an elevation of about 2,000 feet, or about 350 feet higher than Marvin, but the ascent here is more gradual with no sharp escarpment like that separating the hills and the valley.

The topography of the hills, the western portion of the county, varies from undulating to rough, the greater portion being undulating to rolling. This area extends south and east from Marvin through Stockholm, Strandburg, and Labolt, that part having the smoothest topography lies southeast of Labolt along the edge of the hills. The topography to the west of this area is rolling to rough, rough in areas bordering the Big Sioux River basin. That part lying north, east, and southeast of Marvin to the northwest corner of Twin Brooks Township has the same topography, the rougher portion occurring at the eastern edge of the hills.

Another topographic feature of Grant County is Antelope Valley, which lies between the hills proper and the Big Sioux River basin. This is a narrow V-shaped valley beginning in section 6 of Mazeppa Township and extending south into Codington County. The area around Troy is probably part of Antelope Valley.

The drainage is effected by three streams—Big Sioux River, which drains the western part of the county, and Whetstone and Yellow Bank Rivers and tributaries, which drain the eastern part of the county.

Some of the small streams which flow only during rainy periods, after emerging from the hills, spread their waters over the flat valley, while others have distinct stream beds for a short distance, then disappear, and reappear again farther on, until on the eastern edge of the flat area they form streams with distinct channels. An example of such a stream is that flowing through the middle of Kilborn and Melrose Townships. In the flat part of the valley small stream channels originate at bends of the larger streams, such channels being indicated by the soils mapped. It is probable that at one time the water flowed through both channels during wet seasons; but since cutting deeper channels the streams now seldom overflow, and the higher, less-used channel can be traced only by sedimentary deposits. Examples of such abandoned stream channels are found in section 14 of Madison Township, section 16 of Grant Center Township, section

13 of Kilborn Township, and section 36 of Vernon Township. The water table is close to the surface in the flat valley strip, owing probably to the underground water coming from the hills.

Water is easily obtained and is plentiful, being supplied mostly by shallow wells. Along the streams in the flat portion of the valley are several flowing wells. The water from most of these wells contains magnesium sulphate. Some farmers utilize the springs for household and other farm uses.

Grant County was created in 1873 from a part of Deuel County and was organized in 1878. Part of it was annexed to Codington County in 1877 and part to Roberts County in 1883. A part of the old Sisseton and Wahpeton Indian Reservation has been annexed to Grant County. The French fur traders are known to have reached this section early in the eighteenth century, but the first permanent settlement in the county was made about 1865, and general settlement began about 1877 or 1878. The 1880 census shows a total population of 3,010, all classed as rural. This was doubled by 1890 and increased to 9,103 by 1900. Since then the increase has been slow. The 1920 census shows a population of 10,880, classed as rural, with an average of 15.7 persons per square mile. Probably the number per square mile outside of the towns would not be more than 7 or 8. The valley is more densely populated than the hills. The early settlers came principally from the States to the east and from Germany and the Scandinavian countries. The present inhabitants are mostly descendants of these early settlers.

The chief towns are Milbank, the county seat, with a population of 2,215 in 1920, and Big Stone City, with 630 population. The smaller towns are Twin Brooks, Marvin, Troy, Stockholm, Strandburg, Labolt, Albee, and Revillo. The first two are west of Milbank and all the others are in the southern third of the county. Milbank is the largest and best improved city in the county, and it has been the county seat since 1882, when the county seat was moved to Milbank from Big Stone City. The town and country schools are very well equipped. There are very few consolidated schools in the county.

The main line of Chicago, Milwaukee & St. Paul Railway, running from Chicago to Tacoma, Wash., passes through Big Stone City, Milbank, Twin Brooks, and Marvin, and a branch runs from Milbank to Sisseton, in Roberts County. This main-line railroad is double-tracked throughout the county and it is the chief means of transportation. Two other railroads—Great Northern and Minneapolis & St. Louis—cross the southern part of the county, practically paralleling each other. All three railroads run through Minneapolis. Minneapolis, St. Paul, and Chicago are the chief outside markets for the agricultural products of the county.

The county has a rather well-kept road system, and except during periods of excessive rainfall the roads are usually in good condition. Part of the main highways are graveled. Practically all section lines are open and can be traveled by automobile.

CLIMATE

The climate of Grant County is characterized by warm, dry summers and long, cold winters, during which an average of 30 inches of snow falls. The fall months are especially enjoyable

because of their cool, bright, clear days. The mean annual temperature, according to the records of the Weather Bureau station at Milbank, is 42.6° F. January is the coldest month, with a mean temperature of 11.3°, and July the hottest, with a mean of 69.8° The lowest temperature recorded is 38° below zero, and the highest 107° in July. Neither of these extremes, however, is as noticeable here as are milder temperatures in a more humid region. The temperature for the hilly section of the county is said to average about 5 degrees lower than the mean at Milbank.

The mean annual precipitation amounts to 22.82 inches. In the driest year recorded (1891) the rainfall was 12.71 inches, and in the wettest year (1905) it was 35.31 inches. Most of the rainfall occurs during the spring and summer months. The mean annual precipitation during the growing season, from April to August, is 15.16 inches.

The average date of the last killing spring frost is May 14, and of the first fall frost September 25. This gives an average growing season of 133 days, which is sufficient for the crops grown. The latest killing spring frost recorded occurred on June 11, and the earliest fall frost September 9. The average growing season in the hills is said to be from 2 weeks to 20 days shorter. Hailstorms sometimes do considerable damage in the hills, where they are more frequent than in the valley.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation as recorded by the Weather Bureau station at Milbank:

Normal monthly, seasonal, and annual temperature and precipitation at Milbank

[Elevation, 1,148 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1891)	Total amount for the wettest year (1905)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	18.8	63	−33	0.71	0.56	T.	4.6
January	11.3	63	−34	.60	.06	0.60	4.7
February	12.6	63	−38	.75	.25	.15	6.7
Winter	14.2	63	−38	2.06	.87	.75	16.0
March	27.3	77	−24	1.24	1.20	.52	9.0
April	44.2	90	5	2.23	1.86	1.25	.7
May	55.7	97	15	3.35	1.90	7.35	.7
Spring	42.4	97	−24	6.82	4.96	9.12	10.4
June	65.5	102	30	3.93	3.04	8.60	.0
July	69.8	107	40	2.79	1.44	5.27	.0
August	68.4	106	34	2.86	.55	3.55	.0
Summer	67.9	107	30	9.58	5.03	17.42	.0
September	60.4	103	15	1.86	.78	2.17	.0
October	47.2	95	−4	1.72	.67	3.00	.4
November	30.2	80	−20	.78	.40	2.85	3.2
Fall	45.9	103	−20	4.36	1.85	8.02	3.6
Year	42.6	107	−38	22.82	12.71	35.31	30.0

AGRICULTURE

Originally the entire area of Grant County was prairie, with only a few clumps of willow or cottonwood trees growing near some of the sloughs, and some scrub oak and a few elms growing along Big Stone Lake and the larger streams in the hills. Later the settlers planted groves of box elder, ash, and cottonwoods for protection and for proving up on tree claims.

The earlier settlers confined their efforts principally to the production of small grain and some cattle, and thus the agriculture gradually developed along these lines. The most important grain crops are wheat, oats, corn, barley, and flax. The chief market products are wheat, rye, and flaxseed, and the surplus of corn, oats, and barley.

The figures taken from census reports show that in 1879 there were 1,730 acres of wheat; in 1889, 64,750 acres; and in 1899, 142,484 acres. Since 1899 the acreage of wheat has decreased, and is being replaced by corn, rye, and oats. In 1909 and 1919 there were a little over 105,000 acres in wheat, and in 1922 less than 75,000 acres. Uncertainty of the crop which is often affected by rust and unsatisfactory labor conditions which exist during the harvest are responsible for this reduction. Practically all of the wheat sown is spring wheat, only 75 acres of winter wheat being harvested in 1922. About 90 per cent of the wheat planted is Marquis, which yields on an average about 14 bushels an acre. A small acreage of Haynes Bluestem is grown, but it averages only about 8 bushels an acre and is more susceptible to rust than the Marquis. Near Revillo and Stockholm some durum wheats are grown, Kubanka and Acme being the principal varieties. These yield from 18 to 25 bushels an acre. The yields in the hills do not differ from those of the valley, but, since the season is later in the hills, the wheat crop is more likely to become affected by rust.

All of the wheat is drilled as early in the spring as possible. It is either threshed from the shock, or is stacked and then threshed at a more convenient time. Most of the farmers permit their cattle and horses to have access to the straw, or feed western lambs, thereby conserving the fertilizing value of the straw; a few still persist in burning it. The same methods are used in harvesting and handling the other small-grain crops as are used in connection with wheat.

The oat crop ranks second in importance, but its rank is being lost to corn. The acreage of oats increased from 452 acres in 1879 to 15,060 in 1889 and to 40,938 in 1919. The census figures show an average yield of about 25 bushels an acre; but, from information obtained in the county, the average yield is about 40 bushels an acre. The early Kherson oats averages about 40 bushels an acre, and the Swedish Select and Victory average somewhat more. Oats will lodge in most years on the flat lands mapped as Fargo soils. Oats are drilled as soon as possible after the wheat is planted.

Corn, the third most important crop, is gaining in acreage, and eventually it may rank with wheat. This increase is a result of the development of varieties that are certain to mature and produce profitable yields and also of a better understanding of the methods

of cultivation and care of this crop. The acreage of corn almost trebled in the decade from 1889 to 1899, and it increased from 16,551 acres in 1909 to 29,592 acres in 1919 and to 42,213 acres in 1922. In addition 6,249 acres are grown to fill the 142 silos in the county. The average yield of corn in "the hills" is 30 bushels to the acre, and on the flats it ranges between 40 and 50 bushels. The principal yellow variety is Minnesota No. 13, and the principal white variety is Wisconsin No. 7, or Silver King. These varieties do not produce large stalks and ears as do the varieties seen farther south in the principal corn-producing States. Some sweet corn for canning is grown in the Big Stone Lake basin.

Corn is usually planted in checked rows, but a considerable acreage is drilled in. It is planted as soon as the ground is fully prepared and all danger from frost has passed. In harvesting, some of it is shucked from the standing stalks by hand or with machinery, and some is cut by corn binders and shocked and then husked from the shock. Some farmers cut it with binders and shock it and later haul it to the barn and husk and shred it by machinery. Others turn the cattle into the fields or stack it and feed it through the winter. Corn is adapted to all the soils of the county. The Fargo soils produce excellent yields when well drained. Corn is considered better adapted to the lighter soils in the northeastern part of the county than small grains. If planted on the Sioux soils, it is likely to be affected by the dry weather in August or September.

Rye has gradually increased in importance. In 1919 its total acreage was 4,869 acres and in 1922 it was 14,129 acres. This acreage, no doubt, will be increased. It is considered a surer crop than wheat, and where grown it replaces wheat as a money crop. Rye is the only fall-sown crop.

Barley is produced both for home feed and for the market, and at present it ranks with rye in acreage. In previous years the acreage of this crop has been much larger than at present. Some farmers sow barley because it matures early and is usually out of the way before wheat and oats are ready to harvest. In most years it is considered a safe crop to grow on the droughty Sioux soils, but the yields were reduced considerably on these soils in 1922.

Flax is a minor cash crop. It is almost always sown on newly broken sod ground. The present acreage is much below that of former years. The acreage in 1919 was 3,789 acres and in 1922 it was 5,599. The usual yield is about 5 or 6 bushels to the acre. Flax is planted after the major crops have been planted. Buckwheat is another crop that is usually planted late and is grown where it is impossible to get other crops planted, an average of about 200 acres being grown in the county. Some millet is also grown, and also a few acres of field beans, mostly for home use. The potato crop is probably the only vegetable crop that is grown on a commercial scale, about 1,000 acres being grown annually, mostly on the Sioux soils in the vicinity of Troy. Fair yields are obtained in years of normal rainfall.

The 1920 census reports a total of 9,251 acres of tame or cultivated grasses used as hay and forage, including 4,423 acres of timothy, 1,883 acres of alfalfa, and 1,450 acres of timothy and clover mixed. Alfalfa is being replaced to some extent by sweet clover, as the latter

yields about 3 tons of hay and 250 pounds of seed an acre, and the former yields about 2½ tons of hay and 175 pounds of seed. Sweet clover is also being recommended as the crop to grow on spots or fields which contain sufficient alkali to interfere with the production of other crops. In 1919 the census reported 43,466 acres of wild, salt, or prairie grass cut for hay and forage. Most of this is prairie hay, but a large part is cut from the sloughs and spots too wet to put into crops.

The fruits grown in Grant County are comparatively unimportant. Not enough are produced for the home market, though some apples are shipped out of the county. Apples are the most important fruit crop, followed by plums and cherries. Strawberries are the only small fruit grown to any extent, but these are grown only for local use. Gooseberries should do well along the edge of the hills, as a good number of wild bushes well laden with fruit were noticed along the larger streams in the eastern edge of the hills.

The revenue derived from animals sold and slaughtered was not reported in the 1920 census, but was undoubtedly more than $378,774, the value given in the 1910 census. The number of animals on the farms at present, and in the county in general, is below the number needed to use the grass and forage to the best advantage. This is particularly true of the hill section. Several flocks of sheep were seen in the hills and some small flocks in the valley. Dairy products are becoming more important as a source of income, but no large commercial dairy herds were seen. Most of the dairy products are produced by grades or beef strains of cattle. In 1922 there were 9,047 cows used for dairy purposes, but purebred dairy cattle are being introduced rapidly. Some of the cream and milk is sold locally and large quantities are shipped to outside markets.

Poultry and eggs furnish another source of income that is increasing in importance, reaching a total value of $273,625 in 1919.

Most of the livestock is of the better breeds. Swine production is rapidly gaining in importance, as it provides a better way of utilizing the corn crop. Practically all breeds of swine are represented.

Most of the land is plowed in the fall with small tractors or horses. Sulky plows having two or three bottoms are used, and the average depth of plowing is about 5 inches. After being plowed, the land is thoroughly disked or harrowed, or both. In the hills, summer fallowing is practiced to some extent, and it is said to give excellent results. This method of soil management has increased the yield from 50 to 100 per cent.

No very definite system of rotation seems to be practiced, but definite rotation systems will have to be developed in order to combat the yellow mustard which grows abundantly in the western two-thirds of the county, and also the wild oats which grow abundantly throughout the entire county. These weeds are the cause of considerable "dockage" on grain; and in addition they reduce crop yields, as the soil supporting mustard and wild oats would undoubtedly bring more profit to a farmer if it supported a stalk of wheat, oats, barley, or rye for each stalk of wild oats or mustard.

The number of farms has not increased appreciably since the 1900 census; but their value has increased from $5,679 to $36,809 during the same period, the greatest increase being in the value of

land. According to the 1920 census, 56.7 per cent of the farms are operated by owners and 42.8 per cent by tenants. The majority of the farms are well improved and the terms of rental vary considerably. The 1920 census reported 1,347 farms with an average of 285.6 acres to a farm, of which 224.2 acres were classed as improved land.

The following statistics, taken from the report of the South Dakota Tax Commission for 1922, give data relating to the agriculture of Grant County. In that year 732 farms were operated by owners and 640 by tenants. The farms of the county had a total area of 380,444 acres, including 42,213 acres of corn grown for grain, 6,249 acres of corn grown for silage and fodder, 74,060 acres of spring wheat, 75 acres of winter wheat, 41,440 acres of oats, 14,178 acres of barley, 14,129 acres of rye, 5,599 acres of flax, 1,149 acres of spelt, 397 acres of millet, 225 acres of buckwheat, 1,181 acres of potatoes, 8,336 acres of timothy and clover, 1,657 acres of alfalfa, 24,664 acres of other hay crops, and 20,807 acres of tillable land used exclusively for pasture. Alfalfa seed produced in 1921 amounted to 250 bushels. The tax commission further reports that in 1922 Grant County had 11,246 bearing fruit trees, 142 silos, 49 colonies of bees, 9,047 milk cows, 6,045 spring calves, 241 colts, 31,922 pigs, and 1,616 spring lambs.

SOILS

The soils of Grant County owe their most striking and important characteristics to their geographic position. The decrease of rainfall westward in the central part of the United States and the correspondingly diminishing moisture supply in the soil have resulted in less weathering and leaching of the soil materials. Climatic forces have acted uniformly over the county upon materials variable in character, and have developed soils which are remarkably uniform in appearance and composition.

Minor soil variations are the result of differences in drainage and in the texture of the original materials from which the soils have developed. The comparatively low moisture supply of the region has not been sufficient to support a forest vegetation but has been favorable to the growth of grasses. These grasses have been the source of the organic matter which imparts a dark color to all the soils of the region.

Grant County lies in a belt in which the soils have a darker color than any other normally developed, well-drained soils in the United States. Although the soil water is thus ample to allow the production and accumulation of large quantities of black organic matter from the partial decay of grass roots, it is not sufficient to leach the soil to any great depth. In well-drained areas, the carbonates, mainly lime carbonate, occur only in small quantities in the surface soil, due partially to leaching; but below depths of from 18 to 24 inches the percentage of carbonates is considerable, and an actual accumulation of carbonates seems to have taken place.

The principal soil of the well-drained upland has reached a fairly uniform stage of development, a stage which may be regarded as normal for this climatic zone. The upland soils are characterized by three distinct layers, or horizons, which, for convenience, are given

the designations A, B, and C. These major layers may be subdivided according to local variations, but the three general divisions are always present. In cultivated areas, the surface layer, known as the A horizon, is dark colored to a depth varying from 10 to 14 inches. In the virgin soil this surface horizon has two layers which have the same color but differ slightly in structure. The upper layer is very finely granular, silty, or single-grained. The granules are uniform in color throughout the layer, and the material does not change color when crushed. The upper 2-inch layer is usually sod. The lower portion of the A horizon, which begins at a depth of 6 or 8 inches, is slightly more compact, and crumbles into a distinctly granular mass, the granules being larger than in the upper part.

The next layer is the upper part of the B horizon. It is nearly always heavier in texture than the horizon above, being often a heavy clay. This material is rather compact, but it breaks into angular fragments larger in size than the granules in the A horizon. The true color of these particles is brown, but the dark-colored organic matter has been carried down from above and deposited over them as a coating. The dark color decreases downward as the content of organic matter becomes less. This layer is usually from 10 to 15 inches thick.

The lower part of the B horizon is colored grayish brown or grayish yellow with a faint olive tinge, and has spots of light-gray or white lime carbonate scattered through it. The lime may also be present as small concretions, as coatings along the breakage planes, and as deposits in small root channels, animal burrows and wormholes. The material constituting the lower layer of the B horizon breaks up into soft clods. This layer varies from 8 to 16 inches in thickness, and it is apparently a zone of lime accumulation, since it contains a higher percentage of carbonate than the A horizon and seems to contain more lime carbonate than the horizon below it.

The deeper underlying layer, the C horizon, consists of the parent material which has been but little altered by weathering. Its color is grayish yellow with a slight olive tinge. Usually lime carbonate is present uniformly throughout the mass. The material is usually silty in character, structureless, and breaks into soft clods.

Upland soils which have reached the stage of development just described are shown on the accompanying map as types of the Barnes and Moody series. The Bearden soils, on the higher terraces, have characteristics similar to those just described; and in a broad classification they belong to the same group, which includes those of the Barnes and Moody series. The Pierce soils on the upland, and the Sioux and Benoit soils on the terraces, have loose, porous subsoils which in some places have prevented the development of a B horizon and the accumulation of lime; but lime is always present in the parent materials.

The soils of the Beadle series, which occur on nearly level areas on the upland, differ from those of the Barnes group in that an extremely heavy and compact layer composes the upper portion of the B horizon. This heavy layer is believed to be caused by the action of alkali salts during the process of soil development. In some places the heavy texture of the parent material probably explains the imperviousness of the poorly drained soils.

Soils occurring in areas of still more restricted drainage, such as those in the upland depressions, on the flat terraces and low flood plains, have also developed distinct profiles. The surface layers are deep black in color, overlying gray or mottled, highly calcareous, heavy-textured subsoils. The details of their profiles vary considerably, depending upon drainage and oxidation. The soils which have developed from the glacial drift under conditions of poor drainage are grouped in the Webster series. On the poorly drained uplands and terraces, the water-laid deposits have weathered into the soils of the Fargo series; and on the first bottoms along stream courses, into soils of the Lamoure series.

The soils of Grant County have been grouped on the bases of differences in soil structure and other characteristics, source and character of the parent materials, and the process which caused the accumulation of the parent materials. Under each series the soils are grouped according to the texture of the surface soil.

With the possible exception of small areas of loessial soils, the materials giving rise to the soils of Grant County are of glacial origin, most of them having been laid down by the Minnesota and Dakota lobes of the Wisconsin ice sheet. These materials were derived, for the most part, from sandstones and shales which were brought down from the north and ground and mixed with local granitic, sandstone, and shale materials. Granite, known as Ortonville granite, outcrops in the eastern part of Alban Township, but no distinct soil has been produced from its weathering. These outcrops are shown by symbols on the soil map, and they are quarried for tombstones and building material.

The hills mark the edge of the lateral moraine of the Minnesota lobe and its western limit in Grant County. When the ice melted here, the finer particles were carried away; consequently ridges of gravel and sand were formed, and numerous large rocks too heavy to be carried off remained. As the melting proceeded the bulk of the material carried by the ice was deposited as till in the form of a ground moraine. Most of the valley soil has developed over this ground moraine.

Originally the glacial material undoubtedly contained an abundance of lime carbonate; but most of this material in the surface layer has been removed. Erosion has also taken place, and the streams have cut channels in "the hills." Originally the material they carried was deposited over the valley near the hills; but the streams gradually cut channels through this flat area, and the material from the upland was deposited along these stream courses. The only important alluvial soils are found along Whetstone, Yellow Bank, and Big Sioux Rivers. The soils derived from the old alluvial material above overflow levels are known as terrace soils.

Fine-grained material has been washed into the many small basins in the county, so that in them soils have developed which are heavier than those surrounding them. As plant and animal life developed the soil material gradually acquired organic matter, the accumulation being greatest in the low areas, which supported an abundant plant life. In some places, where an abundance of water had prevented oxidation and bacterial action, deposits of partly decayed plant remains exist as peat or muck.

The Barnes soils have dark-brown to almost black, mellow surface layers, and brown subsurface layers, consisting of friable material having a slightly heavier texture than the top layer. The deeper subsoil consists of yellow or grayish-yellow, friable material containing an abundance of lime carbonate. Some of this carbonate exists as nodules, some as lime-coated pebbles, and some as a white coating over the soil particles. Iron stains and faint gray mottlings usually occur in the lower subsoil. The topography of these areas of soils varies from almost flat to hilly. Some gravel is usually present in the subsoil, and bowlders are scattered over the surface. These soils are naturally fertile. Four types—Barnes fine sandy loam, Barnes very fine sandy loam, Barnes silt loam, and Barnes loam with two phases—are mapped in Grant County, the parent material being glacial drift.

The Beadle soils are very similar to the Barnes soils. They differ in having an impervious clay subsurface layer varying in color from brown to black or very dark brown. This heavy layer occurs between the surface soil and yellow calcareous subsoil, and it varies in thickness from 2 to 10 inches, being usually about 4 or 6 inches thick. The depth at which this layer occurs bears no relation to the surface features. The surface soil, as a rule, is heavier than that of the Barnes soils because of a higher content of clay.

The surface layer of the Beadle soil is dark brown to almost black, and it is underlain by a brown and heavier material, which includes the heavy layer already described. The deeper subsoil has the same color as that of the Barnes soils, but the material is heavier and less friable, though in places it seems sandier and more open. Some bowlders are scattered over the surface and some gravel is mixed through the soil. The subsoil is highly calcareous and contains iron stains. The Beadle soils occur as patches surrounded by Barnes soils, but such areas are mapped as Beadle soils because they predominate. The topography here is flat to slightly undulating. Beadle loam and Beadle silt loam are mapped in Grant County. The parent material is glacial drift.

The surface layers of the Pierce soils are dark brown in color, and the subsurface materials are slightly heavier in texture than those composing the surface layers. The deeper subsoils consist of stratified sand and gravel. A 2-inch or 3-inch layer of yellow or grayish-yellow calcareous loam is present usually between the brown subsurface layer and the gravelly subsoil. The subsoils of stratified sand and gravel are calcareous, and they vary from yellow to brown in color, with faint streaks of gray. The surface strata are usually lighter than those of the Barnes soils. The topography of the areas of these soils varies from undulating to bumpy, narrow ridges. Pierce fine sandy loam is the only type of this series mapped in this county. The parent material consists of water-laid drift deposited in the form of kames and eskers.

The Moody soils have black, loose, finely granular surface soils, underlain by brown, granular materials which are slightly heavier than the surface layers. The lower subsoils consist of yellow, calcareous materials, and the substrata consist of grayish-yellow loess, the parent material. The topography is gently rolling. One type

of this series has been mapped in this county, the Moody very fine sandy loam.

The Sioux soils are probably the most extensive and important of the terrace soils mapped in Grant County. The surface material of the Sioux soils is brown to dark brown in color and rather friable. In depth, it gradually becomes lighter in color until it grades into a brown, or lighter-brown, loamy material of slightly heavier texture. This, in turn, is underlain by a 2-inch or 3-inch layer of friable, yellowish, calcareous material. Then the material changes abruptly to calcareous, stratified sand and gravel—the subsoil—varying from brown to yellow in color, with occasional streaks of gray in the more poorly drained soils.

These Sioux soils are droughty, because the open substratum permits the water to escape, so that the soil has no water-retaining power. This terrace soil is very similar to the Pierce soils of the upland, differing chiefly from them in origin and topography. The topography of the areas mapped as Pierce soils is rolling to bumpy, as the original material has been laid down by ice; whereas that of the Sioux areas is flat, since the parent material has been laid down by water. Sioux fine sandy loam, Sioux very fine sandy loam, and Sioux loam are mapped in Grant County. The parent materials consist of water-laid gravels, sands, and finer-grained materials.

The Bearden soils, on terraces, correspond to the Barnes soils of the upland. The surface material is friable, and brown to dark brown in color. The subsurface material is a lighter brown in color, slightly heavier and more friable. The subsoil is yellow or grayish yellow in color, still heavier in texture, and contains carbonate of lime in varying quantities. No gravel occurs in the body of typical soils. The topography of the areas mapped as Bearden soils is usually smooth with a slight slope. Bearden fine sandy loam, loam, and silt loam are mapped in this county.

The Benoit soil series is very similar to the Sioux series, differing only with respect to drainage. The surface soil of the Benoit series is dark brown to black in color. The subsurface soil is slightly heavier than the surface soil, and it is brown, yellow or grayish yellow in color. The subsoil consists of stratified sand and rounded gravel, having a yellow or brown color with some gray layers. These soils occur on terraces, but they are so situated that they remain wet throughout the year. The subsoils and, in places, the surface soils are calcareous. These soils are used chiefly for pasture and hay land. Benoit loam and silt loam are mapped in this county.

The surface soils of the Lamoure series are colored dark brown to black. The subsoils are heavier and vary in color from yellowish brown to gray, or dark drab, or mottled with gray and brown. The subsoils and, in places, the surface soils are calcareous. These soils are formed from recent-alluvial materials derived from calcareous glacial drift. They occur on the present flood plains, and are subject to overflow. These soils are very similar to the Fargo soils, on the terraces; hence mapped areas have a flat topography. Lamoure fine sandy loam, loam, and silt loam are mapped in this survey.

The Fargo soils have very dark-brown or black surface soils and heavier, brown, dark-drab, or grayish, somewhat mottled subsoils. These soils occur on terraces or in old lake beds, and thus they have

developed from reworked glacial material. They contain considerable organic matter and carbonate of lime, the lime being especially abundant in the subsoils. Areas of Fargo soils have a flat topography, and consequently the drainage is rather poor. Fargo loam, Fargo silt loam with a meadow phase, and Fargo silty clay loam are mapped in this area.

There are two other groups of soils mapped in the county, peat and rough stony land. The former group comprises those soils which consist of partly decomposed organic matter and occur in or near the sloughs. In these places the plant remains have accumulated because of standing water which prevented or retarded decay. As a general rule the peat is not more than 2 feet in depth, is dark brown or black in color, and is underlain by clay or silty clay material varying from gray to black. The rough stony land includes all areas which are at present too rough or stony to clear for cultivation, and which may be used only for pasture or hay land. The stones are numerous, so that the expense of preparing the land for cultivation, as compared to the value of the produce that could be raised on such land, is too high.

In the following pages the soils of Grant County are described in detail, and their agricultural relations are discussed. The accompanying map shows the distribution and location of the different types of soils, and the following table shows the acreage and the proportionate extent of each type in the county.

Soil types in Grant County and the extent of each

Soil	Acres	Per cent	Soil	Acres	Per cent
Barnes loam	146,368	42.0	Benoit loam	4,608	1.1
Rolling stony phase	34,368		Benoit silt loam	1,472	.3
Shallow phase	3,328		Pierce fine sandy loam	5,696	1.3
Barnes silt loam	43,712	10.0	Fargo silt loam	27,008	9.8
Barnes fine sandy loam	16,896	3.9	Meadow phase	15,936	
Barnes very fine sandy loam	14,912	3.4	Fargo loam	7,872	1.8
Beadle silt loam	36,480	8.3	Fargo silty clay loam	3,392	.8
Beadle loam	2,944	.7	Webster silty clay loam	1,088	.2
Sioux loam	21,312	4.9	Lamoure fine sandy loam	7,040	1.6
Sioux fine sandy loam	12,160	2.8	Lamoure loam	2,816	.6
Sioux very fine sandy loam	3,520	.8	Lamoure silt loam	3,968	.9
Bearden fine sandy loam	6,144	1.4	Rough stony land	6,784	1.5
Bearden loam	4,288	1.0	Peat	1,088	.2
Bearden silt loam	2,816	.6			
Moody very fine sandy loam	384	.1	Total	438,400	

BARNES LOAM

Barnes loam is characterized by a surface layer of very dark grayish-brown or almost black, friable loam, ranging in depth from 5 to 10 inches. The structure of this loam is very finely granular. It is underlain by a brown, friable material having a texture similar to a heavy silt loam or a silty clay loam. In the upper part of this lower layer, the dark color is due to organic matter which has been carried downward and has coated the soil granules. The quantity of this coating material gradually decreases downward. The material composing this lower layer is distinctly granular, the granules being coarser than those of the surface soil.

The next layer below is colored grayish brown or grayish yellow, with lime concretions and white spots of lime carbonate. This layer of lime accumulation begins at depths ranging from 18 to 24 inches, and it has an average thickness of about 12 inches. Below this, in turn, is the grayish-yellow parent material which has been somewhat altered by weathering. Lime carbonate is present in this parent material, but the white spots and lime concretions are less numerous. This type of soil has developed over glacial drift, and hence glacial bowlders and gravel occur throughout the soil, especially at lower depths.

Barnes loam occurs extensively in the valley, the hills, and in the Big Sioux Valley. The areas mapped in the valley may be regarded as border soils, in that the soil characteristics approach those of the Barnes silt loam, in the western part, and those of the Barnes very fine sandy loam, in the eastern part. This valley area of Barnes loam extends northwest from the corner of Adams Township to the county line at the center of Melrose Township. Another area extends along the county line across the northern end of Big Stone Township. Here the soil may be slightly shallower and lighter in texture and may contain slightly more very fine sand than the soil mapped in the large area. Furthermore, it contains more carbonate of lime in the subsoil, thus imparting a more whitish color to it. There are some knolls in this northern area from which the black soil has been eroded, exposing the light-colored subsoil.

In the western part of the valley the type is mapped as small areas, and it varies considerably. Some farmers consider the soil in these small areas to be better than that which occurs in the larger areas, but it is doubtful if there is much difference. In some places the subsoil is similar to that of the Bearden soils, and in other places it approaches that of the Beadle soils in that it is heavier and rather compact. Gravel spots and strips also occur in these western areas, indicating some water action. This indication of water action is supported by the fact that the old stream ways have become filled with sediments, which now constitute the parent materials of the Fargo soils. In other places the subsoil is more open and porous than that of the typical Barnes loam, as in the areas just north of Revillo, 2 miles west of Albee, in the northwestern corner of Vernon, and the southwestern part of Grant Center Townships. In the areas mapped in sections 4, 10, 26, 27, and 36 of Kilborn Township and sections 10 and 20 of Melrose Township, the subsoils are lighter in texture than that of the typical soil, but these soils are not regarded as droughty. Gravelly spots in the subsoil occur in the areas of the type mapped in the north-central part and southeastern corner of section 12 of Madison Township.

The Barnes loam mapped in the northeastern part of the valley is separated from the hills by a strip of Barnes silt loam and some Fargo soils. Here the topography varies from slightly undulating to rolling, the areas to the west probably being the smoothest. In the southeastern part of the county the topography of the valley and the hills blends; but west and north in the hills the topography of areas of Barnes loam becomes rolling, the smoothest areas occurring in Adams Township, extending to a point 3 miles north of Labolt. Other smooth areas are north of this and close to the hill escarpment.

The area mapped west of Strandburg and Stockholm and bordering the rougher country on the west, is more rolling, whereas that between these towns is undulating to rolling. The streams have cut deep narrow channels through this latter area, giving it, at first glance, a rougher aspect than it really has. Here glacial bowlders and gravel are common. The more level areas are, as a rule, less stony. However, the stones are not sufficiently abundant to interfere seriously with farming operations. About 75 per cent of the soil is under the plow, the remainder being in pasture and hay land. Some of the valley farmers own quarter sections of land in the hills, which are used for pasture and hay land; but with the high price of land and the low yields of hay, this does not seem to be a profitable arrangement. Most of the farmers on the hill areas of Barnes loam keep some livestock and practice general farming.

The type, as mapped in the hill area, varies from that found in the valley in being heavier in texture. This area comprises most of Twin Brooks, Stockholm, Troy, and Georgia Townships and parts of Adams, Madison, Mazeppa, and Osceola Townships. The northern part of the type here grades into that which is mapped in the Big Sioux Valley.

The Big Sioux Valley variation does not differ materially from that mapped in the eastern part of the valley. The soil does not contain such a high proportion of clay as that in the hills, and there are fewer bowlders over the surface, though they are common in the subsoil and also in the associated silt loam. The topography varies from undulating to rolling, the more rolling areas occurring in Mazeppa Township. This variation is in a large area in Mazeppa, Farmington, and Lura Townships and is separated from the hills by a strip of rough stony land and Antelope Valley. In the Big Sioux Valley and the hills the seasons are about two weeks shorter than in the valley proper, though the same crops are grown, with wheat predominating. The current value of the Barnes loam in the Big Sioux Valley is about the same as, or slightly more than, that which occurs in the hills.

On the whole, Barnes loam is highly prized as farm land, being considered by some farmers as valuable as Barnes silt loam. Its current value is about $100 an acre, some of it being valued at about $150 an acre. It produces good yields of all the principal crops of the region—wheat, corn, oats, rye, and barley. The eastern area is thought to be a little better adapted to corn than the western area, as the soil is a little more open. Practically all of this type of soil is in farms, and all of it can be tilled.

Barnes loam, rolling stony phase.—Barnes loam, rolling stony phase, has a surface layer of black loam from 3 to 7 inches deep. The brown layer is seldom as thick as that in the other Barnes types, and the yellow subsoil is encountered at an average depth of about 16 inches and in places at 12 inches. The surface soil is lighter than that of the typical loam soil. The sand particles are coarse, but the soil seems to have about the same proportion of clay as the loam mapped in the hills. The topography of such areas is rolling to almost rough. Stones are scattered over the surface and through the soil. Most of this stony soil is mapped as one large continuous area along the western edge of the hills, extending southeast from the

county line in Osceola Township to the southeastern corner of Troy Township. Other small areas are mapped in the northeastern corner of the county along Big Stone Lake and one or two small patches along North Fork Whetstone River. Most of this soil is used for the production of hay or is in pasture, and the smoother and less stony land—probably less than 50 per cent of it—is cultivated. It is used for general farming and for grazing sheep or cattle.

The current value of this land varies greatly according to the quantity and quality of grass it produces and the water supply, the average value being less than $50 an acre.

Barnes loam, shallow phase.—Barnes loam, shallow phase, differs from the typical Barnes loam in having a more shallow surface soil which contains a larger proportion of very fine sand. The layer of lime accumulation is much whiter and appears chalky when dry. The layer comes to the surface on some of the knolls, where, on such patches, crops require liberal applications of manure. Stones are scattered on the surface of this phase, and on the areas mapped in sections 6, 11, and 8 of Big Stone Township they are rather abundant in the subsoil. The stones are white and at first glance appear to be rounded limestone bowlders, but they are lime-coated granitic or other rocks. Mapped areas of this phase include a large number of poorly drained patches. It is not considered so valuable a soil as the others surrounding it. About 50 per cent of it is in cultivation and the rest is used for pasture or growing hay.

BARNES SILT LOAM

The surface soil of Barnes silt loam is a finely granular, rather heavy loam or silt loam, very dark grayish brown to black in color, extending to depths ranging from 4 to 10 inches, and underlain by a brown granular material having the texture of a heavy silt loam or silty clay loam. This subsurface layer extends to depths ranging from 15 to 30 inches—averaging about 20 or 24 inches—when it becomes a yellow or grayish-yellow, friable silty clay loam which contains a high percentage of lime carbonate in the form of white powder and concretions. Some gravel and sand occur in this layer, with occasional iron stains or slight, grayish-colored mottlings. The large quantity of lime in the subsoil is probably a result of the concentration of the lime from the upper layers. The underlying parent material is yellowish-gray, friable drift. It is calcareous, but the lime is distributed more uniformly through the material than in the layer above.

There are two large areas of this type mapped. One, in the eastern part of the county, occupies a position between the Beadle soils and Barnes loam and seems to be a transition soil between these two types. Some of it which is near the Beadle soils has a trace of the heavy, spotted, compact layer typical of those soils. This is true of the area which is mapped through the center of Vernon Township, where it forms a strip varying in width from 2 to 4 miles, and extends in a northwesterly direction from the southeastern corner of the county to Milbank, thence to the Roberts County line north of Milbank, the Sisseton branch of the Chicago, Milwaukee & St. Paul Railway roughly defining the western limit.

The other large area occurs in the Big Sioux Valley in the western part of the county. The color and thickness of the different soil

layers do not vary greatly from layers of the type mapped in the eastern part of the county, but the texture seems to be more uniform and contains more silt and very fine sand, and less clay and coarse material. Small cobbles varying from 1 to 6 inches in diameter are also more numerous in the lower part of the brown layer. The northern end of this area occupies a terracelike position between the Sioux soils and the Barnes loam, but this terracelike condition disappears or becomes less distinct to the south. This variation occurs principally in Lura and Blooming Valley Townships. The topography here is uniformly more level than in the valley. This soil is as good as that in the valley for crop production, but it is not valued so highly. The growing season is about two weeks shorter here than in the valley. Less Fargo soil occurs in this section of the county. The same crops are grown as in the valley, but wheat probably occupies a larger acreage of this area than of the other area.

The topography of the eastern areas of Barnes silt loam varies from comparatively flat to rolling, most of it being medium to strongly undulating. Rather small low knolls occur, on which the soils are ordinarily shallow; whereas the lower, rather flat areas have deeper soils, as they receive wash from the surrounding higher lands. Both surface and subsurface drainage are good, the surface water finding its way to either the streams or low spots known as sloughs.

Practically all of the Barnes silt loam is in cultivation, only the necessary acreage—the less desirable areas—being left in pasture and meadow. Because of its physical nature, its richness, and abundance of lime, this soil is adapted to all the crops commonly grown in the county, including wheat, corn, oats, rye, and barley. This soil is retentive of moisture, withstands drought well, and is considered about as good a soil as any other in the county. It is well adapted to the growing of such legumes as alfalfa and sweet clover, crops which should be grown more generally.

The current value of Barnes silt loam ranges from about $100 to $150 an acre, depending on location and improvements. The type in the western part of the county is not valued so highly.

BARNES FINE SANDY LOAM

The surface soil of Barnes fine sandy loam, to depths of from 5 to 9 inches, is a dark-brown fine sandy loam, underlain by a lighter-brown, loamy layer which extends to a depth of about 20 inches. At this depth the subsurface material usually grades into a yellowish-brown or yellow loam, and at a depth of 26 to 30 inches the material becomes highly calcareous, yellow in color, and silt loam in texture, with some gravel.

Barnes fine sandy loam is distributed throughout the county. In the areas mapped in sections 1 and 35, bordering the north portion of Lake Albert, the soil is rather sandy. Here the fine sandy loam extends to a depth of almost 3 feet, and the yellow subsurface layer has a loam instead of a silt loam texture. The soils of this type mapped in sections 10, 14, and 27 of Kilborn Township, have subsoils slightly lighter in texture than their surface layers, and for this reason crops suffer from drought during extremely dry seasons. At the southern end of the area mapped in section 10 of Grant Center Town-

ship, gravel occurs in the subsoil. Such areas as these and also those mentioned in Kilborn Township have been affected by alluvial material. In areas of this type mapped in the valley, the soil in spots has a lighter-textured subsoil.

The type mapped in the area east of Revillo has a much heavier subsoil than in most of the other areas of this type. Here the subsoil is brown or brownish yellow and compact, similar to that of the Beadle soils, the compact layer occurring at a depth of about 30 inches. A small sandy knoll or dune occurs in the east-central part of section 15, north of Revillo, and another near the northeastern corner of section 2 of Madison Township. The areas mapped in the valley are very patchy. The type in the area mapped in Troy Township, south and east of Crooked Lake, is coarser in texture than most of the other areas of this type, stone and gravel occurring on the surface and in the soil and subsoil. The type as mapped in Farmington, Blooming Valley, and Lura Townships is about the same as that mapped in Big Stone and Alban Townships.

The topography of the areas mapped as Barnes fine sandy loam varies from almost flat to strongly undulating, the largest and smoothest area lying in the vicinity of Lake Albert.

During dry, windy weather this soil drifts to some extent, especially in the more sandy places. It is chiefly planted to corn, although good yields of the small grains are sometimes obtained. Its difference in texture, as compared with the heavier soils, is easily noticeable after rains. Alfalfa and sweet clover should be grown more extensively on this soil.

BARNES VERY FINE SANDY LOAM

The surface 6-inch layer of Barnes very fine sandy loam varies from a very dark grayish-brown loam to a very fine sandy loam, underlain by a material having a loamy texture and the same or a slightly lighter color extending to depths varying from 12 to 18 inches, when it grades into a yellow, grayish-yellow, or grayish-brown, friable silty material. The lower portion of the 3-foot section is yellowish gray in color and silt loam in texture. This layer is highly calcareous, and appears white or chalky in road cuts where it has dried out. The soil material, resembling loess in texture, is classed between loam and fine sandy loam, and it is recognized as being a lighter soil than a loam or a silt loam.

Most of this type is mapped in the northeastern corner of the county, in Big Stone and Alban Townships, and in the northeastern corner of Vernon Township. The surface soil in the areas mapped in sections 4, 5, 8, 31, and 32, in the northeastern corner of Alban Township and in the southeastern corner of Big Stone Township, is slightly heavier than most of the type. Here it is almost a loam; but because of its uniform texture and whiter subsoil it is classed with the very fine sandy loam.

The topography of areas of this soil is undulating to rolling, the more rolling areas occurring along the streams, but none is so rolling as to interfere with cultivation. The area north of the Whetstone River is rather uniform in topography, but it may be slightly sandier than that mapped east of Lake Albert. This type of soil has good

surface and subsurface drainage. It takes up the moisture rapidly and at the same time it is capable of resisting drought to a considerable extent.

Farmers on this kind of land claim that it is better cornland than that in the flatter part of the valley, and that it is not so good for small grains. This should be a good soil for the production of alfalfa and sweet clover, as it has a subsoil that will allow the roots to penetrate deeply, and it contains sufficient lime. The current value of this land varies from $75 to $150 an acre.

BEADLE SILT LOAM

The surface soil of Beadle silt loam varies from a dark-brown or black silt loam to a heavy loam, from 6 to 9 inches deep, grading into a silty clay material having the same color, and extending to a depth of 8 or 12 inches. This material, in turn, grades into a brown, silty clay or clay varying in consistence from friable to compact. At a depth of about 22 inches is a yellowish-brown, yellow, or grayish-yellow silty clay loam, mottled with brown or gray. This layer corresponds to the yellow layer of the Barnes soils; but here it is usually heavier and less friable, although in some places it is open and porous.

A heavy, compact layer, from 2 to 10 inches thick, is sometimes encountered within the brown horizon, varying from brown to almost black in color. The dark color is found in low spots where the soils are similar to the Fargo soils. This compact layer may occur at any depth within the brown horizon, and its depth does not conform to the surface features of the soil. When dry, the 3-inch or 5-inch layer just above the compact layer has a grayish cast. The surface soil when dry seems rather loamy in places, but when wet it seems very heavy and sticky, indicating a rather large proportion of clay. It was therefore classed as a silt loam instead of a loam.

This type is mapped as an area extending from Albee to the northeastern corner of Osceola Township, most of it occurring in the flat lying at the base of the hills. The surface seems to indicate that at one time it was covered with water, causing a deposition of clay. The source of the water might have been the drainage from the hills, though probably the area was covered by a shallow lake during the melting of the glacier.

The topography of areas mapped as Beadle silt loam varies from flat to undulating. The surface drainage is not so good as that of the Barnes soils; and the grayish layer and the gray mottlings in the subsoil indicate that this type does not have quite so good internal drainage and aeration as the Barnes soils. During the dry season of 1922, fields in alfalfa dried out on areas where the heavy compact layer is well developed. Some of these areas occur in the northeastern corner of Osceola Township, sections 11, 12, 13, and 24 of Kilborn Township, and sections 21, 27, and 28 of Grant Center Township. In places a layer of lighter and more granular material occurs beneath the heavy horizon than is typical of this soil type, such spots being mostly affected by continued drought.

This is one of the most highly prized soils of the county, and it ranges in current value from $25 to $150 an acre, depending on im-

provements and location. A large part of it is planted to wheat, oats, and rye, the principal crops. Corn also gives good yields, but during excessive droughts it suffers on spots where the subsoil is extremely compact. Some alfalfa and sweet-clover fields were seen on this soil; but as the year 1922 was very dry, the results of an average year could not be observed. In most of the fields the alfalfa had died out in spots. This soil is recognized as being a better small-grain soil than most of the Barnes soils. Nearly all of the Beadle silt loam is farmed, only the necessary acreage needed for pasture and hay land being left uncultivated.

BEADLE LOAM

Beadle loam is distinguished by a dark-brown or black, loamy surface layer from 4 to 10 inches deep, underlain to a depth of about 20 inches by a stratum of brown silty clay loam material, which contains a heavy, brown, clayey layer. This brown stratum is underlain by yellowish-brown clay to a depth of about 26 inches, then by the lower subsoil which consists of yellowish or grayish-yellow, highly calcareous and moderately friable material similar to the subsoil of the Barnes soils. Mapped areas of Beadle loam are very patchy, in that this soil occurs in small areas surrounded by well-developed Barnes soils, the former type predominating. Variations from Beadle loam to Barnes soils, in these areas, may best be observed in road cuts. As a whole, Beadle loam does not differ greatly from Beadle silt loam; the former is more variable in soil and subsoil than the latter.

The largest area of this type is mapped in Madison Township, and smaller areas are mapped in the flatter part of the valley. Most of it is located at the base of the hills, and it seems to be associated with the Barnes loam mapped in this part of the county. In places, a decidedly sandy layer occurs beneath the compact horizon. This is to be expected in those areas mapped adjacent to the Sioux soils. Such spots are subject to drought in the drier years. The area mapped in section 26 of Kilborn Township has a rather sandy surface.

The topography of areas of this type varies from flat to slightly undulating. This loam has about the same producing power as the silt loam, and is not regarded by the majority of the farmers as being different from the silt loam. Current values of these Beadle soils are about the same.

SIOUX LOAM

The surface soil of Sioux loam is a dark-brown loam to a depth of 5 or 7 inches. The subsurface is a brown, coarser loam, and at 18 or 20 inches it becomes a yellowish-brown or yellow, calcareous loam. This varies in thickness from 2 to 4 inches and is underlain by beds of brown and yellow stratified sand and gravel. In places the yellow layer above the gravel is very thin and the change from the brown subsurface layer to the gravelly layer is abrupt. Sioux loam is a terrace soil and corresponds to the Pierce soils of the upland. The Sioux and Pierce soils are known throughout the county as "sandy soils."

Most of this type is mapped in the western part of the county, the largest area of the most typical soil occurring in Antelope Valley.

Other large areas are mapped along Big Sioux River and in Troy Township, and smaller areas are mapped in the valley along Whetstone River, and at the eastern edge of the hills. This soil is generally droughty, and crops suffer during dry years, as in 1922. The areas mapped along the eastern edge of the hills are for the most part less droughty because of underground seepage and shallow depth to the water table. In the spring of the year, some of these areas are too wet to work satisfactorily. The area mapped south of Twin Brooks is usually wet in the spring. Crops on such wet areas suffer only in time of extreme drought. The topography of these areas varies from flat to slightly sloping toward the streams.

Most of the crops common in the county are grown on this soil. Cultivated crops and early-maturing crops should be given first consideration. The beneficial effects of cultivation in moisture conservation were easily observed during 1922 in Blooming Valley Township, where barley showed severe effects from the drought, whereas intertilled corn withstood the drought without ill effects two or three weeks longer. The open subsoil does not retain moisture, and frequent rains are necessary during the growing season to get good results. Potatoes are grown to a considerable extent on the less droughty areas of this type in the vicinity of Troy, and good yields are usually obtained.

Most of this land is in cultivation, only a small acreage being used as pasture or hay land. It is not valued so highly as the Beadle and Barnes soils.

SIOUX FINE SANDY LOAM

The surface layer of Sioux fine sandy loam to a depth of about 4 or 8 inches is a dark-brown loam, underlain by a brown, loamy material to a depth of about 12 or 16 inches, which, in turn, is underlain by a calcareous, yellow, loamy layer from 3 to 5 inches thick. At a depth of 18 or 20 inches occurs the typical stratified sand and gravel common to the Sioux soils. This soil varies very little from Sioux loam, and there is very little difference in their agricultural values.

The principal areas are mapped along the Big Sioux River in Lura Township, along the eastern edge of the hills, and along the forks of the Whetstone River. Some small areas of soil in sections 32 and 33 of Georgia Township and section 34 of Troy Township are high enough to be classed as Pierce; but because of their smoother topography they were included in areas of Sioux fine sandy loam. A larger acreage of this type is in pasture and hay land than the loam, and it is considered about equal to the loam in value. Although it occurs as a terrace soil all of it does not occur at the same level; thus terraces of different elevations may occur within a given area.

SIOUX VERY FINE SANDY LOAM

The surface soil of Sioux very fine sandy loam, to depths varying from 4 to 6 inches, is a dark-brown very fine sandy loam, underlain by a dark-brown loam which extends to a depth of 7 to 9 inches. This loam, in turn, grades downward into a lighter-brown loamy material extending to a depth of 22 or 24 inches, to the substratum of stratified sand and gravel common to the Sioux soils. In many places this stratified layer is 30 inches deep, and in places it occurs

at a depth of 3 feet. Except in patches, this type is not so droughty as either of the other Sioux soils described in this report, because the gravel is deeper and the soil itself is heavier than that of the other types.

Most of the Sioux very fine sandy loam is mapped in Alban and Big Stone Townships, as a strip which extends from Lake Albert to Big Tom Hill. The area mapped along Whetstone River is on a high terrace; and because it is so uniform and smooth, one would think that the parent material had been wind blown. The fact that the surface material is slightly deeper along the stream would strengthen the wind-blown theory; but the wind-blown material, if any, is very slight, since some gravel occurs within a depth of 3 feet. The area at Troy is very similar to the one just described. The area west and north of Big Tom Hill, which extends to Lake Albert, does not seem to have the thickly bedded gravel that is characteristic of the Sioux soils, the gravel occurring only in patches.

The topography of the areas of this type varies from flat to undulating. This soil is practically all cultivated. Corn is the principal crop and good yields are obtained. The other crops are the common small-grain crops and they produce well in normal years.

BEARDEN FINE SANDY LOAM

The surface soil of Bearden fine sandy loam to a depth of 6 or 8 inches is a dark-brown fine sandy loam, underlain by a brown or light-brown fine sandy loam material to a depth of about 20 or 24 inches. Below this is a grayish-brown, grayish-yellow, or yellow material having the texture of a fine sandy loam or a loam.

All of this type is mapped in the valley. The type mapped along Whetstone River, on terraces several feet above the present flood plain, is the most typical. The type mapped in the areas which are associated with the Pierce soils in the vicinity of Big Tom Hill varies considerably, the surface soil in some places being slightly heavier than typical, and in other places the subsoil being a loam or silt loam material. This is particularly true of the large area east of Big Tom Hill. In places the surface soil is rather darker colored than typical.

The narrow strips mapped in the central and western part of the valley include patches of soil which are similar to the Fargo fine sandy loam. The subsoil materials of these narrow strips are usually rather dark colored with considerable gray, and are friable. They are on a level with the upland and the narrow stream bottoms are included with the type as mapped. These areas are composed of material which has been laid down during periods of high water. The type does not occur in a true terrace position, as there is no marked line of elevation between this soil and the types back of it. This is true of the strip along Mud Creek northeast of Revillo, and a strip northeast of Labolt, and the area in section 9 of Madison Township.

Most of this land is planted to corn. Some other crops are grown, but corn is the major crop, and it is best adapted to this soil. Legumes should do very well on this soil. It is recognized as an inferior soil when compared with Bearden loam, Bearden silt loam, and the Barnes and Beadle soils.

BEARDEN LOAM

The surface soil of Bearden loam is a dark-brown loam 6 to 8 inches deep, usually grading downward into a brown or light-brown loam material to a depth of 18 or 22 inches. Below this, in turn, is a yellow or grayish-yellow, friable silt loam material which contains a high percentage of lime. This type seems to contain very little clay, though it is composed largely of the finer sand grains and silt.

Bearden loam is a terrace soil and it occurs throughout the county in small areas, being most typically developed along Whetstone River. There are several small low areas in the vicinity of Lake Albert mapped as this type. The area on which Big Stone City is located is underlain with gravel, but only in a few spots does the gravel come within 3 feet of the surface. The eastern edges of areas of this type may have been slightly affected by wind-blown material. The areas along Whetstone River are considerably elevated above the stream, the area at Big Stone City having the greater elevation. The areas occurring along the foot of the hills in the valley vary considerably. In some places the borings indicated the soil to be typical Barnes, whereas in other places the borings showed a dark-colored, friable, subsoil material of a grayish color. However, since these areas are on terraces, they were included with mapped areas of the Bearden soils. Such areas occur south and 4 miles north of Twin Brooks. The soil of the two areas mapped in sections 1 and 6 in the northeastern part of Lura Township grade into the upland soils, making their limits difficult to establish. These areas showed some gravel spots within a depth of 3 feet, but, since these spots did not seem to be more droughty than the typical soil, they were not mapped separately.

Bearden loam is a very good soil and particularly well adapted to the production of corn and the deep-rooted legumes. The soil on the areas mapped in the vicinity of Twin Brooks contains more clay in the surface soil, so that here small grains are grown. Practically all of the type is cultivated, and most of it is planted to corn. It is valued about the same as the soils surrounding it.

BEARDEN SILT LOAM

The surface soil of Bearden silt loam, to a depth of 7 or 12 inches, is a dark-brown, almost black, friable silt loam. The subsurface material, to a depth of 18 or 20 inches, is brown and has a silt or silty clay loam texture. The subsoil consists of a yellow or grayish-yellow, friable, calcareous material having a silt or silty clay loam texture. This type is a terrace soil corresponding to the Barnes series of the upland soils, in that they have similar soil profiles and color horizons, and are composed of friable materials which contain considerable lime.

This soil is mapped in comparatively small areas throughout the valley and in the "hills," the largest areas occurring along the western side of Big Sioux River in Blooming Valley and Lura Townships. These areas occur on rather high benches, and the soil grades into the upland, making it difficult to determine the boundaries. The areas mapped in the northeastern part of the county, east and north of Lake Albert, are low, and poorly drained. However, they are not

so wet in the spring as to prevent their being cultivated. The soils on these areas have positions similar to the Fargo soils; but since their profiles are like those of the Bearden soils, they were included with the Bearden soils in mapping. The other areas mapped in the flatter part of the valley seem to be old terraces which connect the old sluggish waterways. Some small areas are also mapped along the small streams of the county.

The topography of the terrace areas of this soil varies from flat to slightly sloping toward the stream. It is a good productive soil and all of it is cultivated. It compares favorably with the Barnes silt loam. The common crops are grown on it, and good yields are obtained. Corn is the principal crop. More legumes should be grown. It is currently valued at $100 or more an acre.

MOODY VERY FINE SANDY LOAM

The surface soil of Moody very fine sandy loam, as mapped in Grant County, consists of a very dark grayish-brown, friable very fine sandy loam containing considerable silt, ranging in depth from 8 to 15 inches. This is underlain by material of a very fine sandy loam texture, slightly heavier and more compact than the surface soil, to an average depth of about 24 inches. The very dark brown color in the upper part of this layer changes gradually downward to a dark brown. Below 24 inches the material has a grayish-brown color and a very fine sandy loam or silt loam texture, with spots of lime and small lime concretions. The grayish-brown color continues below this horizon, but the lime is apparently not so abundant.

Only a small acreage of this type is developed in Grant County. The principal area of this type begins about 1½ miles south of Big Stone City and extends in a southeasterly direction to the county line.

The topography of this land is gently rolling, the type occurring on stream divides, and thus the drainage is generally good. This is a very productive soil and nearly all of it is in cultivation, the usual crops of the county being grown on it. The yields are fully as good as those on the Barnes silt loam.

BENOIT LOAM

The surface soil of Benoit loam, to a depth of 6 or 10 inches, is a black loam underlain by a dark-gray loam material, to a depth of about 16 or 18 inches. This subsurface material is underlain by a gravelly loam material, yellow in color or mottled with yellow and gray, from depths of 28 or 32 inches to a substratum of stratified sand and gravel, which is yellow, brown, and gray in color.

Areas of Benoit loam have a flat topography, so that drainage would benefit this soil. Narrow strips are mapped along some of the small tributaries on the east side of Big Sioux River, and other areas occur at the heads of similar streams. The larger and more important areas are south of Crooked Lake and in section 4 of Farmington Township.

The better areas of this type are cultivated, especially in the drier years. Corn and potatoes are the principal crops grown, most of the potatoes being grown in the vicinity of Troy. This type is more

favorable for cultivation than the silt loam and it is used during the drier years. It produces large yields of grass.

BENOIT SILT LOAM

The surface soil of Benoit silt loam, to a depth of about 8 inches, is black silt loam. The subsurface is a dark-gray silt loam material and, at a depth of about 14 or 16 inches, it is underlain by yellowish-gray or grayish-yellow loam material, mottled with gray and yellow. Stratified sand and gravel, which are brown and yellow in color with some thin gray layers, occur at a depth of about 26 or 28 inches. In places the gravel bed is below 36 inches.

Benoit silt loam is mapped as small areas associated with the Sioux and Pierce soils. The seepage from these latter soils makes this type wet throughout the year, so that this land is used mostly for pasture or hay. The largest areas are mapped in sections 20 and 21 of Blooming Valley Township, section 34 of Osceola Township, sections 17 and 21 of Mazeppa Township, and sections 6 and 7 of Troy Township. In a succession of dry years this soil could be cultivated. Drainage would benefit this soil.

PIERCE FINE SANDY LOAM

The surface soil of Pierce fine sandy loam, to a depth of 4 or 7 inches, is dark brown in color, grading rather sharply into a brown loam extending to a depth of about 14 or 16 inches, which, in turn, is underlain by a layer of yellow, friable, calcareous loam, from 2 to 4 inches thick. Below this is a bed of yellow and brown, stratified, calcareous sand and rounded gravel; and in places, a thin layer of gray gravel.

The largest area of this type is mapped in Troy Township and other large areas are in the northeastern corner of Vernon Township and in Alban Township. A narrow strip is mapped along the western edge of the hills in Mazeppa Township, which area is probably the roughest mapped.

This land is rolling to rough and has a large number of stony and gravelly knolls scattered over it. Most of it is used as pasture land. The area mapped in Troy Township is undulating to rolling and has fewer gravelly spots exposed and less stone and gravel on the surface. Most of this area is in cultivation, planted to the usual crops grown in the county, all of which suffered from drought in 1922. The type mapped between Lake Albert and Big Tom Hill differs from typical, in that it has a finer-grained surface soil and subsoil; the surface soil is a very fine sandy loam, and the gravelly substratum is not so thick. The topography is gently rolling. As a whole, these areas do not seem to be so droughty as the other areas described. The strip mapped from Big Tom Hill southeastward exists as a ridge, the rougher part of which was included in the areas mapped as Barnes loam, rolling stony phase. The rougher land is used for pasture, whereas the remainder of the ridge is cultivated. This area is very similar to the area mapped in Troy Township.

Most of this type of soil is droughty. It is ordinarily planted to the same crops as the other soils. Cultivated crops give good results in normal years, since cultivation aids in the conservation of moisture. Crops that mature before the dry season sets in should be

considered in planning a rotation on this soil. As a whole this type of soil is not so well improved and is not considered so valuable as some of the other soils of the county. About half of it is cultivated.

FARGO SILT LOAM

The surface soil of Fargo silt loam, to a depth of 5 or 7 inches, is a black, friable silt loam, grading into a black, silty clay material which extends to depths ranging from 18 to 24 inches, below which is a friable material gray or drab in color and silty or silty clay in texture. This deeper layer contains carbonate of lime and magnesium sulphate. In some places this gray layer extends to a depth of 36 inches, but in many places it is underlain, below 30 inches, by a black, plastic, noncalcareous clay which contains no magnesium sulphate. In other places there is no friable layer, but instead a drab or brown, mottled plastic clay or silty clay material occurs below a depth of 20 or 24 inches containing lime but very little magnesium salts. Such variable soils occur throughout the mapped areas of this type. These patches were not separated because of their varied character and because all had the same position, formation, and cropping value. The surface soil is sticky when wet, showing a comparatively high content of clay.

Fargo silt loam is commonly known as gumbo. In places narrow sandy ridges and mounds occur, similar to those on areas of Fargo silty clay loam. Areas of Fargo silt loam have a flat topography, so that the type does not have good surface or subsurface drainage. The water table is close to the surface, especially where the gray friable layer occurs. Fargo silt loam usually occurs at a slightly lower level than the surrounding Barnes and Beadle soils.

Most of this type is mapped in the valley near the foot of the hills, and it represents both lacustrine and alluvial materials which have been brought from the hills. Narrow areas, which at one time probably were sloughs or sluggish drainage channels, project meanderingly from the main body into the Barnes and Beadle soils. On this soil crops suffer from too much water in very wet years. The large broken area near the foot of the hills extends from the vicinities of Albee and Revillo to the northern part of Kilborn Township. The largest areas are in the northern part of Kilborn Township, along North Fork Yellow Bank River in Vernon Township, and in the southern parts of Madison and Vernon Townships. Those bodies of Fargo silt loam which are composed of more heavy materials are usually located farthest from the streams. There are numerous smaller areas associated with the Beadle soils. Only a few small areas are mapped in the eastern part of the valley, these usually being low, poorly drained spots, but having sufficient drainage to permit their use for crop production. Drainage would help this kind of land. Some fields have been tiled with good results.

Fargo silt loam is one of the most productive soils in the county. It produces best in seasons of moderate rainfall. Practically all of it is farmed. Some cornfields seen in the dry year of 1922 yielded probably 50 or 60 bushels of corn an acre. Wheat does very well, but oats tend to lodge. Some alfalfa is grown.

Fargo silt loam, meadow phase.—The meadow phase of Fargo silt loam, to a depth of about 6 or 8 inches, is a dark-brown to black silt

loam underlain by a black or dark-brown silty clay loam material to a depth of about 20 inches. This material grades downward into a clay of the same color. At a depth of about 28 or 30 inches occurs a brown or gray, mottled clay or a heavy gray plastic clay. In many places this mottled or gray clay occurs at a depth of 20 inches.

The meadow phase of Fargo silt loam is mapped exclusively in the low areas known as sloughs, and it is practically all associated with the Barnes soils. Some of the small poorly drained stream bottoms are included in mapped areas of this soil. Most of the sloughs have sufficient water in them in the earlier part of the season to prevent their being plowed, so they are used for pasture or as hay land. Some of these slough areas contain certain patches that are wet throughout the year, and in others there are spots that are entirely covered with water during years of normal rainfall. Such spots are indicated on the map by swamp symbols. The surface soil of this phase is calcareous in places and the subsoil is generally so. The large area south of Troy, in sections 29, 32, and 33, is underlain in places by gravel within a depth of 36 inches.

All of this kind of soil needs artificial drainage. The area in section 33 of Stockholm Township has been tile drained with good results. The acreage of this soil and the possibility of utilizing it for hay or pasturage affects the value of farms more or less.

FARGO LOAM

The surface soil of Fargo loam, to a depth of about 7 inches, is a black loam containing considerable clay. This surface layer grades downward into a dark-brown or almost black loam material which extends to depths ranging from 10 to 16 inches; and it is underlain first by a grayish-yellow or gray loam material, to a depth of 30 or 34 inches, and then usually by a black plastic clay. The layer of heavy clay is not calcareous and it contains no crystals of magnesium sulphate. In some places the clay layer is absent. This type is associated with Fargo silt loam and grades into it, so that the mapped boundaries of the areas are more or less arbitrary.

The topography of Fargo loam areas is flat and the drainage is not good; so that the soil is rather wet when the rainfall is above normal. Tiling would benefit this soil.

The principal areas of Fargo loam are mapped in the vicinity of Big Tom Hill, along South Fork Yellow Bank River, near Revillo, and along North Fork Yellow Bank River in Madison, Grant Center, and Alban Townships. The area mapped in section 13, Kilborn Township, has a heavy, compact layer resembling that of the Beadle soils. The type mapped in section 7 of Kilborn Township approaches the Lamoure soils in its characteristics. This type of soil closely resembles Fargo silt loam, and it is doubtful if there is any appreciable difference in their agricultural value.

FARGO SILTY CLAY LOAM

The surface soil of Fargo silty clay loam, to a depth of 7 or 8 inches, is a dark, almost black silty clay loam. The subsurface material is a dark-brown or black clay, to a depth of 18 or 22 inches,

which grades downward into a drab or gray, crumbly silty clay loam material. This gray material contains carbonate of lime and magnesium sulphate crystals, and it may extend to a depth of 36 inches, in many places being underlain, at a depth of 32 or 34 inches, by a black, plastic, noncalcareous clay. In some places no gray, crumbly layer occurs, but instead a layer of drab or mottled, plastic clay. This soil is commonly known as gumbo. Low sandy ridges from 10 to 30 feet wide, covered by a loamy soil, occur throughout areas of this type. These ridges are affected by drought in dry years, as in 1922.

Fargo silty clay loam is practically all mapped in the valley, on terraces and on lacustrine deposits in the poorly drained sections. The largest areas are mapped in section 2 of Grant Center Township and section 28 of Vernon Township. These areas are cultivated, but the smaller areas and narrow strips which usually lie at lower levels, remain wet so long in the spring that they are used only for pasture or hay land. The map shows some areas containing swamp symbols, indicating that in normal years such areas are usually wet throughout the major part of the year. This type as a whole would be benefited by drainage.

Wheat, corn, and oats are the chief crops grown. In some years oats and wheat tend to lodge on this soil. The soil is rather difficult to handle because of its high content of clay; but when properly handled, it gives excellent results because of its richness. It is only when this land is too wet for cultivation or when it occurs in large areas that it affects the value of a farm unfavorably. The low meadow patches are known as sloughs.

Variations from the typical soil occur in sections 11 and 12 of Kilborn Township, in section 27 of Vernon Township, and in other areas in the valley. In such areas a heavy compact subsoil which corresponds to the heavy compact layer of the Beadle soils, though it is black in color and is of lacustrine or alluvial origin, occurs at a depth of about 10 or 12 inches. This heavy layer is underlain by a heavy, gray, drab, or brown mottled clay. The soil in these areas is not considered such valuable farm land as the typical Fargo silty clay loam.

WEBSTER SILTY CLAY LOAM

The surface soil of Webster silty clay loam, to an average depth of 8 inches, is a very dark-brown or almost black silty clay loam. Below this is a dark-brown clay which extends to an average depth of about 20 inches. The next deeper layer is a drab, gray, or mottled silty clay loam or clay, which in many places becomes more friable as the parent material of a calcareous drift is approached. The upper two horizons do not as a rule contain sufficient lime to cause a sample to effervesce when treated with acid; but at depths ranging from 24 to 30 inches the subsoil is highly calcareous. Bowlders and glacial gravel occur over the surface of this type and throughout the soil profile. This soil has been developed from glacial drift under the condition of poor drainage.

This soil occurs as a few scattered areas along the eastern border of the county, usually in depressions and shallow valleys, or on terracelike formations. The natural drainage is usually deficient, but

most of the type can be efficiently drained by ditches or tile. Where this land is well drained it is one of the strongest and most productive types of the county. Wheat, corn, and oats are the principal crops. The soil is rather difficult to handle on account of its high clay content, but it works up well under the proper moisture condition. Only in very wet years are the yields reduced by poor drainage.

LAMOURE FINE SANDY LOAM

The surface soil of Lamoure fine sandy loam, to a depth of about 6 inches, is a dark-brown fine sandy loam, and the subsurface is a brown fine sandy loam. In the area mapped along Whetstone River this subsurface layer extends to a depth of 36 inches; but layers of sand or silt material, and in places gravel, may be found. The fact that this type represents bottom lands which are overflowed frequently, explains its variation in texture.

This type mapped in the vicinity of Revillo generally has a gray, calcareous, friable subsoil underlain by a heavier and darker-colored substratum. Areas of this type mapped in the hills are patchy with soils having subsoils which are heavier or lighter in texture, and lighter or darker in color than the surface soils, the heavier subsoils usually being the darker colored. This soil which is mapped along the branches of Big Sioux River, having lighter-textured subsoil than typical, really belongs to the Cass series of soils; but it was mapped as Lamoure soil because of the wide variations in the patches.

Most of the Lamoure fine sandy loam is in pasture. The area along Whetstone River near Big Stone City is practically all in cultivation and planted to corn. This area is very patchy and the surface soil is colored a lighter brown than most of the type.

LAMOURE LOAM

Lamoure loam differs from Lamoure silt loam in having a lighter-textured surface layer. The topsoil is a black loam about 6 inches deep, underlain by a dark-brown loam which extends to a depth of about 10 inches. Below 10 inches the material is brown and loamy to a depth of 20 inches, where it usually contains lime. At a depth of about 30 inches the material has a gray or grayish-yellow color and a silt loam texture. In places the soil is dark colored to a depth of 3 feet and in other places the subsoil is slightly lighter in texture than typical.

Some of this type of soil is cultivated and some is used for pasture. The area mapped along North Fork Whetstone River, being several feet above the river, is seldom under water and closely resembles Bearden loam. Practically all of this area is tilled, corn being the principal crop. Most of the areas mapped along the smaller streams are patchy, with soils having heavier and lighter surface soils and subsoils. Most of this type of soil is first-bottom land and is subject to overflow.

LAMOURE SILT LOAM

Lamoure silt loam, to a depth of 14 or 16 inches, is a friable, black silt loam. The subsurface material has a silt loam texture and is

colored a dark gray or drab. It gradually becomes heavier with depth, until at about 20 or 26 inches it assumes a silty clay loam or clay texture. The surface soil is calcareous in places and the subsoil is generally so.

Along the streams, Lamoure silt loam is mapped as first-bottom land. The most important and extensive areas occur in the southeastern corner of the county and along Big Sioux River in the western part; and in addition there are several smaller and less important areas.

Almost all of this soil is used for pasture or hay land. It produces good yields of native grasses and its value is determined largely by its yields of hay. This is naturally a very fertile soil, and if drained it would produce large yields. It is often under water during the spring, and the water table is close to the surface.

ROUGH STONY LAND

Rough stony land includes the areas that are too rough for cultivation and areas which are so rocky that they can not be profitably cleared for cropping. Most of it is mapped on the western edge of the hills and extends in a more or less continuous strip from Boating Lake to the county line southeast of Troy. Some of the areas are not rough, but are merely covered with large stones. This land is used almost exclusively for pasturing cattle and sheep. Some areas mapped in the northern part of Mazeppa Township include knolls on which occur Pierce soils, but these were included with the rough stony land in mapping because of topography. The remainder of it resembles Barnes loam.

PEAT

Peat is mapped in the low spots and on seepage areas associated with the Sioux and Pierce soils. Most of it is mapped in Troy and Mazeppa Townships. It is saturated with water throughout the year and it shakes when it is walked upon. It represents deposits of partially decomposed organic matter on materials which have given rise to Fargo soils. Most of it is muck rather than peat. The covering of organic matter is from 16 to 24 inches deep, and it is underlain by a sticky, black, drab or grayish clay. Most of this kind of land can not be utilized as pasture or hay land in its present undrained condition.

SUMMARY

Grant County is situated in the northeastern corner of South Dakota, and has an area of 685 square miles or 438,400 acres.

Its topography varies from flat to rough, most of it being undulating. Drainage is fairly good. A flat area just east of the hills is not well drained, and there are also numerous potholes or sloughs, without any outlet, where water collects. The principal streams are Big Sioux and Whetstone Rivers, and tributaries of Yellow Bank River. The hills which extend through the center of the county constitute a watershed between the first and the last two streams. The latter two flow into Minnesota River and the former into Missouri River.

The county naturally falls into two divisions—"the valley" and "the hills." The average elevation of the valley is between 1,200 and 1,300 feet; and of the hills, about 1,600 feet. The elevation ranges from less than 1,000 feet at Big Stone Lake to about 2,000 feet at Boating Lake.

Grant County was organized in 1878. The present population is practically all white. They are descendants of the early settlers, of German or Nordic extraction. According to the 1920 census the total population is 10,880. Milbank is the county seat and principal town.

The county has good dirt roads, and it is graveling some of the main highways. Three railroads pass through the county, but some places in the western part are 12 miles from shipping points.

The climate is characterized by comparatively long, cold winters and short, warm summers, with clear, cool falls. The mean annual temperature, as reported by the Weather Bureau station at Milbank, is 42.6° F.; the mean precipitation, 22.82 inches; and the average growing season, 133 days.

Wheat is the principal cash crop, 90 per cent of it being Marquis. Corn is increasing rapidly in importance and acreage. Other important crops are oats, rye, barley, and some flax and potatoes. Apples are the principal fruit grown. Vegetables for home use are grown by all farmers.

The 1920 census reports 1,347 farms with an average of 285.6 acres per farm, of which 224.2 acres are improved.

The land ranges in value from less than $50 to more than $200 an acre, depending upon soil, location with respect to towns or shipping point, and improvements.

The soils of Grant County are classified into 10 series, including 23 types and 3 phases, in addition to 2 miscellaneous classes, peat and rough stony land. About 90 per cent of the soils are glacial and the remainder are lacustrine and alluvial. The glacial soils include those of the Barnes, Beadle, and Pierce series, and rough stony land; the Barnes soils being the most important. The Sioux, Benoit, Bearden, and some of the Fargo soils are classed as old alluvial or terrace soils and the Lamoure series as recent-alluvial or flood-plain soils. Peat and some of the Fargo types comprise the lacustrine soils.

The Barnes and Bearden soils and the rough stony land have dark surface soils, friable, brown subsurface materials, and yellow, or grayish-yellow, friable, calcareous subsoils. The Beadle soils differ from these in texture, and in having compact clay layers within the brown horizon.

The Pierce, Sioux, and Benoit soils are characterized by a stratified bed of brown and yellow sand and gravel at a depth of about 20 inches. This gravel bed occupies the same position as the yellow horizon in the Barnes soils.

The Fargo and Lamoure soils have dark surface soils and lighter-colored but heavier, calcareous subsoils.

The Sioux and Pierce soils are droughty. Practically all the soils are well suited to the common crops grown in this section.

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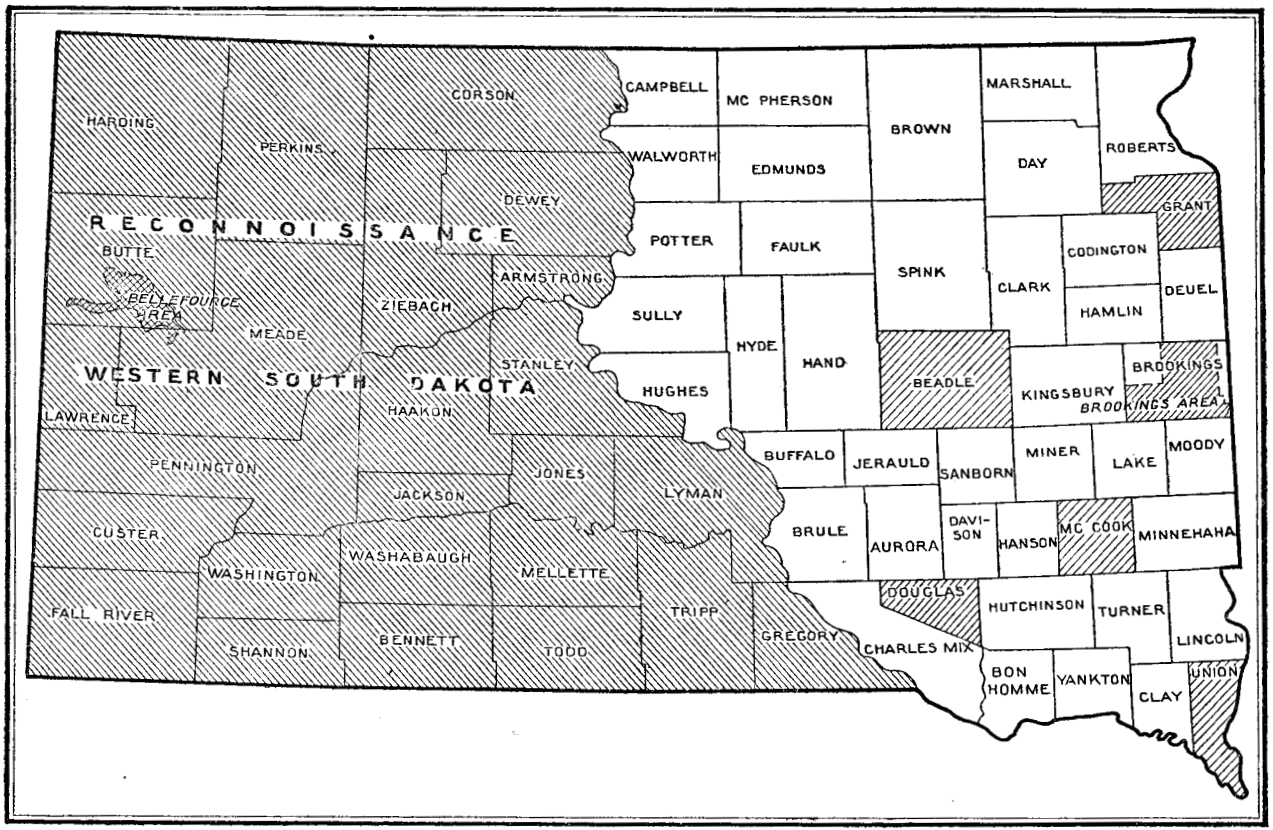

Areas surveyed in South Dakota, shown by shading

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