U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE STATE OF NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION, THOMAS P. COOPER, DIRECTOR; AGRICULTURAL AND GEOLOGICAL SURVEY, R. C. DONEGHUE, DIRECTOR.

SOIL SURVEY OF SARGENT COUNTY, NORTH DAKOTA.

BY

F. Z. HUTTON, IN CHARGE, AND B. H. HENDRICKSON, OF THE U. S. DEPARTMENT OF AGRICULTURE, AND MELVIN THOMAS AND SPENCER BUSTER, OF THE NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

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

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Soils,
Washington, D. C., March 31, 1919.

Sir: I have the honor to transmit herewith the manuscript report and map covering the survey of Sargent County, North Dakota, and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1917, as authorized by law. This work was done in cooperation with the State of North Dakota Agricultural Experiment Station and Agricultural and Geological Survey.

Respectfully,

Milton Whitney,
Chief of Bureau.

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

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SOIL SURVEY OF SARGENT COUNTY NORTH DAKOTA.

By F. Z. HUTTON, In Charge, and B. H. HENDRICKSON, of the U. S. Department of Agriculture, and MELVIN THOMAS and SPENCER BUSTER, of the North Dakota Agricultural Experiment Station.—Area Inspected by THOMAS D. RICE.

DESCRIPTION OF THE AREA.

Sargent County, North Dakota, lies in the southeastern part of the State, being bounded on the south by the South Dakota State line. Except for a small projection in the southeastern corner, the county is rectangular in shape, being 36 miles long and 24 miles wide, and has an area of approximately 834 square miles, or 533,760 acres, including lakes and streams.

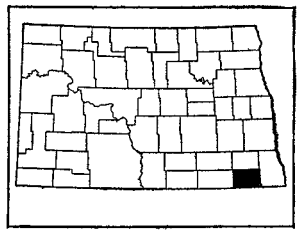

FIG. 1.—Sketch map showing location of the Sargent County area, North Dakota.

Sargent County occupies parts of three topographic divisions, known as the Prairie plains, the Sheyenne delta region, and the glacial Lake Sargent region. The Prairie region is the most important, forming approximately three-fourths of the county. This region ranges in elevation from 1,100 to 1,300 feet above sea level. It shows a gradual descent from the southwestern part of the county to the northeastern corner. The surface of this region varies from level to rolling. Several lines of prominent hills or moraines traverse this region in various directions. The first of these moraines, known as the Dead Colt and Whitestone Hills, is situated in the northern part of the county, beginning at about the county line in sec. 3, T. 132 N., R. 56 W., and extending in a southerly direction, gradually disappearing west of the town of Gwinner. On the eastern side these hills rise quite sharply from the plain, but they slope gradually toward the west, and there is no perceptible bluff marking the western edge of these hills from the plain proper. The second range of hills lies in the southwestern part of the county, extending from the town of Hample south to the county line. It forms a topographic division separating the glacial Lake Dakota region in Dickey County, on the west, from the glacial Lake Sargent region to the east. The third range of moraines occurs in Tewaukon and Marboe Townships (T. 129 N., Rs. 53 and 54 W.), and is known as the

Sisseton Hills. These hills are a part of the Coteau des Prairies, which extends into the county from South Dakota in a semicircular form, entering the county about 3 miles east of Havana, curving gradually around to the northeast, reaching their northern limit in sec. 6, T. 129 N., R. 54 W., and sec. 1, T. 129 N., R. 55 W., then gradually bearing to the southeast and leaving the county in the southeastern corner. The Sisseton Hills comprise the most extensive and most rugged morainic region in the county. They consist of several single ranges, with intervening valleys, running in a northwest-southeast direction. The hills rise rather abruptly on the northern side, being marked by a distinct bluff line, but the slope southward from the crest is smoother. A number of creeks and draws flow through these hills, or from them into the Wild Rice River.

In detailed topography the Prairie plains consist of a rolling country marked by numerous depressions varying from 1 acre to as much as 40 acres or more in extent. In some cases these depressions cover several square miles. They usually dry up during the summer, although some contain enough water during the entire year to be called lakes. Drainage is imperfectly established over this region, although the Wild Rice River, the only stream of any importance in the county, rises within its limits in the southwestern part of the county.

The second topographic division, known as the Sheyenne delta, occupies the northeastern corner of the county. The town of Milnor is just on the edge of the region. Its western boundary is marked, in general, by a chain of lakes beginning near the north county line, northwest of Milnor, and extending in a southeasterly direction, leaving the county in sec. 25, T. 131 N., R. 53 W. This delta region is characterized by a level to faintly undulating topography. Large areas, especially southeast of Milnor and northeast and east of De Lamere, are poorly drained. The areas farther east and south are more rolling and are well drained, and some areas in this region, especially the country east of Lake Fedje, are excessively drained. The most level part of this delta formation lies east and north of De Lamere, where the surface is so level that no slope can be detected by the eye.

The third topographic division, known as the glacial Lake Sargent region, lies in the western part of the county. Its western boundary enters the county on the north about 4 miles east of the Dickey County line and continues in a southerly direction to the town of Crete, where a small neck of the old lake extends west into Dickey County. From Crete the western shore line of the lake extends in a southeasterly direction, crossing the Minneapolis, St. Paul & Sault Ste. Marie Railroad about 1 mile west of Nicholson. From that point the boundary runs in a southwesterly direction,

crossing the State line about 4 miles east of the Dickey County line. The glacial Lake Sargent region varies in width from 2 miles, on the Ransom County line, to 11 miles on the State line. Its average width is about 4 miles. The eastern side of the region is marked in a general way by the towns of Stirum, Harlem, Cogswell, and Brampton. From Brampton the boundary of the region extends southwesterly, leaving the county approximately in sec. 33, T. 129 N., R. 58 W. The Lake Sargent region is marked by flat to gently rolling topography, relieved by large sloughs and low swales. There is no well-established drainage system and, although most of the sandier soils are well drained, owing to their slight elevation and coarse texture, the water table over this region is within 10 feet of the surface, and large areas of low-lying, heavier soils are poorly drained. As a consequence, this is spoken of as the wet, poorly drained portion of the county. At the present time (1917) contracts are being let for a system of drainage ditches which will drain most of these wet areas, swales, and sloughs into the Wild Rice River. When these ditches are completed a large area of land can be put under cultivation which heretofore could only be used for pasture or for hay production.

In the Sheyenne delta region, in the northeastern part of the county, much of the land is likewise poorly drained. Drainage here will be similarly improved by drainage ditches which are now being constructed to drain into the Wild Rice River.

The Wild Rice River rises in a large slough just east of Straubville and follows a general easterly course to Lake Tewaukon. It receives a number of northward-flowing tributaries from the Sisseton Hills, east of Havana and south of Lake Tewaukon. From Lake Tewaukon the river flows in a general northeasterly direction out of the county. Aside from the areas drained into the Wild Rice River and its tributaries and into the drainage ditches now being constructed, most of the rainfall over the county, not immediately absorbed by the soil, finds its way into swales and potholes or lakes, where it finally evaporates or is absorbed by the surrounding soil as the dry season advances.

As early as 1881 there were a few settlers in this territory, mostly squatters, who took up land in the eastern part of the county along the Wild Rice River. During the fall of 1882 the Northern Pacific Railroad was completed as far as Milnor, and the following spring large numbers of settlers came in to take homesteads. By this time the greater part of the county had been surveyed. In the period from 1883 to 1886 the Great Northern Railroad was completed across the county. Together with the Minneapolis, St. Paul & Sault Ste. Marie Railroad, which was completed during the same period, it added greatly to the shipping facilities of the county, and was the

means of bringing in large numbers of settlers. The county was organized in 1883. By 1890 the population had increased to 5,076. During the period from 1890 to 1900 there was an increase of only about 1,000 in population, but by 1910 the number had risen to 9,202. The population is entirely rural, and in 1910 averaged 10.8 inhabitants per square mile.

The extreme eastern part of the county was settled largely by people from Poland, whose descendants still occupy this section. A large percentage of the inhabitants of that part of the county around Cayuga, Rutland, and Milnor are native, having settled here from Minnesota, Wisconsin, and some from as far east as New York. A number of German farmers have settled around Forman. A large part of the area of the county was settled by people of Scandinavian ancestry. Settlers from Minnesota, Wisconsin, and the Central States comprise most of the American-born population.

Forman, with a population of 350, is the county seat. It is situated in the center of the county, on the Minneapolis, St. Paul & Sault Ste. Marie Railroad, thus having direct connections with St. Paul and Chicago. Cogswell, located 6 miles directly west of Forman, at the junction of the Minneapolis, St. Paul & Sault Ste. Marie Railroad and the Chicago, Milwaukee & St. Paul Railroad, with a population of 450, is the principal business town for the western part of the county. Havana, with a population of 400, in the southern part of the county, is the main shipping point for a large territory. In the northwestern part of the county Crete and Stirum, with a population of 150 each, are the principal markets, and Gwinner, situated 9 miles north of Forman, and Hoving are shipping points for the north-central part. Milnor, the largest town in the county, with a population of 650, and De Lamere, with a population of 200, are marketing and shipping points for the northeastern part. Every town in the county is situated on some railroad that has direct connection with eastern markets. There are four railroads in the county, with a total length of about 140 miles. Most points in the county are within 5 miles of a railroad, and no place is more than 10 miles from a shipping point.

The public roads over most of the county are poor, especially during the spring and early summer. This is partly due to the many swales and ponds, through which there is only a narrow grade built. In places the grades are rough and in poor condition, so that there is danger of sliding to one side, and at certain times of the year these grades are quite dangerous. Very little attention is paid to improving the roads, and in many cases the main roads meander across fields so as to avoid potholes and sloughs. Probably one cause for the lack of attention to road improvement is the good railroad facilities of the county. However, there is a movement now in progress

to secure a system of State roads across the county. The common use of automobiles among the farmers is arousing more interest in securing better roads.

A good class of farm dwellings and other buildings predominates throughout the county. In many cases the farm homes have modern improvements. Practically every farm has telephone connections.

The water for domestic use, although alkaline, is adequate over all of the county. Artesian water can be had at varying depths from 300 to 800 feet. Most of the farms have artesian wells, which furnish an abundant supply of water for live stock and household use.

This county was originally treeless except for a few places along the Wild Rice River and a fringe of forest around Lake Tewaukon. Most farmsteads now have well-established groves and windbreaks. With proper care good shelter belts can be established on practically every farm in the county. They are of great value in furnishing protection against the strong northwest wind in winter, in addition to relieving the otherwise monotonous landscape.

CLIMATE.

The climate of Sargent County is subhumid and marked by cold winters and short, cool summers. The summer days are warm, but the nights are generally cool. Thawing weather usually begins about March 10, and field work can be begun about April 1, but the weather is usually cool and plant growth slow until about June 1, after which the higher temperatures and long days hasten growth. Occasionally, wet weather during the spring prevents the early seeding of crops, which, as a result, are sometimes considerably damaged by drought later in the season. However, such injury is suffered only under abnormal conditions. As a general rule, the fall season is somewhat dry, with many days of fair weather. The ground seldom freezes before the middle of November, so that there is usually ample time to finish the fall plowing and other fall work before the winter sets in. During short periods in the winter the thermometer may go as low as —45° F., but the dry air makes the cold less penetrating than in more humid regions. These extreme cold periods are less disagreeable than periods of moderately low temperature accompanied by blizzards. As a rule, the small grains and grasses are well protected from severe cold by an ample covering of snow.

Weather Bureau observations at Forman covering a period of 25 years show an average frost-free period of 124 days, from May 19 to September 20. The latest killing frost in the spring on record occurred on June 28, and the earliest in the fall on August 12.

The mean annual precipitation is reported as 20.41 inches. The total for the driest year on record (1907) was 13.90 inches, and for

the wettest year (1916), 35.51 inches. The rainfall is greatest for the growing months of June, July, and August, and about three-fourths of the annual precipitation occurs in the period from April to September, inclusive.

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

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

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1907).	Total amount for the wettest year (1916).
	0° *F.*	0° *F.*	0° *F.*	*Inches.*	*Inches.*	*Inches.*
December	15.0	58	— 36	0.49	0.48	0.75
January	6.9	57	— 45	.51	1.40	1.62
February	9.7	64	— 53	.43	.30	.10
Winter	10.5	64	— 53	1.43	2.18	2.47
March	25.6	84	— 34	.92	.22	1.15
April	43.9	99	— 5	2.21	.30	3.05
May	55.5	99	18	2.90	1.54	5.16
Spring	41.7	99	— 34	6.03	2.06	9.36
June	65.6	102	24	3.37	3.21	6.78
July	69.2	104	28	2.92	2.00	10.10
August	67.6	103	29	2.97	1.00	4.09
Summer	67.5	104	24	9.26	6.21	20.97
September	59.1	102	11	1.82	1.57	2.59
October	45.9	97	— 6	1.36	1.78	.05
November	27.2	82	— 28	.51	.10	.07
Fall	44.1	102	— 28	3.69	3.45	2.71
Year	40.9	104	— 53	20.41	13.90	35.51

The relatively short but hot summer season, with 14 to 16 hours of sunshine daily, favors quick growth and early maturity of crops, and warm south and southwest winds, with showers every week or 10 days, also favor rapid growth. Occasionally, a long period of dry weather occurs during the summer, with a few days of hot winds at the end of the period, which reduces the yields of crops, especially small grains. These periods, however, do not occur frequently. In some years there is heavy rainfall during the early part of the growing season, and, as the soils are retentive, crops are damaged by an excess of moisture.

The rather short period between killing frosts in some years may affect the maturing of corn, but early-maturing corn can be ripened in any ordinary season, and corn for silage can be easily grown every year. Some damage to crops is done by hailstorms, but it is confined to local areas, and the damage is usually small.

AGRICULTURE.

The first settlers came into Sargent County in the early eighties. In 1881 there were a few scattered settlers in the eastern part, along the Wild Rice River, but owing to the distance from railroads and the lack of equipment very little agricultural progress was made until after the railroads entered the county, between 1883 and 1886. After the building of the railroads settlers came in rapidly, and by 1886 all parts of the county were more or less settled. The early farmers in Sargent County, as in most counties in this section of the State, at once began grain production, almost to the exclusion of every other type of agriculture. Wheat became the main crop, followed by oats and barley, the latter two being grown at first principally for feed. As late as 1890 practically no cattle were sold from the county. Flax was introduced at an early date, and for a number of years, as long as there was an abundance of unbroken land in the county, it ranked high as a money crop. As late as 1910 a large acreage of flax was seeded each year. Of recent years, however, it has declined in favor as a money crop, owing to the fact that it does not seem to do well on old land in a system of exclusive grain farming.

The early settlers broke the prairie sod in the spring or early summer, "backset" it in the fall, and prepared the land and sowed it to small grains the following spring. This method of tillage usually produced good crops, but the income was small, as it was difficult for farmers to prepare more than a small acreage each year. With the introduction of flax, methods were changed, as the land could be broken in the spring and sown to flax. In this way the farmers were enabled to secure working capital at the end of the first year.

Some corn has been grown almost from the time the county was first settled, but prior to 1900 very little was grown in a commercial way. Since this date more corn has been grown each year. Early-maturing varieties have been introduced, and the farmers are gradually learning how to prepare the best seed bed and how to cultivate the crop to secure better yields and to mature it before frost. Another factor favoring the increase in the acreage of corn is the increasing presence of noxious weeds in the small-grain fields and the general decrease in yield of the small grains when grown to the ex-

clusion of cultivated and forage crops. With the steady increase in the acreage of corn the farmers are keeping more live stock, in order to use the crop to better advantage.

In 1890, according to the census, 273,000 acres, or about 61 per cent of the area of the county, was in farms, and of this, 142,272 acres, or about 52 per cent, was improved land. In 1900 there were 361,152 acres in farms, or about 66 per cent of the total land area of the county. The percentage of improved land was about the same as in 1890. In 1910, 484,909 acres, or 88.6 per cent of the county, was included in farms, and of this area 78.6 per cent was improved.

The average assessed value of farm land advanced from $7.88 to $34.14 an acre during the period from 1900 to 1910. During the same period the average value of farm buildings advanced from 82 cents to $3.24 per acre, the investment in farm machinery rose from 41 cents to $1.26 per acre, and the investment in live stock from $1.59 to $3.31 per acre.

While there has been a great increase during the 20-year period from 1890 to 1910 in the total land area in farms, the number of farms has not shown a marked increase. In 1890 there were 935 farms in the county, of an average size of 397 acres. In 1900 the number had decreased to 924, while the average size had increased to 389 acres. In 1910 there were 1,191 farms of an average size of 407.1 acres. Of the total number of farms, 74 per cent were operated by owners and 25 per cent by tenants. The greater part of the land not operated by owners is leased under the share system.

Wheat has always been the principal crop grown in Sargent County. Up to 1900 the percentage of improved land per farm devoted to this crop remained about the same, but since 1900 there has been a gradual decrease in the wheat acreage. In 1889 wheat occupied 50 per cent of the improved land in farms, and in 1899 51 per cent, but by 1909 the proportion had fallen to 35 per cent. In the latter year wheat was grown on 135,953 acres. Durum, Velvet Chaff, Marquis, Fife, and Bluestem are the principal varieties of wheat grown. The Marquis is a recently introduced variety that is rapidly gaining in popularity.

Oats rank second in point of acreage. In 1889 there were 13,801 acres devoted to this crop, and the acreage was practically the same in 1899, but by 1909 the acreage devoted to oats had increased to 29,475 acres.

Flax has supplanted wheat to a considerable extent on newly broken sod. In 1889 there were 2,504 acres devoted to flax. In 1899 there was an increase to 15,140 acres, and in 1909 to 27,773 acres. At the present time, owing to the high prices, there is a much larger acreage devoted to this crop than in 1909.

Barley is grown to a considerable extent. In 1889 there were 2,190 acres devoted to this crop. In 1899 the area had increased to 7,080 acres, and in 1909 to 23,220 acres. Barley is taking the place of wheat to a considerable extent, especially since the farmers are rotating crops more and more each year.

The next crop in point of acreage is corn. In the last few years there has been a large increase in the acreage devoted to this crop. In 1889 only 111 acres were planted to corn. By 1899 the area had increased to 4,230 acres, and in 1909 there were 7,628 acres in this crop. The steady increase in the corn acreage is due to the fact that early-maturing varieties have been found adapted to this climate and to the fact that farmers are now generally seeing the need of growing some cultivated crop in order to clean the land of noxious weeds resulting from continuous small-grain farming. Also, the farmers are keeping more live stock, which enables them to use the roughage from the corn crop. Many of the more progressive farmers are using silos, into which a large proportion of the corn crop is put each year. Corn is grown in all parts of the county, but most extensively on the more sandy soils in the southwestern and northeastern parts.

In 1889 there were 18,776 acres of wild hay cut in the county. In 1899 there were 39,382 acres of wild grasses and 2,900 acres of millet cut for hay. In 1909 there were 69,465 acres of wild grasses cut for hay, 4,955 acres of timothy, 702 acres of clover and timothy mixed, 66 acres of clover alone, 1,403 acres of millet, 30 acres of alfalfa, and 3,674 acres of other tame grasses. As the prairies are broken for cultivated crops more tame grasses are grown each year. Timothy and clover mixed is becoming one of the leading hay crops. Alfalfa is gaining considerable headway. At the present time (1917) at least 500 acres are devoted to this crop. There are some fields as large as 40 acres, and a number of the farmers have plats of 5 to 20 acres. Alfalfa does well on all the well-drained soils of the county, and a great deal of attention is being paid to this crop on the sandier types. The Grimm strain of alfalfa is most widely grown. Considerable millet is grown for seed and for hog pasturage. Of the millets, the German and Broom-corn varieties are most generally grown.

Potatoes are grown on all farms for home use. On the sandier soils potatoes are grown commercially in fields as large as 100 acres. The census reports a production of 68,450 bushels of potatoes in 1909. Very few farmers have facilities for storing any considerable quantity of this crop, and most of the surplus production is sold in the fall.

Strawberries, currants, gooseberries, and plums are produced, but little fruit of other kinds.

During the early stage of agricultural development few animals other than the work stock were kept, except on a few ranches in the southwestern part of the county devoted to raising cattle. As the county has developed, however, more cattle have been kept from year to year. Thus in 1889 no cattle were reported sold from the county. In 1899 $145,833 worth of beef products were sold and $41,093 worth of dairy products. In 1909 the value of animals sold or slaughtered amounted to $402,040, and that of all dairy products produced to $125,976. This represents an increase in the value of the live-stock products sold of over 35 per cent. There are still some large cattle ranges in the southwestern part of the county, and the farmers in all sections are seeing the advantages of live-stock farming and are increasing the number and quality of their cattle from year to year. Many pure-bred sires have been brought in, with a view to building up the quality of the herds, and a number of farmers have herds of pure-bred beef cattle. The dairy products sold from the farms consist largely of cream, which is shipped either to the creamery at Oakes, in Dickey County, or to Minneapolis or St. Paul. The county has unusually good facilities for shipping cream, as all the railroads crossing the county from east to west have direct connections to St. Paul and Minneapolis, and two of the railroads run directly to Oakes. All the larger towns in the county have cream stations, where cream is bought on the basis of butter-fat content. The recent high prices paid for butter fat have led the farmers to sell cream rather than to make butter on the farm. This is true to such an extent that there is not enough country butter made to supply the local trade, and most people in the towns depend on creamery butter for home use.

Owing to the newness of the agriculture of this region, little attention has been given to studying the adaptation of crops to soils. The same crops are grown on all the soil types over most of the county. The excessive drifting of certain soils by the wind has led some farmers to grow crops which help to check this tendency. This is especially noticeable in the sandy areas in the southwestern part of the county, where the farmers grow more corn and allow large areas to remain in grass.

Most of the farms are well equipped. Labor-saving machinery is used as far as possible, in most cases in order to meet the scarcity of labor, which is a serious problem at certain seasons. Heavy teams are used in farming operations, and power tractors, double-gang plows, and even triple-gang plows are in use.

SOILS.

The soils of Sargent County are derived from glacial drift, either weathered in the position in which it was left by the ice, or trans-

ported and redeposited in the beds of glacial lakes, in terraces along glacial streams, or in later times in the present flood plains of existing streams. The original drift was deposited as a part of the Dakota lobe of the continental ice sheet, at the time of one of the latest advances of the ice, known as the Wisconsin glaciation.

The presence of limestone and granite bowlders and gravel in the drift indicates that a considerable part of the material was derived from rocks of these formations. The sandy nature of the soil in places and the shale fragments found in some of the deposits indicate that sandstone and shale were also a source of the drift material. As the glacier receded, a deposit of till or drift was laid down over the county, varying in thickness, but averaging about 100 feet.

The till was modified to some extent by the melting of the ice. Large glacial lakes were formed over parts of the county, which, after the receding of the glacier, were finally dried except for relatively small areas which remain as lakes or sloughs. The subsequent influence of vegetative life and the action of drainage, erosion, and wind movement have also brought about some change in the character of the drift. The action of one or more of these factors has varied from place to place, and this has produced differences in the original material, resulting in different types of soil.

The soils of the county may be classed in three main groups, viz, glacial soils, glacial-lake and river terrace soils, and river flood-plain soils. The glacial soils occupy the greater part of the county. They are associated in occurrence with small areas of glacial-lake and river-terrace soils, as well as with areas of old glacial-lake beds. One of these latter areas is found in the northeastern part of the county, extending from Milnor eastward, and known geologically as the Sheyenne delta. The other glacial-lake region, known geologically as Lake Sargent, occupies a large portion of the central-western part of the county, as previously defined. The river flood-plain soils consist of first-bottom or low-terrace areas along streams.

The glacial soils are classed in the Barnes, Marshall, Valentine, and Pierce series. The Barnes is the most extensive series in the county. The soils of this series have been derived from glacial drift by weathering under semiarid conditions and are characterized by dark-brown to black surface soils and light-brown to yellowish-brown subsoils, which are mottled with greenish brown and grayish brown and are highly calcareous. The subsoils are of the same texture as the surface soils, or are somewhat finer and slightly more compact. The topography ranges from level to rolling, and in places hilly. The Barnes soils are well drained.

The surface soils of the types included in the Marshall series are dark brown to black; the subsoils are light brown, and little, if any,

heavier than the soils. The topography is usually rolling. The Marshall soils are derived from wind-blown material.

The Valentine series in this county represents glacial or terrace soils reworked by the wind. The types have dark-brown to dark grayish brown surface soils and light-brown to brown subsoils, grading into loose sand in places. Drainage is good, though in most places the water table is near the surface. This series is of considerable extent in the southwestern part of the county.

The Pierce series includes types with dark-brown to almost black surface soils, underlain by lighter brown to gray subsoils, which rest upon stratified layers of coarse sand, fine gravel, and coarse gravel, extending to depths of 30 feet or more.

Of the soils of the glacial-lake and river-terrace group the Fargo series is the most extensive. It is characterized by black surface soils extending to a depth of 10 to 24 inches, underlain by a black, grayish-drab, or bluish-drab subsoil, whose texture is heavier than that of the surface soil. The subsoil is usually stiff and plastic.

Next in importance, locally, to the Fargo is the Bearden series. The Bearden soils are developed on high terraces, where they were probably deposited at the time of the recession of the glacier. They lie above overflow. The surface soil is black, with a grayish subsurface stratum, grading quickly into a yellow or straw-colored subsoil which is as heavy as, or heavier than, the surface soil.

The Sioux series differ from the Bearden in that the material is the result of stream action, having been deposited by flood currents, but it resembles the Bearden series in occupying high terraces now lying above overflow. On account of their coarse-textured subsoils, the members of the Sioux series are usually droughty. The surface soils range from dark grayish brown to almost black in color and usually consist of a mixture of fine and coarse material. The subsurface layer is usually light brown in color. It has a high percentage of clay, which gives it a rather compact structure. Below this layer the material consists of a mixture of light-brown loose, coarse sand and fine gravel, which is rather uniform in texture and structure throughout the areas.

The Rogers soils are poorly drained. They occupy about the same topographic position as the Fargo, being found in old glacial-lake beds, but the material is lighter in color and generally contains a high percentage of alkali, which forms incrustations of salts upon the surface. The surface soil is usually gray to dark drab in color and underlain by a light grayish drab, sticky plastic, impervious subsoil, mottled with yellowish brown. The surface is very flat, and the soils are poorly drained.

The soils of the Maple series occupy sloughs, abandoned glacial channels, and first bottoms along streams. They differ from the

Fargo in the lighter color of the soils and from the Rogers in having a sandy substratum. The surface soil is dark brown to almost black, often streaked with gray alkali salts. The subsoil is usually grayish drab, but with depth it shows rusty-brown and yellowish-brown mottlings. The distinguishing feature of the series is the presence of interlaminated layers of sand and sandy clay. The Maple soils are usually water-logged or poorly drained, and in most places they receive drainage water from surrounding land.

The soils of the first bottoms are classed in the Lamoure series. The Lamoure soils occupy first bottoms which are seldom overflowed, except during excessive spring floods. The surface soils are dark brown or black, with dark-colored, heavy subsoils, which are usually calcareous.

Dunesand consists of areas of loose, incoherent, gray-colored sand or fine sand, underlain by gray to yellowish loose sand. The soil when not covered with grass is constantly being shifted about by the wind and is of low agricultural value.

The three soil groups in Sargent County, embracing 10 series, include 26 distinct types in addition to Dunesand. The distribution of the soils is shown on the map accompanying this report, and individual type descriptions follow the table below, which gives the name and the actual and relative extent of each soil mapped.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Barnes silt loam	201,472	51.3	Fargo clay	5,248	1.0
Smooth phase	72,000		Sioux sandy loam	5,248	1.0
Barnes loam	37,824	7.1	Sioux loam	4,480	0.9
Fargo silty clay loam	35,968	6.7	Silty phase	448	
Marshall loamy very fine sand	26,176	4.9	Bearden silty clay loam	2,944	0.6
Bearden very fine sandy loam	23,424	4.7	Sioux fine sandy loam	2,644	0.5
Light phase	1,472		Fargo silt loam	2,368	0.4
Barnes very fine sandy loam	18,304	3.4	Lamoure very fine sandy loam	2,048	0.4
Bearden silt loam	17,856	3.3	Rogers silty clay	1,984	0.4
Maple very fine sandy loam	13,440	2.5	Dunesand	1,792	0.3
Marshall loamy fine sand	13,376	2.5	Maple clay	1,664	0.3
Maple clay loam	9,088	1.7	Barnes gravelly loam	1,600	0.3
Barnes silty clay loam	9,088	1.7	Lamoure silt loam	960	0.2
Valentine fine sand	7,488	1.4	Pierce gravelly loam	768	0.1
Lamoure silty clay loam	6,720	1.3			
Fargo clay loam	5,888	1.1	Total	533,760	

BARNES GRAVELLY LOAM.

The Barnes gravelly loam has about the same characteristics as the Barnes loam, except that the soil contains more bowlders and gravel and the topography is more broken. The surface soil consists of

a brown to dark-brown light silt loam to very fine sandy loam, containing gravel of various sizes. At a depth of 8 to 10 inches the soil changes to a gray loam or silt loam, mottled with brown and yellowish-brown spots.

The surface is covered with stones and bowlders, ranging from fragments 6 inches in diameter to those weighing several tons. The topography is usually rather steep and broken. Drainage is well established, and in places excessive. Very little of the type is in cultivation, and where it is cultivated crops often suffer from lack of moisture. The type is used largely as pasture and hay land. Most farmers own some of this land in connection with areas of smoother types, and they use the gravelly loam as range for cattle. It is valued at $10 to $15 an acre.

BARNES VERY FINE SANDY LOAM.

The surface soil of the Barnes very fine sandy loam consists of an extremely dark brown loamy very fine sand to very fine sandy loam, extending to a depth of 4 to 6 inches and underlain by a lighter brown or chocolate-brown very fine sandy clay, which continues to a depth of about 16 inches. Below the subsurface the material quickly changes to a light yellowish brown silt loam, which grades into grayish-yellow silt loam. The subsoil is friable, but compact. In some areas there is considerable loam mixed with the surface soil, but in the western part of the county the sandy layer in many places is deeper than the average. Here the type seems to be made up of wind-blown sand which has been drifted over an old moraine of Barnes silt loam or loam, thus forming the Barnes very fine sandy loam.

This soil is found mostly in the western part of the county, in several large areas. The largest are mapped north of Crete, in Denver Township, and in Verner Township. Smaller areas are scattered over all parts of the county.

The surface varies from level to hilly. In most places the type is rolling. It is well drained, but retains moisture for considerable periods of dry weather. In fact, the sandy areas in the western part of the county are considered to hold water at least as well as the Barnes silt loam, if not better. This is probably due to the relative position of the water table rather than to the character of the soil, though it may be due in part to the better natural mulch in the lighter soil.

Most of the type is in cultivation, but a few of the sandier areas in the southwestern part of the county are used for pasture. Care must be exercised in cultivating the soil to prevent drifting.

In some areas this soil does not contain as much organic matter as the Barnes silt loam or loam, but most of it is well supplied with

both organic matter and lime. It is well suited to most of the common crops and seems especially well adapted to corn, and a larger percentage of the type than of the loam or silt loam is used for this crop. It is also a good soil for the production of potatoes. Its sandy nature makes the cultivation of these crops very easy, so that in general the fields are free from weeds. Corn yields about 40 bushels per acre, and oats about 50 bushels. Wheat does not do so well, because of the loose structure of the soil, but it usually yields about 10 bushels per acre. The soil supports a good growth of grass, and hay is one of the leading crops. There are some cattle ranches on this type in the western part of the county.

Land of this type of soil usually sells for about $30 an acre.

BARNES LOAM.

The surface of the Barnes loam varies from a very fine sandy loam to a heavy gravelly loam, but is typically a loam in texture. The surface soil to a depth of 4 to 8 inches is a dark-brown loam containing a relatively high percentage of very fine sand and small gravel. Below this the subsurface material grades in color from brown to reddish brown and then to grayish brown, and in texture from a loam to a heavy silt loam which is quite crumbly and friable. Below 22 inches the subsoil changes to pale yellowish brown or yellowish drab, tinged with a greenish color, and slightly mottled with rusty brown. The subsoil is a heavy silty clay, but is quite friable and crumbly.

This type differs from the Barnes silt loam in the thickness of the surface layer, in topography, and in drainage. The topography varies from rolling to hilly. In many places the type occupies dome-shaped areas which stand above the surrounding land. Because of its topography and manner of formation it is more variable in texture than the silt loam, and the soil and subsoil contain more stone and gravel, although in most areas stones are not abundant enough to interfere with cultivation.

The Barnes loam is found to some extent in all parts of the county, but is most extensively developed in Tewaukon and Marboe Townships in the southeastern part. Here the type occupies a terminal moraine known as the Sisseton Hills or the northern edge of the Coteau des Prairies, which extends into this part of Sargent County. In the western part of the county the type occupies a portion of the moraine between glacial Lake Dakota and glacial Lake Sargent. The remaining areas in the county are not so extensive and are more level. The largest and roughest area is in the southeastern part of the county.

The type lies slightly higher than the Barnes silt loam, except where it occurs on slopes adjacent to lakes and drainage ways, and

it is consequently well drained and free from alkali. It is, however, retentive of moisture and crops on it withstand long periods of dry weather.

Probably 60 per cent of the Barnes loam is under cultivation, the remainder being used as pasture and hay land. It is devoted to practically the same crops as the silt loam. The average yields of the various crops are: Wheat 12 bushels per acre, oats 25 bushels, barley 10 bushels, flax 5 bushels, potatoes about 80 bushels, corn about 25 bushels, and millet 1½ tons per acre. The physical conditions of the soil is usually good, but yields do not run as high as on the silt loam, and the type is not as desirable agriculturally, owing to its rougher topography and to the numerous bowlders and stones scattered over the surface and mixed with the soil material.

The Barnes loam could be improved by removing some of the stones and bowlders and by adding more manure to the soil, which in many places is becoming deficient in organic matter. In many instances the soil is not sufficiently cultivated, and weeds are abundant.

The average price of this land is about $30 an acre.

BARNES SILT LOAM.

The Barnes silt loam as mapped in Sargent County is a dark-brown to almost black loam to heavy silt loam, a fairly uniform silt loam texture predominating. The soil has a mellow, fluffy feel, due to its high content of organic matter, and is easy to till, not baking nor cracking on drying. The surface soil varies in depth from 8 to 16 inches, with an average of about 10 inches. It is thinner on knolls and deeper in the lower places. Below 10 inches the soil becomes lighter brown in color, and it gradually changes to a lighter grayish-yellow, heavy silt loam, friable in structure and containing some gravel and stones. Below 20 to 24 inches the subsoil changes to grayish-brown or yellowish-brown material, tinged with green and mottled with rusty brown and dark brown. It consists of a friable heavy silt loam, always highly calcareous. There is no perceptible concentration of heavy materials in the subsoil, which is not compact enough to interfere with root growth.

The Barnes silt loam contains unsually large quantities of lime, especially in the subsoil, where calcareous material gives rise to gray streaks. Many of the stones embedded in the soil are incrusted with lime. Some stones, bowlders, and gravel are scattered over the surface and throughout the soil. They consist of crystalline rock, granite schist, gneiss, and dark-colored sandstones and limestones. The type as mapped north of Cayuga and to the southeast of Milnor is finer in texture than the average and more free from stones and bowlders. The boundaries between the Barnes silt loam and the

Barnes loam, very fine sandy loam, and silty clay loam are sometimes drawn arbitrarily, as the change in texture is often gradual.

The Barnes silt loam is the predominating type in the county, occupying 51.3 per cent of its area. It is developed over most of the county, except in Hall and parts of Herman and Milnor Townships, in the northwestern part of the county, where the glacial-lake and river-terrace soils predominate, and in the western and southwestern parts of the county in Denver, Harlem, Sargent, Jackson, Brampton, and Southwest Townships, where the sandy soils of glacial Lake Sargent predominate.

The surface of the type varies from almost level to rolling. The numerous sloughs and potholes tend to give it a rolling appearance, but nowhere are the areas too rough for cultivation, and in some places, as north and east of Rutland, northwest of Forman (Bowen Township), and north of Stirum in Vivian Township, the type is fairly level and free from sloughs, except for small depressions a few acres in extent. Drainage is mostly by percolation, but melting snow and spring rains usually produce such an excess of water that it runs off into the depressions, where it eventually evaporates, is taken up by the soil as the dry season advances, or finds its way through ditches and sloughs to the well-defined drainage ways. The depressions are occupied by other soil types, so that the Barnes silt loam itself would not be benefited by artificial drainage. The soil is retentive of moisture, and cultivation has increased its absorptive capacity. There is not enough alkali present in any area to injure crops.

The Barnes silt loam is naturally a productive soil, adapted to a wide range of crops, the latter feature giving it a decided advantage over many of the other soils. About 70 per cent of the type is devoted to small grains, principally wheat, oats, barley, and flax; the remainder is used for corn, millet, and hay. The ordinary yields per acre are about 12 bushels of wheat, 35 bushels of oats, 20 bushels of barley, and 5 bushels of flax. Millet hay yields about 1½ tons per acre, and prairie hay about 1 ton per acre. About 100 bushels per acre is the average yield of potatoes. Where properly managed, this soil will produce much larger yields. Most of the potatoes grown in a commercial way are produced on the lighter, sandier soils. The quality of the crop is good. Corn is widely grown on this type, and it is considered well suited to the crop. Alfalfa, timothy, and clover are grown to a small extent in all parts of the county, and their acreage is being increased from year to year as the area in wild grasses is reduced by extension of the area under cultivation. The high lime content and the favorable structure of the subsoil make the type especially well adapted to alfalfa.

The moisture supply is usually a limiting factor in crop production on this type. In some years there is too much rainfall, and in others not enough. If the season is wet, the farmers have great difficulty in preparing a good seed bed for small grain, owing to the retentive nature of the soil, so that later in the season, during dry weather, the small grains may suffer from lack of moisture resulting from poor condition of the seed bed. Under proper farming methods and in favorable years as much as 40 bushels of wheat, 60 bushels of oats, 30 bushels of flax, or 35 bushels of barley per acre have been produced.

In general, there are a number of factors that tend to prevent high yields. The numerous potholes in places may prevent thorough cultivation. Poor stands, which are often checked in development by weeds and later suffer from dry weather, result from poor preparation of the seed bed, which it is not always possible to avoid. Day labor is high in price and hard to obtain. Apparently better results would follow the more general rotation of crops, and consequent improvement in seed bed conditions. As more cattle are kept on the farms each year, more manure is produced, and this when put on the corn and hay land not only greatly increases the yield of corn, but puts the land in better physical condition for other crops which follow in the rotation.

Most farms on this type are well improved. The buildings are substantial and well built, and many of them have modern improvements. Most of the older farms are partly fenced and have groves or windbreaks about the farmstead. Many farms have a silo, in which case dairy products generally form one source of income. Most farmers raise hogs, mainly for family use, though there is often a surplus for sale. In addition to the vegetable gardens many farms have plots of fruits, such as plums, currants, gooseberries, and strawberries. Well-improved farms on this soil usually sell for $40 to $75 an acre, depending upon the location.

Barnes silt loam, smooth phase.—The Barnes silt loam, smooth phase, is extensively developed in several parts of the county. It differs from the typical soil in having a much smoother topography, with few sloughs and potholes, and in being almost stone free. It has long, gentle slopes, with just enough fall to give good drainage. The surface soil may reach 24 inches in thickness, but the average ordinary depth is 14 to 16 inches. It consists of a very dark brown to black mellow silt loam, having a soft, floury feel, and high in organic matter. The subsurface material, usually extending to a depth of 24 inches, is a silt loam of lighter brown or grayish color tinged with green, which grades to light greenish-gray, mottled with rusty yellow spots. The subsoil is a friable mellow silt loam to silty clay loam.

Considerable areas of this phase are found in the eastern part of the county, around Cayuga and extending 5 or 6 miles north from Ransom. An area is mapped in the vicinity of Gwinner, another extending from the top of the Whitestone Hills, north of Gwinner, to the county line, and a third in the vicinity of Stirum.

In the western part of the county, at Hample, there is a slight variation in the phase as mapped. The soil here is quite similar to the Bearden silt loam, except that it is a little more rolling and has a few stones and bowlders scattered here and there over the surface. Farmers recognize these areas as especially good farming land.

The ease with which the phase can be cultivated and the depth of the soil promote a better physical condition of the seed bed, and yields average higher than on the typical Barnes silt loam.

BARNES SILTY CLAY LOAM.

The Barnes silty clay loam, to a depth of 6 to 10 inches, consists of a very dark brown to black silt loam. This is underlain by a heavy, stiff, compact, silty clay, dark brown in color, but becoming lighter with depth. This layer extends to a depth of 20 inches and is underlain by a yellowish-brown silty clay, tinged with green. The lower subsoil is mottled and streaked with grayish-white. In some places it is more friable and open in structure than the intermediate layer.

This type occurs in flat areas and near slight depressions. It resembles the Fargo silty clay loam, but has better drainage and is better aerated. The largest areas are mapped in the southeastern part of the county. There are several large areas in Tewaukon and Marboe Townships, just north of the edge of the Sisseton Hills, and in the vicinity of Cayuga and Ransom, adjoining the Wild Rice River. These areas apparently were formed by the deposition of finer material brought down from the hills and deposited in shallow water. At the present day, in many places, small streams issuing from the hills disappear in wide flats occupied by this soil. The areas in the vicinity of Cayuga and Ransom have been formed by sediments deposited by the Wild Rice River at some remote time, when the stream stood at a higher level than at present. Even now the type receives considerable sediment from excess water flowing from higher levels during the wet season.

The areas of Barnes silty clay loam merge with the Barnes silt loam and other types, so that in many places the line of separation can be drawn only arbitrarily.

The type is rather poorly drained, and in certain seasons it is difficult to prepare the seed bed. If the soil is plowed late in the spring, it clods so badly that it can not be cultivated into a good tilth.

The Barnes silty clay loam has about the same crop-producing power as the silt loam for small grains and grasses. It is rather cold and wet for corn, but in some years good yields are obtained. Wheat yields from 11 to 20 bushels per acre, oats about 30 bushels, barley 15 to 20 bushels, and corn about 25 bushels.

The type would be greatly improved by tile drainage, which would permit operations earlier in the spring. Drainage would so improve the physical condition of the soil that better yields of corn could be obtained. The more extensive growing of corn would make it possible to follow a better rotation, and this would rid the land of weeds, which reduce the yields of small grains under present conditions.

The price of land of the Barnes silty clay loam averages less than that of the silt loam, with which the type is usually associated. Farms consisting in part of the silty clay loam are not considered as valuable as those composed entirely of the Barnes silt loam.

MARSHALL LOAMY FINE SAND.

The Marshall loamy fine sand, to a depth of 20 inches, consists of a grayish-brown to dark-brown loamy fine sand, in most areas well supplied with organic matter. Below 20 inches the subsoil becomes lighter brown, loose, incoherent fine sand, changing quickly to light brown or yellowish brown.

The surface of the type varies from level to undulating or slightly billowy. Drainage is effected by percolation through the subsoil and is thorough, but where the soil is kept well mulched it holds moisture better than the heavier upland types.

This soil is easy to handle and prepare for crops, but some care must be practiced to prevent drifting. All the common crops are grown, but corn, potatoes, and alfalfa seem to do best. Corn ordinarily yields about 35 bushels per acre and potatoes 100 bushels, without fertilizer. Two cuttings of alfalfa can be made in a season, and three cuttings have been made in a small area northeast of Milnor. A good stand of alfalfa can be obtained by inoculating the soil before sowing. Wild hay yields 1½ tons per acre. Some rye is grown and the crop seems to do well, yielding about 15 bushels per acre. Winter rye is well adapted to this soil and should be more extensively grown than at present. By stubbling in the rye in early fall a good growth will be secured before freezing weather sets in. The stubbles help to protect the rye during the winter. The rye gets an early start in the spring and prevents drifting of this soil later in the season.

This soil can be improved by adding more manure and by practicing proper rotations, such as will prevent drifting. The farm equipment is usually ample. In some cases weeds are allowed to get ahead of corn and potatoes and thus decrease the yield.

Land of the Marshall loamy fine sand is held at about $45 an acre.

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

Mechanical analyses of Marshall loamy fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
351626	Soil	0.1	5.9	12.8	58.7	8.9	8.4	5.0
351627	Subsoil	.0	3.9	9.4	62.5	13.4	5.4	5.1

MARSHALL LOAMY VERY FINE SAND.

The Marshall loamy very fine sand consists of a very dark brown, loamy very fine sand, with a depth of 20 inches. When moist the surface layer in most places is almost black. At about 20 inches the soil grades to a dark-brown very fine sand which continues to about 30 inches, this grading into yellowish-brown to yellow very fine sand. Both the soil and subsoil have a loose, incoherent structure.

The surface of the type is level to slightly rolling or slightly billowy in places. The soil has some tendency to drift, but less than the Valentine fine sand or Marshall loamy fine sand. Although the drainage, which is by percolation, is thorough, the water table is within 10 feet of the surface, and grasses or cultivated crops do not suffer for water, even after long periods of dry weather.

Large areas of this soil are found in the southwestern part of the county in T. 129 N., Rs. 57 and 58 W.; and in the vicinity of Harlem, T. 131 N., R. 57 W. There is also a considerable area north of Milnor in T. 132 N., R. 54 W. The type is not as productive for some crops as the Barnes soils, and its tendency to drift lessens its value for general farming, but for certain crops the type seems to be well adapted. Corn, alfalfa, millet, potatoes, and sweet clover do well. Corn ordinarily yields about 35 bushels per acre, potatoes 100 to 150 bushels, and alfalfa about 2 tons per acre, at one cutting. One 40-acre field of alfalfa on this type gave an estimated yield of 100 tons for the first cutting. The second cutting was allowed to set seed and yielded about 3 bushels of seed per acre. At present prices for hay and seed, alfalfa should be a paying crop for this soil. Broom-corn millet is grown in a number of fields and yields about 1½ tons of hay per acre. A few small patches are devoted to sweet clover, which makes a strong, vigorous growth. Of the small grains commonly grown, oats, rye, and barley do best. Oats yield about 30 bushels per acre, rye about 15 bushels, and barley 15 to 25 bushels per acre. Large areas of the type are used as pasture and wild-hay land. The soil supports a good stand of native prairie grasses which yield about 1½ tons of hay per acre.

In many places the land has been allowed to become infested with weeds. Many cornfields are grown up with Russian thistle, foxtail, and other weeds. Special precautions should be taken to have the land free from weeds before seeding down to alfalfa. All intertilled crops should be kept clean of weeds, so as to prevent the spread of seed. Special precautions should be taken to prevent the drifting of soil in bare fields during the winter. A light application of manure will help to check drifting under these conditions. Soil on stubble fields would probably be less apt to drift if plowed in the spring shortly before seeding instead of in the fall. Results at the Edgeley (Lamoure County) substation seem to indicate that if stubble land is free from weeds, fairly good yields can be obtained from soils of loose structure without plowing. A cropping system should be followed on such types that will reduce to a minimum the number of times the land is plowed. The cultivation given corn and potatoes prepares the best kind of seed bed for small grain, thus eliminating one plowing, and if sweet clover is seeded with this small grain three crops are grown with one plowing. By the time the sweet-clover field is ready to plow the next spring the soil will be quite compact and will contain more organic matter than at the beginning, especially if the land was manured during the winter it was in corn stubble.

A considerable proportion of the farms on this type should be more largely in forage crops. Where a good stand of alfalfa has been obtained, it can profitably be left for several years, as the soil is steadily accumulating organic matter, and if the hay is fed and the manure returned, considerably more nitrogen is added. As the organic matter tends to keep the soil from drifting, and as nitrogen is the element of plant food exhausted most rapidly on this soil, the increase in fertility is an important gain resulting from the growing of alfalfa.

At the present time this soil is not highly improved. There are, however, a number of well-equipped farms, showing that the type can be farmed profitably. The land sells for about $25 an acre.

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

Mechanical analyses of Marshall loamy very fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
351679	Soil	0.1	0.1	0.6	40.4	40.2	11.8	7.0
351680	Subsoil	.0	.1	.7	44.3	34.5	16.2	4.2
351681	Lower subsoil	.0	.0	.3	34.3	49.8	11.0	4.8

VALENTINE FINE SAND.

The Valentine fine sand consists of a loose brown fine sand, extending to a depth of 10 inches, underlain by a light-brown fine sand which continues to a depth of more than 40 inches. The soil is very uniform in texture and structure throughout its area.

The Valentine fine sand has a billowy surface, caused by alternating swells, or hillocks, and depressions. Only one area is mapped, in the southwestern part of the county, where the type occurs adjacent to and in connection with the areas of sand dunes. It has been formed by wind action, and the soil shows evidence of having been drifted about considerably at some remote time. The Dunesand areas and this type merge into one another, so that in places the two are difficult to separate.

Drainage of the Valentine fine sand is by means of percolation through the subsoil, and is usually excessive, but ground water stands near the surface, and crops are not readily affected by dry weather. Very little of the type is cultivated. It supports a good sod of native prairie grass, which is used for pasture and for hay.

Owing to the rough, billowy topography and the loose structure of this soil, care must be practiced in cultivating it, so as to prevent drifting. Cultivated crops, such as corn and potatoes, do better than small grains. Once alfalfa is started, it makes a good crop for this type. The Valentine fine sand is used mostly for grazing cattle. Outside of several ranch headquarters, there are few improvements in the areas of this soil.

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

Mechanical analyses of Valentine fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
351673.....	Soil.....	0.4	2.6	8.8	63.8	15.1	4.8	4.6
351674.....	Subsoil.....	.4	1.8	6.5	65.6	17.7	3.4	4.5

PIERCE GRAVELLY LOAM.

The surface soil of the Pierce gravelly loam is a dark-brown sandy loam, containing small gravel and having large and small gravel scattered over the surface. Below 6 inches the soil changes to a layer of grayish-brown small gravel and fine sand, which in turn grades at about 24 inches into stratified coarse gravel and fine sand. These beds of stratified gravel and sand may extend to depths of 30 feet or more. In some places the substratum contains large quan-

tities of lime, in others the material is discolored by iron-oxide stains, and nodules of iron material are abundant throughout this substratum.

The type occurs on small, rounded peaks (kames) or on narrow ridges (eskers) which show prominently above the surrounding country. The deposits are rather isolated, except in the vicinity of Cayuga, where a chain of these hills extends in a southerly direction. The type is of low agricultural value because of its droughty nature. The deposits, however, contain road-building material and gravel for concrete work and other building purposes. There are several large gravel pits in the county, one at Cayuga, another about 3 miles northwest of Ransom, and one about 3 miles west of Rutland. The Great Northern Railroad has a lease on a large deposit 2 miles north of Havana, from which it has taken material for road ballast.

The soil is seldom cultivated, except where the knolls are smooth and where they occur in connection with other soils. The type can be distinguished by the short, stunted growth of crops.

FARGO SILT LOAM.

The Fargo silt loam consists of a black, mellow silt loam, grading abruptly at about 18 inches into a black, stiff crumbly clay, which extends to depths below 36 inches. Both the surface soil and subsoil contain a high percentage of organic matter, but the former is open and friable, while the subsoil is rather compact and plastic.

This is the best drained of the Fargo soils. It consists of bench-like areas, bordered by a soil of the Barnes series on one side and by a lower lying, heavier Fargo soil on the other side. The type has a smooth, gentle slope from the higher area to the lower.

This type occurs mainly in the southeastern part of the county from Havana eastward.

This is recognized as a strong soil, and it is used largely for the production of small grains. It is easy to cultivate. Wheat yields from 10 to 30 bushels per acre. The yield depends upon the season, but averages around 20 bushels. Corn yields about 30 bushels per acre, oats, 40 bushels, and barley, 30 bushels. Several good-sized areas east of Havana are used largely for wheat production. This land sells at about $60 an acre.

FARGO SILTY CLAY LOAM.

The Fargo silty clay loam, to a depth of 10 inches, consists of a black silt loam high in decaying vegetable matter. This surface soil is underlain at from 10 to 20 inches by a black, rather plastic silty clay, which grades below 20 inches into drab or black clay. In most areas the black soil extends to a depth of 3 feet or more, but in some

of the shallower depressions it is underlain at 25 to 30 inches by a gray to ashy-gray clay subsoil.

This soil is found in every part of the county in numerous sloughs and potholes. The areas are especially numerous near Forman and between Forman and Cogswell.

The greater part of the type is too wet in the spring to be seeded to small grain, except when the preceding summer has been dry and the winter one of moderate snowfall. Most of these areas are never plowed, being used for hay production. Hardly a farm on the Barnes silt loam is without one or more of these Fargo silty clay loam areas, which yield from 1 to 2 tons of native hay per acre. Since more land is being cultivated around these depressions, less water runs off from the surrounding land and many of the areas dry up in late spring. Others have been artificially drained, and each year more of the type is brought under cultivation. Good yields are obtained, although there is danger of small grains growing too rank. Corn, barley, and oats are the principal crops on these areas. Corn yields about 30 bushels per acre. The type can be used to good advantage for silage corn, as the crop makes a rank growth in this highly productive soil. Oats yield as much as 70 bushels per acre in favorable years, and barley 50 bushels.

This type is usually owned in connection with other soils and is valued chiefly as hay lands. The average value of the type, based on its use for producing hay, is about $25 to $30 an acre.

FARGO CLAY LOAM.

The surface soil of the Fargo clay loam consists of about 3 inches of black silty clay loam, grading into a black silty clay which extends to 7 inches, and this into a friable, crumbly clay which continues to 15 inches. Below 15 inches the subsoil changes to a black, stiff, plastic, impervious, adhesive clay, which continues unchanged to about 26 inches and then grades quickly in color to dark grayish drab.

The Fargo clay loam, as mapped in this county, occupies about the same topographic position as the Fargo clay, i. e., glacial-lake beds. The type, however, lies a little higher than the Fargo clay and, although the surface is level, has better drainage.

This soil is stone-free, and it is a strong type, high in organic matter and lime, and well improved. It is devoted largely to small grain, but some corn is grown. Wheat averages about 16 bushels per acre, but in some years the yields are much higher. Oats ordinarily yield about 50 bushels per acre, barley about 30 bushels, and corn 25 to 30 bushels. The soil is rather heavy for corn, but it gives high yields when well cultivated. The type can be improved by tiling and ditching to drain away the excess water.

FARGO CLAY.

The surface soil of the Fargo clay consists of about 20 inches of black crumbly clay, high in organic matter. This is underlain by a dark grayish drab, or bluish-drab, stiff, plastic, impervious clay.

Areas of Fargo clay are confined to the southeastern part of the county, in Tewaukon and Marboe Townships. The type occupies the lowest part of old glacial-lake beds and is poorly drained. The excess moisture usually finds its way into adjacent streams. In some areas ditches have reclaimed much of the type, which was once a swamp. Under present conditions water never stands on the surface for long periods, and most of the type is cultivated. It is rich in organic matter and lime and is considered a strong soil. The ground must be plowed in the fall or early spring in order that it may be worked down for seeding, and the heavy texture makes the use of heavy teams and implements necessary.

The Fargo clay is confined to the growing of small grains and the production of wild hay. Yields of wheat average about 20 bushels per acre, of oats 30 bushels, barley 30 bushels, and wild hay 1½ to 2 tons.

This soil could be greatly improved by ditching and tiling. There are some large grain farms on the type in the southeastern part of the county, where modern machinery is used and the farm improvements are good. Areas which have been ditched and improved are held at about $75 an acre.

BEARDEN VERY FINE SANDY LOAM.

The surface soil of the Bearden very fine sandy loam is a dark-brown very fine sandy loam, high in organic matter, friable, and of very smooth feel. Below 12 inches it changes to a brown very fine sandy loam, which contains some clay but which has a mellow, friable, open structure. At 20 inches the subsoil quickly changes to a yellow or straw-colored silty clay, faintly mottled in places with shades of gray. At 30 inches it becomes more friable, grading into a deep, yellow silt. The type is composed of fine sandy particles which have been washed or blown over heavier sediments laid down in lake beds.

The largest areas occur in the northeastern part of the county and in the western part in the upper end of glacial Lake Sargent. The topography is flat to gently rolling. The principal areas are mapped in T. 132 N., Rs. 53 and 54 W. The town of Brampton, in the southwestern part of the county, is situated in a large area of this soil.

The type is suited to all the general farm crops common to the region and produces good yields. Corn ordinarily yields 30 bushels, wheat 15 bushels, and oats about 30 bushels per acre. Millet yields

1½ to 2 tons per acre. This is a good alfalfa and potato soil, and sweet clover also can be grown to advantage. In some places more organic matter is needed, and larger quantities of manure could be applied to advantage. Some of the rotations suited to this type are: (1) Corn or potatoes 1 year, wheat 1 year, oats 1 year, sweet clover 1 year, and alfalfa 4 years; (2) corn or potatoes 1 year, barley 1 year, oats 1 year, millet 1 year, and alfalfa 4 years; (3) corn or potatoes 1 year, millet 1 year, oats 1 year, sweet clover 1 year, and alfalfa 4 years (alfalfa fields should be left down for 4 years, during which time the 4-year rotation can be followed on the four remaining fields); and (4) corn or potatoes 1 year, barley 1 year, oats 1 year, sweet clover 1 year, and brome-grass pasture 4 years.

This is one of the most valuable soils in the county. The farm equipment and buildings are good. The land is held at about $60 an acre.

Bearden very fine sandy loam, light phase.—The Bearden very fine sandy loam, light phase, consists of a dark-brown fine sand or loamy fine sand to sandy loam, grading below a depth of 16 inches into a lighter brown sandy loam to sandy clay or silty clay loam, which is rather plastic in the lower part of the layer. Below 26 inches the subsoil changes quickly to a yellow silt loam marked with brown, rusty-brown, and light-drab mottlings in the lower part.

The areas of this soil are somewhat depressed below the level of surrounding types, so that it is not as well drained as the other members of the Bearden series.

This soil is of very small extent in Sargent County, but all of it is under cultivation and used largely for growing corn, barley, oats, and millet. Corn ordinarily yields about 25 bushels per acre, barley 15 to 20 bushels, oats 30 bushels, and millet 1½ tons of hay. The soil is usually farmed in connection with other types.

BEARDEN SILT LOAM.

The Bearden silt loam to a depth of 15 inches consists of a very dark brown to black light silt loam to heavy silt loam, very uniform in color and texture. Below 15 inches the subsoil changes to a brown silt loam which has a uniform texture and a high content of organic matter. Below 26 inches it quickly changes to a yellow silt loam, faintly mottled with light-yellow and yellowish-brown spots. The texture remains uniform thoroughout the 3-foot section. The surface soil is jet black when wet. It has a high organic content and a smooth, fluffy feel, but is very friable in structure and in excellent condition for tillage. The subsoil is also friable and has an open, porous structure. The subsoil material has a very peculiar feel, much like that of sulphur, when rubbed between the fingers.

This soil is almost entirely free from stone, gravel, or coarse sand to a depth of 40 inches. In most borings crystals of earthy salts are found in pockets in the lower subsoil. Both soil and subsoil are calcareous, the latter effervescing with hydrochloric acid.

The Bearden silt loam is found almost entirely in the northeastern part of the county. The largest area is mapped at De Lamere and extends south and east to Wild Rice River. The character of the soil shows that it must have been deposited by water action, but at the present time it occupies a high, terracelike position, about 20 feet above the bed of the Wild Rice River, and is never overflowed. Other areas occur in the western part of the county, west of Cogswell. The topography is level to faintly undulating. Rainwater is disposed of by ready percolation into the subsoil, but the type is nevertheless retentive of moisture. It is valued very highly, as it is suited to all the common crops.

Practically all of the type is in cultivation. Wheat, oats, barley, and corn are the leading crops grown. Wheat generally yields 15 to 20 bushels per acre, oats about 50 bushels, barley 30 bushels, and corn 40 bushels. Some alfalfa and clover are grown. These crops do well and should be more widely grown. The type is devoted largely to the production of wheat, and as a consequence no definite rotation is generally practiced. Frequently the same land is put into wheat for a number of years, and this practice is decreasing the yields of this crop on some farms. Alfalfa generally gives two cuttings a season and should prove a profitable crop either for hay or for seed.

Farms on this type are well improved and are held at about $60 an acre.

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

Mechanical analyses of Bearden silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
351647	Soil	0.0	0.4	1.0	20.9	13.4	46.8	17.2
351648	Subsoil	.0	.3	.7	19.4	13.4	47.6	18.5
351649	Lower subsoil.	.0	.1	.5	10.6	6.2	61.3	21.4

BEARDEN SILTY CLAY LOAM.

The Bearden silty clay loam consists of 5 inches of black loam to heavy silt loam, underlain by a black silty clay to a depth of 15 inches. This black layer changes to grayish in the lower part of the section. Below 15 inches the subsoil changes quickly to a deep-

yellow heavy silt to silty clay, mottled in the lower part with light-yellow and orange-colored mottlings. Earthy salts, probably gypsum crystals, occur in pockets. In places pale-drab mottlings are found. The surface and subsurface material is rather compact, while the deeper subsoil is always open and porous. The topography is flat and, in places, rather depressed, so that drainage is not as good on this type as on the other Bearden types.

Areas of Bearden silty clay loam occur in the northeastern part of the county, in the region once occupied by Lake Agassiz, where they occupy a terrace now lying above overflow, but not as high above as the Bearden silt loam or very fine sandy loam, from which it receives wash during periods of heavy rainfall. The principal areas are located in secs. 13 and 14, T. 132 N., R. 53 W., and in T. 129 N., R. 56 W.

The Bearden silty clay loam does not dry off nor warm up as early as the lighter textured members of the series, but all of the crops grown in this region do well on it. The soil stands dry weather well, probably owing to its high percentage of organic matter and the structure of the subsoil, which allows moisture to rise readily by capillarity. Corn, wheat, oats, barley, and timothy do well. Corn yields about 40 bushels per acre, wheat 20 bushels, oats 35 bushels, and barley about 25 bushels. Timothy yields 1 to 1½ tons of hay per acre. The land is valued at about $45 an acre.

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

Mechanical analyses of Bearden silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
351650	Soil	0.0	0.5	0.5	7.8	17.0	52.4	21.4
351651	Subsurface	.0	.4	.6	8.0	17.4	52.5	20.8
351652	Subsoil	.0	.3	.2	2.0	6.4	60.0	30.9

SIOUX SANDY LOAM.

The Sioux sandy loam, to a depth of 8 inches, consists of a dark grayish brown loamy sand to sandy loam. Below 8 inches the material changes to a lighter brown or rusty-brown sandy loam which has a high percentage of clay, giving it a plastic structure. The subsoil below 15 inches changes to a mixture of light-brown loose coarse sand and fine gravel.

The largest areas of this type lie in the northeastern part of the county, in Ts. 131 and 132 N., Rs. 53 and 54 W. Other smaller areas are mapped in the northwestern part of the county. The surface

of the type varies from level to gently rolling. It usually occupies broad terracelike positions. Much of the rainfall is lost by percolation through the loose, sandy subsoil.

On account of the droughty nature of the soil, the small grain crops suffer from lack of water, but corn and alfalfa do well. Corn yields about 30 bushels per acre and alfalfa 2 to 3 tons of hay during the season. Ordinary yields of wheat are about 8 bushels per acre, of oats 25 bushels, and of barley about 12 bushels.

This soil could be improved by growing more legumes, such as alfalfa and sweet clover, and by applying more manure. The growing of legumes would be beneficial in conserving the water supply.

SIOUX FINE SANDY LOAM.

The surface soil of the Sioux fine sandy loam consists of a black loamy fine sandy loam to very fine sandy loam, with a high content of organic matter. Below 10 inches the material changes to a brown or rusty-brown sandy loam containing a high percentage of clay, which gives it a plastic structure. Below 20 inches the subsoil becomes a mixture of mottled rusty-brown to grayish-brown coarse sand and fine gravel.

The Sioux fine sandy loam is an inextensive soil. It occurs in small areas in the northwestern and northeastern parts of the county in association with the other Sioux types, often occupying narrow bands or benches adjacent to the upland. The surface is level to gently sloping.

The greater part of this type is under cultivation. Although it is thoroughly drained, the water table is quite near the surface, so that crops do not suffer as much from dry periods as would be expected. The same crops are grown as on the other soils of the Sioux series, and the yields average about the same.

The selling price of this land averages about $35 an acre.

SIOUX LOAM.

The Sioux loam, to a depth of 10 inches, is a dark grayish brown loam, becoming black when wet. The soil is underlain by an 18-inch stratum at light-brown sandy loam, which contains enough clay to give it a rather compact structure. Below 18 inches the subsoil changes to a compact mass of brown coarse sand and fine gravel. There is considerable gray mottling in the lower subsoil.

Several large areas of this soil are mapped. One is situated in the northeastern part of the county, just east of Borg Lake. The soil here is somewhat heavier than the area in the western part of the county, near Crete.

The Sioux loam has a loose, porous structure, even where unbroken. When wet, it is easily worked into a good seed bed. The type is

rather droughty, so that it is not well adapted to small grains. More corn is grown than on most of the other soils. Wheat in ordinary seasons yields about 10 bushels, barley 20 bushels, oats 30 bushels, and corn 40 bushels per acre. Where corn is well cultivated, so as to keep the weeds under control and keep the soil well mulched, the yields are considerably higher. Alfalfa is grown to some extent and yields an average of 2 tons per acre from 2 cuttings. Many farmers are experimenting with alfalfa, and it is probable that in the future this crop will be grown much more extensively.

This soil would be benefited by adding barnyard manure to the corn land. Manuring would incidentally help to conserve moisture, which is greatly needed for the small grains.

The type is well improved. The buildings are good and the equipment ample for thorough cultivation. A systematic rotation is more nearly approached than on the Barnes soils. Corn is generally followed by small grains, usually wheat or barley.

Land of the Sioux loam ordinarily sells for about $45 an acre.

Sioux loam, silty phase.—The Sioux loam, silty phase, is the heaviest soil of the Sioux series in the county. The surface soil consists of a black light silt loam, containing a relatively high percentage of coarse sand. At 10 inches the material grades to a heavy sandy loam containing a high percentage of clay and cementing material, which causes the layer to be somewhat plastic. Below 18 inches the subsoil consists of a light-brown to yellowish-brown mixture of loose, incoherent, coarse sand and fine gravel, mottled with grayish brown and containing small scattered fragments of shale.

This phase is of very small extent. The best developed areas are in Denver Township, in the northwestern part of the county. The phase occupies high terraces lying above overflow and has a nearly level surface. It is generally surrounded by other members of the Sioux series or by lower lying soils. Drainage is thorough, but the phase is not as droughty as some of the other members of the series.

The Sioux loam, silty phase, is used for the production of corn and small grain. Corn yields about 40 bushels per acre, wheat 10 bushels, oats 30 bushels, flax 3 to 5 bushels, and barley 30 bushels. Corn seems to do better than any other crop, because the cultivation prevents the soil from drying out. A few patches of alfalfa have been tried, and the indications are that alfalfa will do well on this soil when once established. The land sells for about $30 to $40 an acre.

ROGERS SILTY CLAY.

The surface soil of the Rogers silty clay ranges from gray to dark gray or, in places, almost black silty clay. Below 10 inches the subsoil is a stiff, plastic, impervious gray and drab mottled clay.

Below 20 inches the subsoil becomes lighter in color, being yellowish brown to light drab, and is a very adhesive and plastic clay.

In the larger areas of the type near De Lamere the surface is usually covered with a layer of brown peat about 1 inch in thickness, and the soil is a clay rather than a silty clay.

The topography of the Rogers silty clay is nearly level, the type occupying about the same character of country as the Fargo clay or Maple clay. It differs from the former in color and in content of alkali salts, and from the latter in the texture and structure of the subsoil.

The Rogers silty clay is developed in the glacial Lake Agassiz and glacial Lake Sargent regions. Its drainage is poor, and it contains alkali salts, which show as incrustations on the surface and as streaks throughout the soil in dry periods.

Very little of the type is cultivated. It is used largely as hay land, and the annual production of hay is large. The soil supports a growth of coarse water grass, salt grass, and in the lowest spots, reeds. The large body of the type at De Lamere is traversed by a main ditch, which drains a large part of the area. Hay seems to be the crop best suited to this type at the present time. The land sells for $10 to $20 an acre.

MAPLE VERY FINE SANDY LOAM.

The typical Maple very fine sandy loam consists of a black to dark-gray very fine sand to a depth of 12 inches. In the lowest spots the surface soil is often a silty clay loam. Below 12 inches, and extending to about 22 inches, the subsoil changes to a light grayish drab very fine sand, which quickly gives way below 22 inches to a light-gray or grayish-drab very fine sandy clay. Below 26 inches there is usually a layer of mottled grayish drab and rusty-brown very fine sand to very fine sandy loam or very fine sandy clay, but in some areas the sandy substratum extends throughout the 3-foot section.

There is some variation in the type in the vicinity of Milnor. Here the surface soil is a dark grayish brown very fine sandy loam to a depth of 15 inches. Below this depth the subsoil changes to a gray very fine sandy clay. This grades, below 18 to 20 inches, into silty clay, and at about 30 inches into a yellowish-brown loose very fine sand, which may pass beneath into a grayish-brown to yellowish-brown silty clay or clay.

The type as mapped at Milnor and in the northwestern part of the county is connected with the county drainage through creeks and sloughs, while in the southwestern part most of the areas are inclosed by land forms and have no surface drainage outlets, water

escaping mainly by seepage through the subsoil. The type is water-logged most of the time, and none of it is under cultivation. It supports a native growth of cat-tails in the lowest parts of the depressions, and swamp grass, wild barley, and other wild grasses elsewhere. These are cut for hay each year. Drainage ditches now being constructed will bring most of this type under cultivation. The land at present can be bought for about $8 an acre. The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Maple very fine sandy loam:

Mechanical analyses of Maple very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
351675	Soil	0.0	0.7	3.6	40.5	38.8	10.1	7.0
351676	Subsoil	.0	.7	2.4	43.4	37.4	7.1	8.2
351677	Lower subsoil	.1	.2	.6	18.2	59.2	12.9	8.5
351678	Lower subsoil	.0	.1	.4	34.4	44.8	13.5	6.0

MAPLE CLAY LOAM.

The Maple clay loam consists of a dark grayish drab clay loam, with a depth of 10 to 15 inches. The immediate surface material is very dark, owing to accumulations of organic matter. Below 15 inches the subsoil changes to a light-drab very fine sandy clay, mottled with gray and rusty brown.

This soil is developed in the northern part of the county, in the vicinity of Milnor, and along a small sluggish creek that flows into the Wild Rice River in the eastern part of the county. There are also a number of scattered areas in the northwestern part.

The type is poorly drained and is water-logged most of the year. It generally lies lower than adjoining soils, even where it is not directly adjacent to a stream, so that it receives the drainage from other areas. The soil contains relatively large quantities of alkali.

The Maple clay loam is not cultivated, but is used for pasture and for the production of hay. The native vegetation consists of salt grass, coarse reed grass, and other water-loving grasses. When the present projected system of drainage ditches in the county is completed, most of this soil will be drained, and it is probable that in time it will become a productive soil for all the general-farm crops. The land at present is valued at about $10 an acre.

MAPLE CLAY.

The surface soil of the Maple clay consists of a dark-brown to black clay, with a depth of 12 inches. The surface shows alkali deposits, and the soil is streaked with alkali salts. Below 12 inches the

material changes to a grayish-drab clay, also containing much alkali. This layer extends to about 18 inches, where it passes abruptly into a layer of yellow sand mottled with rusty brown, drab, and gray. The depth of this layer, as also its texture, is variable, but usually continues for several inches, where it rests upon a stratum of gray and yellow mottled, stiff clayey sand, rather plastic in structure. In other places this underlying stratum may be a sandy clay or a silty clay. In still other places, at about 34 inches, the subsoil becomes a yellowish-brown sand or fine sand, with some faint mottlings of rusty brown, which is more uniform than the first sandy layer. In some borings the heavy subsoil material extends to 36 inches before any sandy material is found, while in others the sandy layer comes quite near the surface. In general, however, there are about five distinct layers of soil above a depth of 40 inches.

The Maple clay is found just north of De Lamere and extends to the county line. The topography is flat and the areas poorly drained, so that very little of it is cultivated. Some wheat and barley are grown on the areas near De Lamere. The greater part of the type is used as pasture and hay land. In general it yields about 2 tons of hay per acre.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, subsoil, and lower subsoil of the Maple clay:

Mechanical analyses of Maple clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
351656	Soil	0.0	0.2	0.4	30.4	16.4	16.1	36.4
351657	Subsurface	.0	.2	.2	36.9	15.4	13.8	33.3
351658	Subsoil	.0	.0	.4	70.9	13.2	5.4	9.9
351659	Lower subsoil	.0	.0	.2	61.2	16.1	12.1	10.3
351660	do	.0	.0	.0	68.3	21.3	5.3	4.9

LAMOURE VERY FINE SANDY LOAM.

The Lamoure very fine sandy loam consists of a black loamy fine sand or very fine sandy loam, with a depth of 20 inches. Below this the material becomes a dark-brown loam or very fine sandy loam. The soil is smooth and friable, and both soil and subsoil have an open structure.

The type is developed in first bottoms along the lower part of Wild Rice River. It begins about 2 miles north of Ransom and extends almost continuously to within 1 mile of the county line. The type is subject to overflow during high water, so that it is not cultivated. In most places the areas are fenced for pasture. Some hay is obtained. The land is valued at $15 to $20 an acre.

LAMOURE SILT LOAM.

The surface soil of the Lamoure silt loam consists of a very dark-brown to almost black mellow, friable silt loam, 15 inches deep. The surface soil contains a large amount of organic matter which gives the soil a light, fluffy feel. At 15 inches there is a change to grayish-drab, heavy silt loam, which continues to about 24 inches, where it grades into a yellowish-drab to pale grayish-drab, heavy silt loam or silty clay loam.

This soil is developed along Wild Rice River, about 3 miles west of Lake Tewaukon. It lies somewhat above the present stream bed, but is cut up into small irregular areas by old stream channels, so that little of it is cultivated. Parts of the type that are convenient to upland fields are cultivated in connection with these fields, the yields average higher than on the upland soils. Most of the type is used for pasture and hay production. It is an open, friable, well-drained soil, and where not liable to overflow would be well suited to alfalfa.

This soil is usually owned in connection with other types, so that no accurate estimate can be made regarding its value. Farms in which it is included sell for about $45 an acre.

LAMOURE SILTY CLAY LOAM.

The Lamoure silty clay loam comprises the undifferentiated material occurring in the first bottoms or flood plains of Wild Rice River and its branches. It is the most extensive alluvial soil in the county. The surface soil is usually a black silty clay loam to a depth of 12 to 14 inches, although in some places the surface layer may be a heavy silt loam. The subsoil, beginning at about 14 inches, is a dark grayish-drab, rather plastic silty clay. The color becomes somewhat lighter with depth, until at from 30 to 36 inches it is grayish-drab, tinged with brown. The soil has a rather mellow, open structure, and the structure of the lower subsoil is more open than that immediately below the surface soil.

The topography is generally level, except for abandoned channels, and the type is subject to overflow during periods of high water. A small part of it is cultivated, where included with fields on the upland soils, but most of the type is used as pasture land or for hay production. It supports a good growth of native grass, from which about 1 ton of hay per acre is obtained.

The selling value of the type depends upon the surrounding land and ranges from $25 to $35 an acre.

DUNESAND.

There are several areas of Dunesand in Sargent County. One small area is situated in the eastern part of the county in sec. 13, T. 131

N., R. 53 W. The other areas, which are large, occur mainly in Jackson and Southwest Townships. The type is made up of loose, dry sand, occurring as hills which range in height from 40 to 80 feet above the surrounding county. The soil consists of a loose, gray to grayish-yellow sand. The areas have the characteristic choppy, billowy topography of wind-blown sand. The depressions between the hills are generally moist and support a growth of swamp grass, and the hills themselves are generally covered with a scanty growth of grass which affords some grazing.

Dunesand is a delta deposit which has been blown up to its present form by the winds. The deposit in the eastern part of the county is still drifting slightly and is crowding Wild Rice River out of its channel. The other areas are covered with grass which prevents drifting.

The type is of some value for pasture and is held at about $8 an acre.

SUMMARY.

Sargent County lies along the southern boundary of North Dakota, in the southeastern part of the State. It has an area of 834 square miles, or 533,760 acres, including lakes and streams. The county comprises three main physiographic divisions; the Sheyenne Delta, a rolling treeless prairie, and an old sandy lake bed. The elevation ranges from 1,100 feet in the northeastern part of the county to 1,300 feet in the southwestern part. Drainage is poorly established. The southern and eastern parts of the county are drained by the Wild Rice River. Much of the run-off in the western and northeastern parts finds its way into sloughs, where it evaporates.

The total population of Sargent County in 1910 was 9,202, all of which is classed as rural. The county is well supplied with railroads and shipping points. Forman, the county seat, is centrally situated. Other towns are Cogswell, Rutland, Cayuga, Havana, Gwinner, Milnor, and De Lamere.

The climate is characterized by long cold winters and short cool summers. The mean annual temperature is reported as 41° F., and the mean annual precipitation as 20.4 inches. The growing season averages 124 days in length.

Agricultural development in this territory began about 1883, after the first railroad was built. From the first, grain farming was engaged in, with wheat as the leading crop, followed by oats and flax. A few ranches were established in the southwestern part of the county.

Grain farming is still the predominant type of agriculture. The value of the wheat, oats, barley, flax, corn, and other cereals produced in 1909 amounted to $2,587,406, while the value of live-stock

products amounted to $616,447. Dairy products are becoming an important item. Vegetables, fruit, and poultry are of minor importance.

Of the total area of the county, 88.6 per cent was reported in farms in the 1910 census, and of land in farms 78.6 per cent was improved. The average size of the farms is given as 407 acres. About 74 per cent of the farms are operated by owners. The change from exclusive grain farming to a system of mixed farming, in which live stock is taking a prominent place is progressing rapidly. Modern labor-saving machinery is found on all the farms. Most farms are well equipped with horsepower. The farmsteads, barns, and houses are substantial and generally well kept.

The soils of the county are derived from glacial material, either weathered in the position in which it was left by the ice, or transported and redeposited as terraces along glacial streams, as recent alluvium, or as eolian deposits. The drift consists of materials derived from granite, limestone, shale, and sandstone of many formations. The deposit varies in thickness, but averages about 100 feet.

The soils are classified into 10 series, including 26 soil types, in addition to Dunesand. The soils of the glacial-drift region, covering the central part of the county, are classed in the Barnes and Pierce series. The glacial-lake and river-terrace soils are classed in the Sioux, Fargo, Rogers, Maple, and Bearden, the eolian soils in the Marshall and Valentine series, and the first-bottom soils in the Lamoure series.

The Barnes soils predominate over the county and include the best farming land. The Pierce gravelly loam is found on knolls and represents poor agricultural land.

The Sioux series includes river-terrace soils underlain by coarse sand and gravel beds. The water-holding capacity of these soils is deficient. The Fargo, Maple, and Rogers soils are lake-bed types of little present value, except for the production of hay. The Rogers and Maple soils are impregnated with alkali. The Bearden series includes good agricultural soils.

The Lamoure soils are deep, strong types, but they are subject to overflow for certain periods.

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[PUBLIC RESOLUTION—No. 9.]

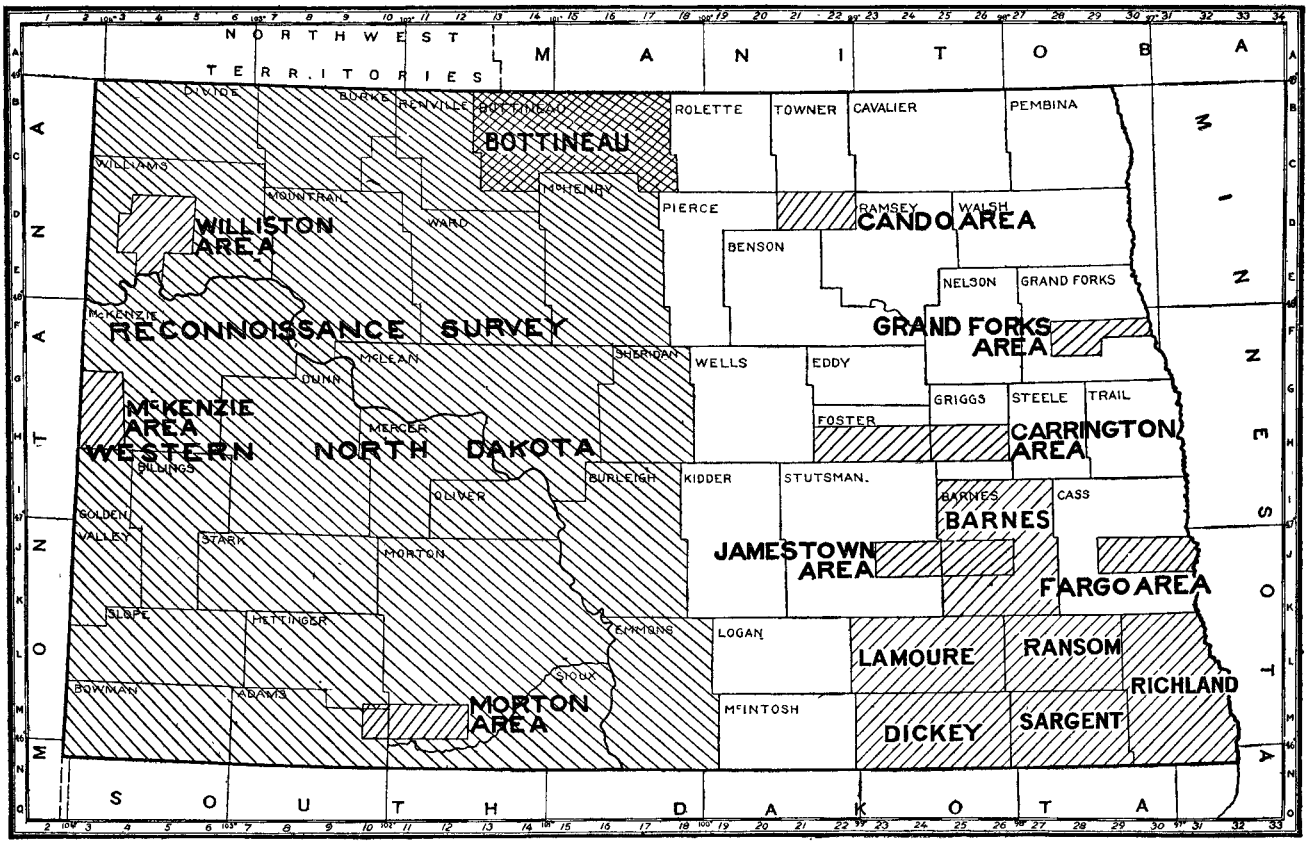
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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 or Agriculture.

Approved, March 14, 1904.

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



Areas surveyed in North Dakota.

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