

# SOIL SURVEY OF McHENRY COUNTY, NORTH DAKOTA.

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## DESCRIPTION OF THE AREA.

McHenry County is situated in the north-central part of North Dakota, 25 miles south of the Canadian line. It is 54 miles long north and south and 36 miles wide east and west. It is composed of 53 townships, with a total area of 1,888 square miles, or 1,208,320 acres.

Physiographically, McHenry County lies within the glaciated part of the Great Plains. It includes parts of two topographic divisions, the drift plain, which includes a part of the bed of glacial Lake Souris and the Missouri Plateau, on the edge of which is found the rough belt of the Altamont moraine. The old bed of Lake Souris comprises approximately one-half of the entire area and represents the low-lying stone-free soils of very mild relief.

The old bed of Lake Souris covered part of the drift plain. Since Lake Souris existed only for a short period in geological time, its shore line is not well established. In general, it occupied the northern part of the county, within a curved line extending southeast from the northwest corner of the county to the Souris River<sup>1</sup> at Falsen, then east to Karlsruhe, and then in an irregular line to the eastern part of the county near Smoky Lake. The topography is gently undulating, with a few prominent hills such as Medicine Lodge, Rose Bud, and White Rock Hills. A large part of this division lies between 1,400 and 1,500 feet above sea level.

That part of the drift plain which was not covered by old Lake Souris occupies a large proportion of the southern and western parts of the county. It lies south of a general line from Smoky Lake to Karlsruhe and thence to the northwest corner of the county. It does not include the southwest corner of the county or that part within 12 miles north or 15 miles east of the southwest corner. The topography is undulating to hilly. A few hills north of Round Lake and one north of Balfour are rolling, and the slopes along the Souris River are hilly and steep. The greater part, however, is undulating. It includes a number of intermittent lakes in the northeastern part, and small depressions throughout its extent.

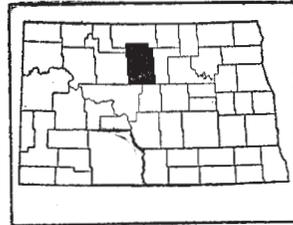


FIG. 32.—Sketch map showing location of the McHenry County area, North Dakota.

<sup>1</sup>This river is still called by some "Mouse River." "Souris River," the name adopted as the correct official designation by the U. S. Geographic Board, is used through this report. Consult 5th Report U. S. Geographic Board, 1890 to 1920.

The Missouri Plateau occupies a belt about 6 miles wide extending diagonally across the southwestern part of the county but not including the 5-mile strip in the extreme southwest corner. The plateau is characterized by a number of drainage ways sloping to the northeast. The surface is very gently sloping or undulating, with only an occasional depression. The general elevation is between 1,600 and 1,675 feet.

The Altamont moraine occupies a rough belt resting on the edge of the Missouri Plateau. It is the highest land in the county, and occupies an area of approximately 10 square miles in the extreme southwestern part. It is characterized by numerous depressions, intermittent lakes, and sharply rolling hillocks. In most places the elevation is probably between 1,700 and 1,800 feet.

A striking feature of the landscape consists of a long ridge between Balfour and Falsen, with small outliers southeast of Balfour. To the geologist it is known as an esker, but locally it is known as a "hog-back." From a point just west of Balfour the ridge extends in a northwesterly direction almost to Falsen. It varies from a few feet to 70 feet or more in height and from a few yards to over 200 yards in width. It is the straightest and most remarkable esker in the State. A public road runs along the crest for about 11 miles.

The county is drained mainly by the Souris River, which flows in a general northeasterly direction and divides the county into two nearly equal parts. The river here forms a large loop; in fact, the country north of the river is known as the Mouse River Loop country. The current of this stream is very sluggish and its course so crooked that the water flows 138 miles in traversing the county. The main tributaries of the Souris River within the county are Wintering, Deep, and Little Deep Rivers and Willow, Snake, Cut Bank, and Spring Creeks, all of which are intermittent. That part of Cut Bank Creek from about 4 miles north of North Lake to sec. 9, T. 158, R. 78, is fed by springs and contains water the entire year. A considerable number of deep holes in the bends of Deep and Little Deep Rivers also contain water the year round.

The principal lakes, named in order of size, are Buffalo Lodge, Smoky, Round, George, North, Hester, Cottonwood, Brush, and Spring Lakes. There are a number of intermittent lakes south of Smoky Lake, but the largest single intermittent lake is situated between Bergen and Balfour.

Prior to the coming of white settlers, the land now included in McHenry County was within the boundaries of disputed territory of the Assiniboines at the northwest, the Chippewas at the east, and the Dakotas (or Sioux) at the south. The Souris River Valley from Velva north constituted the great aboriginal highway of travel and trade between the tribes of the north woodland region, the Creeks and Chippewas, and the Missouri River and Western Plain tribes, the Mandan, Hidatsa, Arikara, Crow, and others to the west and south of the Missouri River.

A few white pioneers began making settlements along the Souris River in the early eighties. As more settlers came in, a part of their livelihood was made by picking up bleached buffalo bones and hauling them 50 to 150 miles or more to the nearest market. Some were sold for \$12 a ton. After the coming of the railroad in 1886 this source of livelihood soon ceased.

McHenry County was named in honor of Hon. James McHenry, a pioneer of what is now Clay County, S. Dak. The county was created by the Territorial legislature in 1873, but its boundaries were changed several times before 1900. The county seat was located first at a place called Scriptown, about 2 miles southeast of Velva, and on December 20, 1886, was moved to Towner.

The advent of the Great Northern Railway in 1886 marks the beginning of real development in McHenry County. It gave rise to the towns of Berwick, Towner, Denbigh, Riga, Granville, and Norwich. By 1890 the county had 1,584 inhabitants and 324 farms. In 1891 the Minneapolis, St. Paul & Sault Ste. Marie Railway was built through the southern part of the county, and the towns of Anamoose, Drake, Balfour, Bergen, Voltaire, and Velva were established. In 1900 the Granville and Sherwood branch of the Great Northern was opened to traffic and the town of Deering sprang up. In the meantime the population of the county had increased to 5,253. In 1905 the Towner and Maxbass branch was completed and the towns of Bantry and Upham began to develop. In 1910 the Surrey cut-off (Fargo branch) of the Great Northern was built, giving rise to the towns of Guthrie, Karlsruhe, Falsen, Simcoe, and a few small stations. The growth of the county from 1900 to 1910 was rapid, the 1910 census reporting the population as 17,627. The population was greatest about 1916 and since then has decreased slightly on account of droughty years and the effects of the World War. The 1920 census reports the population as 15,544.

Towner, the county seat, with a population of 610 in 1920, is situated in the east-central part of the county. It has an excellent brick and stone courthouse and an accredited high school. Velva, the largest town in the county and situated in the Souris River Valley, had a population of 836 in 1920. Drake, a junction town on the "Soo" Railway, has the largest high school. Anamoose, Granville, Bantry, Balfour, Upham, Kief, and Norwich are live towns with accredited high schools. Deering, Karlsruhe, Voltaire, Falsen, Guthrie, and Denbigh are smaller towns with fair schools—not accredited, but doing high-school work.

The population of the county has an average density of 8.2 persons per square mile. Many are immigrants or the immediate descendants of immigrants, including Norwegians, Swedes, Poles, Russians, Finns, Icelanders, Hungarians, Germans, and Canadians. Those of the Scandinavian races are most numerous. A considerable part of the population, however, came from Minnesota, Wisconsin, Iowa, Illinois, Missouri, and South Dakota.

The county has adequate transportation facilities. It has 178 miles of railroad and 27 shipping points, all which give direct connections with St. Paul and Minneapolis either over the "Soo" or Great Northern Railways. Most points are within 6 miles of a railroad, the more distant points lying between Drake and Towner, where the land is sandy and of low agricultural value. There are 72 elevators, 28 banks, and 56 churches in the county.

The common-school system compares favorably with that of any other section of the country. The rural schools are open seven months or more and the town schools nine months of the year. There were 119 schools in session in 1921, several of which were consolidated schools.

In general, the farms are fairly well improved. The improvements usually include a large barn and windmill, in many cases a silo, granaries, and a cottonwood or poplar grove commonly protects the farmstead from the winds. (Pl. XXX, figs. 1 and 2.) The well water is good as a rule, although in some low-lying areas near intermittent lakes it is alkaline. Ordinarily it is obtained at depths ranging from 10 to 60 feet, the more shallow wells occurring in the sandy soils. Many farmers have telephones and automobiles. Most of the grain fields are unfenced, the stock being fenced in the pastures.

Four automobile trails are found in the county—the Indian, Theodore Roosevelt, North Star, and Yellow trails. They are receiving considerable attention, and when they have received sand and gravel throughout they will afford fast auto and truck transportation. Sand and gravel is abundant in the county.

Prior to its settlement by whites the county was treeless except in parts of the Souris River Valley and on some areas occupied by sand dunes. The remaining native forest growth is close to the meanderings of the Souris River.

#### CLIMATE.

The climate of McHenry County is subhumid, with comparatively long winters and relatively cool summers. The summer days are warm, usually windy, with 14 to 16 hours of sunshine. The nights are always cool. Occasionally a hot wind comes from the southwest and the temperature rises as high as 104° F. Snow flies sometimes as early as October 5, but usually comes about the middle of November and remains until sometime in March. The average depth of snowfall is about 20 inches. The ground often remains bare for long periods in the winter and freezes to a depth of 3 to 6 feet. Temperatures as low as -40° F. and -50° F. occasionally occur, but owing to the dryness of the air the cold is less penetrating than in more humid regions. Zero weather in Missouri or Iowa is sensibly as cold as 20° below in McHenry County.

The following table shows the average percentage of damage from various causes in McHenry County during the several years noted:

*Percentage of damage to crops due to climatic influences, pests, plant disease, and other causes, McHenry County, N. Dak.<sup>1</sup>*

Crop.	Number of estimates.	Total per cent damage.	Percentage of damage from—							
			Deficient moisture.	Hot winds.	Hail.	Rust.	Grasshoppers, gophers, and insects.	Frost.	Diseases.	Other causes.
Wheat.....	68	62	30	10	1	9	9	.....	.....	3
Oats.....	68	61	32	9	0	.....	15	1	3	1
Barley.....	56	55	30	9	1	.....	10	1	3	1
Flax.....	51	50	30	6	0	.....	7	3	2	2
Corn.....	45	36	22	5	0	.....	1	7	.....	1
Potatoes.....	58	34	23	2	0	.....	4	3	1	1

<sup>1</sup>Compiled by department of farm management, North Dakota Agricultural College, in cooperation with U. S. Bureau of Agricultural Economics.

NOTE.—Wheat=1917 to 1922; oats=1917 to 1922; barley=1915, 1917 to 1922; flax=1913, 1915, 1917 to 1922; corn=1917 to 1922; potatoes=1916 to 1922.

By referring to the table on page 934, the reader will note that 1915 was a cool, relatively moist year, well suited to small grains, but too cold for corn; that 1917 was droughty and cold; that 1918 was a somewhat better year for small grains, but very unfavorable for corn; that 1919 again was droughty, but, being warm, cultivated crops thrived; that 1920 and 1921 were relatively warm years well suited to corn, but unfavorable to small grains.

These damage estimates are based on poorer crop years than the average for small grains. Note that hail is only an occasional cause of damage; that frost hurts corn to the extent of only 7 per cent. The fact that the crop estimators' figures place the frost damage on corn at only 7 per cent as an average of these years is most significant, since in this 6-year period are included 2 of the only 3 years in the last 15 years in which corn did not get ripe enough to husk out and was cut for fodder. Note also that corn is less damaged by deficient moisture than any other crop and that oats suffers the most.

The average frost-free period, based on a 22-year record at Towner, N. Dak., is 121 days. The last killing frost in the spring occurs on the average on May 18 and the first killing frost in the fall occurs on the average on September 16. The latest killing frost in the spring on record at Towner occurred on June 20 and the earliest in the fall on August 24.

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

*Normal monthly, seasonal, and annual temperature and precipitation at Towner.*

[Elevation, 1,482 feet].

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1917).	Total amount for the wettest year (1899).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December .....	10.0	53	-42	0.41	1.00	0.30
January .....	2.6	51	-49	.49	.45	.17
February .....	5.2	50	-44	.38	.40	.04
Winter .....	5.9	53	-49	1.28	1.85	.51
March .....	19.2	69	-30	.90	T.	1.30
April .....	41.4	88	-20	1.10	1.02	1.70
May .....	52.3	97	12	2.32	.27	6.84
Spring .....	37.6	97	-30	4.32	1.29	9.84
June .....	62.2	99	25	3.08	.98	9.02
July .....	67.1	104	32	2.23	1.82	2.43
August .....	64.4	100	29	2.09	.78	4.09
Summer .....	64.6	104	25	7.40	3.58	15.54
September .....	55.8	102	17	1.65	.69	.56
October .....	42.4	91	-10	.90	.76	2.10
November .....	25.0	69	-24	.48	.05	.10
Fall .....	41.1	102	-24	3.03	1.50	2.76
Year .....	37.3	104	-49	16.03	8.22	28.65

The following table shows the seasonal precipitation and seasonal mean temperatures at Towner, in McHenry County, for the 15-year period 1909 to 1923, inclusive. At the sides of this weather record have been set the average yields per acre of corn and spring wheat in the county during the same period. Similar data for all the important crops are reported in the table on page 936.

*Average yields per acre of wheat and corn in McHenry County, N. Dak., and seasonal precipitation and mean temperature at Towner, 1909-1923.*

Year.	Wheat, yield per acre.	Seasonal precipitation.					Mean temperature.					Corn, yield per acre.
		May.	June.	July.	Aug.	Total (May to August, includ- ing).	May.	June.	July.	Aug.	Average (May to August, includ- ing).	
	<i>Bushels.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>	<i>Bushels.</i>
1909....	13	4.22	2.69	2.84	0.50	10.25	52.66	62.9	67.0	68.8	62.84	24
1910....	( <sup>1</sup> )	.90	1.53	2.03	.85	5.31	.....	.....	.....	.....	.....	.....
1911....	5	1.90	2.98	1.95	5.11	11.94	55.1	65.9	64.2	61.8	61.75	23
1912....	17	4.48	1.66	3.34	2.58	12.06	55.0	62.0	65.0	61.2	60.80	22
1913....	7	1.39	1.77	2.16	2.74	8.06	52.0	65.9	65.1	68.6	62.90	27
1914....	9	2.84	5.06	1.06	2.50	11.46	58.0	62.0	72.6	63.4	64.00	36
1915....	19	3.22	2.01	1.57	.24	7.04	52.2	56.9	63.2	66.1	59.60	( <sup>2</sup> )
1916....	6	1.61	2.98	4.12	2.79	11.50	51.8	58.2	72.6	66.2	62.20	31
1917....	4	.27	.98	1.82	.78	3.85	51.3	61.0	71.0	65.6	62.23	( <sup>2</sup> )
1918....	7	1.53	2.66	2.42	1.55	8.16	51.4	64.2	66.1	66.8	62.13	( <sup>2</sup> )
1919....	4	2.35	1.44	.25	1.71	5.75	58.1	68.6	72.6	68.3	66.90	25
1920....	6	.83	2.04	1.59	3.12	7.58	54.4	61.7	68.8	70.2	63.78	20
1921....	6	1.66	3.40	1.62	2.48	9.16	53.5	67.8	71.2	67.2	64.93	26
1922....	15	2.55	3.04	3.92	.89	10.40	57.2	65.1	65.2	68.4	63.98	27
1923....	5	1.64	1.98	1.36	1.31	6.29	56.0	68.7	73.2	62.8	65.18	27

<sup>1</sup> Yield data and temperature data not available for 1910.

<sup>2</sup> Corn did not ripen; harvested for fodder.

#### AGRICULTURE.

Agriculture in McHenry County is of comparatively recent development. In 1881 there were a few scattered settlers along the Souris River and elsewhere, but owing to the distance from the railroads and lack of equipment, little agricultural progress was made.

Agricultural development began in earnest in 1886, when the Great Northern Railway was completed and towns and elevators were built. Small-grain production was practiced, almost to the exclusion of every other type of farming. Five years later the "Soo" Railway extended its lines through the southern part of the county. In the later eighties two crop failures, resulting from droughts, caused many farmers to be discouraged and leave the county. The financial depression following these crop failures continued until 1895. Beginning with that year there was a succession of good crops and the county developed rapidly.

The following table gives the acreage and production of the principal crops of the county in 1889, 1899, 1909, and 1919, as reported by the census:

*Acreage and production of the leading crops in 1889, 1899, 1909, and 1919.*

Crops.	1889		1899		1909		1919	
	Area.	Production.	Area.	Production.	Area.	Production.	Area.	Production.
	<i>Acres.</i>	<i>Bushels.</i>	<i>Acres.</i>	<i>Bushels.</i>	<i>Acres.</i>	<i>Bushels.</i>	<i>Acres.</i>	<i>Bushels.</i>
Wheat.....	3,336	22,707	16,864	209,230	313,862	4,097,885	214,453	766,444
Rye.....	4	89	407	6,020	2,195	25,636	136,211	476,338
Oats.....	1,836	16,186	4,259	119,531	78,755	2,207,266	46,639	272,064
Barley.....	362	2,043	688	16,090	22,618	477,211	7,086	33,362
Flax.....	149	608	3,143	28,160	22,548	190,387	2,965	4,429
Corn.....	79	1,057	68	2,280	1,141	24,696	1,521	18,660
Potatoes.....	159	11,671	213	23,152	1,329	128,825	1,381	55,220
		<i>Tons.</i>		<i>Tons.</i>		<i>Tons.</i>		<i>Tons.</i>
Tame hay.....	0	0	120	261	6,933	9,247	11,099	11,249
Wild hay.....	13,733	20,378	32,500	55,824	92,488	100,310	90,697	58,365

Weather records are not available for any point in McHenry County in 1889, but from the yields obtained, as calculated from the area and production figures, it is to be presumed that the year was rather dry. The precipitation record for 1899 at Towner shows the heaviest rainfall on record for the county since 1896, a total of 28.65 inches, with 6.84 inches in May, 9.02 inches in June (the highest on record), 2.43 inches in July, and 4.09 in August; hence the season was a most distinctly unusual one. In 1909 the annual rainfall was 13.30 inches, with 4.22 inches in May, 2.69 inches in June, 2.84 inches in July, and 0.50 inch in August, a fairly normal supply of moisture. In 1919 the annual rainfall was 13.29 inches, with 2.35 inches in May, 1.44 inches in June, 0.25 inch in July (the lowest on record), and 1.71 inches in August; in addition to the fact of very deficient moisture the growing season was exceptionally hot. Summarizing, it would appear that two of the census years were abnormally dry, one abnormally wet, and one approximately normal.

The census figures of acreage and production do not represent averages but are based upon a single year's report in each case. As has just been pointed out, these figures may be collected in rather abnormal seasons; for this reason the census data is supplemented by the following table showing acreages, yields per acre, and total production in McHenry County during the 15-year period 1909 to 1923, inclusive. The facts set forth in this table show plainly that it is unwise to stake all upon small grain crops; but fortunately they also show that a diverse method of cropping makes possible good yields from some crops in even the most unfavorable years. The average yields of wheat, and indeed of the other small grains, can be greatly increased through the more general adoption of crop rotations that stress cultivated crops and legumes. Better crop varieties must be used and more effective efforts directed toward keeping the better varieties pure.

*Acreage, yield per acre, and total production of principal field crops in McHenry County, N. Dak., 1909 to 1923, inclusive.<sup>1</sup>*

ACREAGE (000 omitted).

	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Corn .....	1	3	11	9	7	11	111	6	7	8	7	8	12	15	23
Spring wheat (all) .....	314	286	291	246	231	220	62	182	200	170	214	215	190	178	191
Barley .....	23	16	11	19	33	28	17	26	23	14	7	6	7	5	8
Oats .....	79	69	66	61	53	54	49	60	78	70	61	56	60	45	50
Rye .....	2	3	3	11	12	20	58	45	100	110	115	60	65	90	74
Potatoes .....	1	1	1.5	1	1	1	0.5	0.5	1.5	1.5	1.5	1.5	1.5	2	2
Flax .....	22	24	21	21	6	5	4	2	10	5	3	1	1	2	4
Tame hay .....	8	9	8	9	9	11	9	9	12	12	26	30	25	24	31

YIELDS PER ACRE (in bushels; hay in tons).

Corn .....	24	23.0	22.0	27.0	36.0	31.0	31.0	25.0	20.0	26.0	27.0	27.0	28.0	27.0
Spring wheat (all) .....	13	5	17	7	9	19	6	4.0	7.0	4	6	15	5.0	
Barley .....	21	10	27	16	16	39	18	5	12	5	12	10	28	12.0
Oats .....	28	15	39	20	26	36	20	8	15	5	21	11	37	18.0
Rye .....	12	12	16	9	15	15	12	7	8	5	9	8	15	5.0
Potatoes .....	120	172	131	93	122	83	175	75	115	45	85	70	118	67.0
Flax .....	9	6.5	9	7.5	7	8	9	3	6.5	1.5	3	3	12	6.0
Tame hay .....	140	.8	1.38	1.28	1.36	1.04	1.31	.4	.9	1.0	1.4	1.4	1.8	1.5

PRODUCTION (bushels; hay in tons) (000 bushels or tons omitted).

Corn .....	24	253	198	189	396	3,078	1,092	186	800	1,190	175	160	312	405	621
Spring wheat (all) .....	4,082	1,455	1,722	1,617	1,980	3,078	1,092	186	800	1,190	356	1,290	1,140	2,670	955
Barley .....	483	110	513	528	448	663	468	115	163	35	73	70	75	96	
Oats .....	2,222	990	2,379	1,060	1,404	2,761	1,200	624	1,050	305	1,172	660	1,260	900	
Rye .....	24	36	176	108	300	870	540	700	880	575	540	520	1,080	370	
Potatoes .....	120	258	131	93	122	42	88	112	173	67	127	105	236	107	
Flax .....	198	136	189	45	35	32	18	30	32	5	3	3	24	24	
Tame hay .....	11	6	12	11	15	9	12	4	11	26	42	35	43	47	

<sup>1</sup> Data supplied through the courtesy of the Bureau of Agricultural Economics, Division of Crop and Livestock Estimates, United States Department of Agriculture. Acreage basis 1909 and 1919 are census data, with acreages for intercensal years determined from estimated changes.

Spring wheat always has been and still is the leading crop in McHenry County. It reached its maximum acreage and maximum production in 1909. The total acreage has declined rather steadily during the last 15 years, except for a temporary rise in 1919 and 1920. Annual yield statistics are available for a 14-year period, 1909-1923 (omitting 1910, yield records of which are missing). In this 14-year period spring wheat has returned an average yield of 8.8 bushels per acre. The highest average yield during the last 15 years was the 1915 average of 19 bushels per acre and the lowest average was 4 bushels per acre obtained in 1917 and 1919. In 10 years out of the 14 wheat yields have averaged less than 10 bushels per acre. An examination of the table on page 934 and that on page 936 shows that wheat yields in McHenry County have been largely governed by the amount of rainfall during the growing season, being particularly favored by abundant rainfall in June and July. The mean temperature also exerts a controlling influence; e. g., an unusually low mean temperature, as in 1915, distinctly offsets the rainfall deficiency of June and July, enabling the excess precipitation of May, assisted by the rather low rainfalls of June and July, to mature a good crop. Until recent years the general practice has been to grow wheat, either continuously or occasionally rotated with other small grains. The experience of the passing years is demonstrating the necessity of growing wheat after cultivated crops. As an average of 10 years (1912-1922, omitting 1920, when wheat followed small grain and millet) on the very light soil on the Granville demonstration farm (soil types Valentine sand and Barnes fine sandy loam), wheat after corn returned an average yield of 16.6 bushels per acre, while the county average for that same period was only 9.4 bushels per acre.

In choosing systems of soil management most likely to place the agriculture of the county on a firm footing, it should be recognized that during the 15-year period, 1909-1923, corn has been a relatively more certain crop than wheat, in spite of the fact that in 1910, 1915, 1917, and 1918, 4 years out of the 15, the crop could only be utilized for fodder. Examination of the table on page 936 on the acreage, yield, and production during the 15-year period 1909-1923, emphasizes the wisdom of including corn, flax, potatoes, and tame hay in soil management systems, as well as wheat. Livestock will, of course, be needed in order to consume the feed crops grown.

The principal variety of common wheat grown in the county is Marquis. This variety was introduced about 1912 from Canada. Marquis has largely supplanted the Scotch Fife and Bluestem varieties which were formerly grown and which aided in giving this region its enviable reputation for producing high-quality wheat. Marquis is valued especially for its early maturity, which enables it in some degree to escape damage from stem rust or hail, its strength in bread making, and its tight husk, which prevents shelling, though this at times makes it more difficult to thresh. Marquis is especially suited to the richer, finer textured soils.

Kota, a new variety of common wheat, developed by the North Dakota Agricultural Experiment Station, has recently been introduced and grown in a small way. Kota is especially known for its resistance to stem rust.

Durum wheat is also grown to a considerable extent in McHenry County. In 1922 half of the wheat acreage was devoted to durum

wheat, but this proportion declined somewhat in 1923. Durum wheat is generally considered more drought resistant than common wheat, has longer straw, resists rust to a greater degree, and ordinarily yields more grain. The flour from durum wheat has a weaker gluten than common wheat and is used chiefly in the manufacture of macaroni products and other alimentary pastes. Compared to Marquis, durum wheat is usually regarded as being better suited to the sandy, coarse-textured soils, yet is grown quite generally on the heavier loam around Velva.

Kubanka is one of the leading varieties of amber durum grown in McHenry County. It is fairly resistant to rust, yields well, and produces a high quality of wheat for the macaroni trade. Kahla, a black-bearded, black-chaff, amber durum variety also is grown. Monad (D-1) amber durum, while not common, is grown to a certain extent. Monad is highly rust resistant and is a very good yielding wheat. Monad is not so desirable a wheat for the macaroni manufacturers as Kubanka.

Pentad, commonly called D-5 a red durum, occupies a large part of the durum acreage in this county. D-5 is perhaps the most rust resistant wheat available, and this resistance has made it very popular among growers. The quality of semolina produced by this wheat however, does not meet the favor of macaroni manufacturers, and in the more recent years D-5 has not brought the market price of amber durums.

In preparing land for wheat, both spring and fall plowing are practiced. The more important advantages of fall plowing are: It checks the increase of grasshoppers, it encourages bacterial activity, helps to eradicate weed pests—as many seeds sprout after early fall plowing— aids materially in the decomposition of organic matter, and makes possible a more equal distribution of farm labor. In the more sandy areas it is often advisable to plow in the spring to minimize drifting. As far as yields are concerned, it makes little difference whether the land is plowed in the fall or early spring. However, under normal farm conditions, early fall plowing would probably prove more profitable than spring plowing, because, when a considerable acreage is handled, as usually is the case, some of it must be sown rather late if the seeding is delayed by plowing in spring. The decrease in yield due to the later seeding would usually offset any better soil condition that might be brought about by spring plowing.

The depth of plowing usually is 4 to 7 inches on the heavier soils, and 3 or 4 inches on the more sandy soils. The land is usually harrowed in the spring before seeding. The use of packers is advisable when the soils are loose or when they have been plowed deep. Wheat should be sown as early in the spring as soil and weather conditions permit, generally from April 1 to May 1. Seeding later than May is likely to result in low yields. Hard red spring wheats are best seeded at the rate of from 3 to 5 pecks per acre, using the lighter seedings on lighter, more droughty soils. Durum wheat has larger kernels and consequently is ordinarily seeded at a slightly higher rate, about 4 to 5 pecks per acre.

Summer fallowing is practiced to some extent, but is inadvisable on the lighter, sandy soils of the county on account of the danger of drifting. Intertilled crops, such as corn and potatoes, save about

as much water and destroy as many weeds as does a summer fallow, and besides are usually in themselves a source of profit.

Since 1915 rye has been the second largest crop in point of acreage, reaching its high point in 1919, from which it has declined except for a temporary rise in 1922. In 1923 rye occupied 74,000 acres and wheat 191,000 acres, only about two and one-half times as much.

Rye should continue to occupy a rather prominent place in the agriculture of the county, because winter rye provides a fall-sown crop which covers the lighter soils so likely to drift in the spring, because its earlier maturity frequently enables it to escape drought or hot-wind injury, and because of its low cost of production.

As a rule, the grain is sown on stubble land with very little preparation, and in the sandier soils the seed is often drilled in without previous disking. Although this practice of "stubbling in" is economical, it sometimes results in serious consequences, for these hard "stubbled in" fields have been found to be a favorite place for the grasshopper to lay its eggs. When rye is "stubbled in" it should be put on land that was spring-plowed the year previous. Earlier seeding on summer fallow or on land plowed very early in the fall and well packed may enable the crop to make growth enough so as to catch winter snows and thus protect itself from winter injury.

Winter rye is sown from the middle of August to the middle of September and later, the latter part of August and early part of September being most favorable. Fall pasturing of rye, although practiced at times, is not generally advisable. Rye is sometimes used as a nurse crop in which to start sweet clover and grasses. Where used as a nurse crop, the sweet clover or grasses should be drilled in the rye in early spring. Unscarified sweet clover may be sown in the fall with the rye seed. During the 14-year period 1909 to 1923 (omitting 1910, whose record is missing) rye has returned an average yield of 10.6 bushels per acre.

The oat crop is the third largest in point of acreage and second in production (1923). Oat yields are influenced by the same factors that determine wheat yields, a good wheat year being in general a good oat year, and a poor wheat year a poor oat year. Although oats are grown extensively on the sandy soils, heavier yields would be obtained on the heavier soils. The crop is used almost entirely on the farm, horses receiving little grain except oats. In droughty years many fields are cut green for hay.

The principal varieties grown are Swedish Select, Silvermine, and Big Four, among the midseason maturing varieties; White Russian of the late-maturing varieties, and Sixty-Day of the early varieties. Midseason varieties have a wider and a more general adaptation to seasonal conditions than either early or late oats. Early oats do well in warm seasons, which tend to force maturity. In such seasons high temperatures may be unfavorable to the later maturing varieties. Early oats are often ripe before weeds, such as wild oats, have dropped their seed, and hence prompt harvest of the early oats removes many such weeds from the land. Since early oats are somewhat short strawed, they are more difficult to harvest in a dry season.

As a rule, the seed bed for oats receives less attention than that for wheat. Oats seeding is usually delayed until the last possible date for seeding wheat. Repeated wheat failures are emphasizing the necessity of giving feed crops, such as oats, a better opportunity,

through seeding them earlier on better prepared seed beds. Oats are seeded at the rate of 8 to 10 pecks per acre.

The barley acreage suffered a sharp decline in 1919, since which year the new level has been maintained. Only 8,000 acres were devoted to this crop in 1923. The six-rowed Manchuria type of barley is most commonly grown. Barley is sown a little later than oats. The crop matures in a short season and is useful in helping clean the land of weeds. Barley is usually seeded at the rate of  $1\frac{1}{2}$  to 2 bushels per acre. Barley yields have averaged 16.5 bushels per acre during the 14-year period 1909-1923 (omitting 1910, whose yields are missing). During the same period oats have averaged 21.1 bushels per acre. Figuring barley to weigh 48 pounds per bushel and that 79.4 per cent of it is digestible, an average acre of McHenry County barley has produced 628.8 pounds of digestible nutrients. Figuring oats to weigh 32 pounds per bushel and that 70.4 per cent of it is digestible, an average acre of McHenry County oats has produced 482.1 pounds of digestible nutrients. Barley should apparently be given more consideration as a feed crop than has hitherto been the case.

Flax reached its maximum acreage in 1910 and has declined since 1912, there being a temporary increase in 1917. Although the acreage is small at present, it has been on the increase during the last three years, indicating that it is probably coming back as a rotation crop. Heretofore it has been almost exclusively grown as the first crop on newly broken virgin sod.

Flax is subject to injury by the wilt disease, a disease commonly found on old land. Wilt-resistant varieties, however, such as N. D. R. No. 114, or N. D. R. No. 52, will thrive in wilt-infested soils. Rotation of crops aids in controlling the wilt disease in the soil. A cropping system suited to flax production should include a cultivated crop and a sod crop. These aid in the control of weeds, conserve moisture, add humus, and help to maintain the supply of plant food.

Loams and silt loams are more desirable for flax production than the sandy soils. The seed bed is prepared by plowing and harrowing, the flax being usually seeded at the rate of 2 pecks per acre. Seeding is frequently delayed until as late as the middle of June. Earlier seeding of flax would, as a rule, insure higher yields. More attention needs to be given to seed bed preparation. Loose seed beds should be firmed by packing. Wherever the land is infested with Russian thistle, harrowing or disking every 10 days or 2 weeks from the opening of spring until the last week in May or first week in June will do much toward lessening the damage from this weed.

Corn is rapidly gaining in favor in McHenry County. Fifteen years ago (1909) there were only 1,000 acres grown; in 1923 the acreage had increased to 23,000. During the 14-year period 1909-1923 (excepting 1910, whose record is missing) for which acre yields are available, corn returned an average yield of 26.2 bushels per acre in 11 years and made fair fodder but no ripe corn in three years (1915, 1917, and 1918). The highest average yield per acre for the county, 36 bushels, was obtained in 1914.

The average growing season, based on a 22-year record at Towner, comprises 121 days. During the period of record at Towner the frost-free season has been 105 days or less only six times. These figures,

together with the record of the last 15 years, prove that corn growing in the county is not as hazardous as is commonly supposed.

Corn does remarkably well in years of drought, provided proper tillage methods are employed. F. W. Weidler, a farmer living 6 miles south of Velva, demonstrated this fact by the results he obtained in 1921, a comparatively dry year. His field of Rustler White Dent averaged 40 bushels per acre. The soil was well prepared, the corn was planted by the check-row method, and given four cultivations, two each way. This corn was grown on land of average fertility.

Corn is not only a profitable crop, but the benefits that accrue from its cultivation can not be too highly emphasized. The continuous growing of wheat on the same fields not only causes the yield to decline, but allows the land to become infested with weeds. In the past, summer fallowing has been practiced more or less to get rid of weeds and conserve moisture, but this has proved unprofitable and unsatisfactory, not only because the use of the land is lost for a year but because the unprotected surface soil on many fields is subject to serious drifting.

The production of corn is useful in many ways. It rids the soil of weeds and insect pests, it helps the soil change its stock of plant-food material over into a form that plants can use, and lessens the dangers from drifting.

Cultivating the corn enables the soil to retain moisture in the soil and subsoil for the use of the next year's crop, thereby insuring a larger grain crop. Corn provides a roughage in the form of fodder or silage that can readily be carried over from one season to another (Pl. XXXI, fig. 1). Pit silos and many different types of erect silos are increasing in the county.

The principal varieties grown are Northwestern Dent, a red semi-dent; Minnesota 13, a yellow dent; Rustler, a white dent; Minnesota 23, a white-capped yellow dent; Payne, a white dent; Square Deal, a yellow dent; Golden Dent, a yellow dent; Pioneer, a white dent; Mercer, an orange-yellow flint; Smut-nose, a yellow flint; Rainbow, a multicolored flint; Gehu, a lemon-yellow flint; and Dakota, a white flint. Gehu and Dakota are very early, low-growing flints well adapted to "hogging-off"; Square Deal, Golden Dent, and Pioneer are very early dents; Rustler, Northwestern, and North Dakota selections of Minnesota 13 are later than the foregoing group of very early dents and make a taller growth. Mercer, Rainbow, and Smut-nose are three later flints, Rainbow being especially late. The later flints are not well adapted to the county. Northwestern Dent is the most popular variety of corn grown in the county.

Potatoes are an important cash crop in parts of the county, although the acreage has not shown a substantial increase in the last 15 years. The acreage reported for 1923 was 1,600 acres. The average yield of potatoes during the 14-year period, 1909-1923 (omitting 1910), is 105.1 bushels, a very good yield considering that it includes several dry years. In 1921, 50 carloads of potatoes were shipped from Upham and a number of carloads from Velva and Granville. The development of potato-marketing associations, such as that which operated at Granville in 1921, promises much aid to the potato-growing industry of the county. Warehouses and farm

storage are both needed. The county has a possibility of developing a market for seed potatoes in the Southern States in common with other parts of the State.

The production of potatoes has the same desirable effects on the soil as corn. Many of the soils of the county, particularly the fine and very fine sandy loam soils, are especially well suited to the crop. The potatoes are easily grown and are of excellent quality. Potato diseases have done very little damage so far. The Colorado potato beetle (commonly called potato bug), which has made its appearance, can be combated most effectively by the use of poison sprays or dusts. Potato yields could probably be greatly increased by better cultural methods and by the inclusion of sweet clover or other legumes in the potato-growing rotations. Where manure is used it should be applied to the crop preceding potatoes rather than directly for the potatoes. The varieties grown are Early Ohio, Irish Cobbler, Green Mountain, and Triumph, Early Ohio being most extensively grown. All of these, except the Green Mountain, are relatively early potatoes. Triumph and Early Ohio, and Irish Cobbler to a lesser extent, are in considerable demand in the Central and Southern States for seed purposes.

Sweet clover is probably the most generally useful leguminous crop for the county, it being useful for both hay and pasture. Alfalfa, however, is much superior for hay purposes and its acreage should greatly increase in the county. Red clover is not adapted to the climatic conditions of the county. Sweet clover will thrive in practically any of the soils in the county. On the low-lying, sandy textured soils sweet clover produces large yields of palatable, nourishing stock feed (Pl. XXXI, fig. 2). Sweet clover is seeded at the rate of 10 to 12 pounds of scarified seed to the acre. Where unhulled and unscarified seed is used, the amount of seed is frequently doubled.

Where hardy varieties of alfalfa, such as the Grimm, are used, excellent stands can be obtained. Farmers contemplating growing alfalfa should anticipate their needs by providing a cleanly cultivated corn-field, potato field, or clean summer fallow on which to sow the seed. Under the climatic conditions in the county, alfalfa is preferably sown without a nurse crop at the rate of 8 to 10 pounds of seed to the acre. If the soil is free from weeds and a very firm seed bed is available, the rate of seeding can be reduced somewhat. Inoculation of the seed is advisable, but many have succeeded without this precaution. As a general rule, about two cuttings of alfalfa can be obtained each season from a good stand. The heavier soils in the western part of the county should make ideal alfalfa land and farmers in this area can well consider the possibility of growing alfalfa for seed. Sweet clover fits into the rotations needed better than does alfalfa.<sup>2</sup>

Canadian field peas and other annual legumes, such as navy beans or very early varieties of soybeans, hold out considerable promise of usefulness in contributing to a program of diversification of crops in the county.

Millet is grown to some extent as an emergency forage crop. It occupied 1,242 acres in 1909 and 5,931 acres in 1919. Hungarian and common millets are most commonly grown. Millet seeding is usually delayed until after corn planting, when the ground is well

<sup>2</sup> Write to Extension Division, North Dakota Agricultural College, Agricultural College, N. Dak., for Extension Circ. No. 59, Guide Posts on the Alfalfa Trail.

warmed. Millet may be safely sown from the last week in May to about the middle of June. The crop is seeded at the rate of 15 to 20 pounds of seed to the acre. Sudan grass, another annual forage crop, has produced excellent crops in the county during the warmer seasons. It is seeded and handled much like millet.

Brome grass (*Bromus inermis*) is the best perennial grass for the county, being much more drought resistant than timothy. It makes an excellent quality of hay. Slender wheat grass and crested wheat grass, although not commonly grown as yet, are well adapted to the soil and climatic conditions of the county and will contribute to a much needed diversity of feeds. Brome grass is seeded at the rate of 18 to 20 pounds of seed per acre if to be used for hay, or at the rate of 20 to 25 pounds per acre if used for seed. Care should be taken to obtain brome grass seed free from quack grass seed.

Prairie grasses will probably always be used to a considerable extent. In 1909, 92,488 acres of wild grasses were cut, yielding 100,310 tons of hay, and in 1919, a dry year, 90,697 acres were harvested, yielding 58,365 tons. The yields on alkali or very sandy soils are low and of inferior quality. The Souris River bottoms afford an abundance of wild hay, especially on the heavy soils, with yields normally varying from 1 to 2 tons per acre, and occasional yields as high as 4 tons. The principal wild grasses used for hay are hollow stem, false reedtop, tall manna grass, wild timothy, reed grass, and the more undesirable grasses—such as salt grass, green pigeon grass, porcupine grass, feather grass, hair grass, wild barley, wild rye, cord grass, witch grass, and northern drop-seed grass.<sup>3</sup> Slender wheat grass or western rye grass is mixed more or less with the wild grasses and is a desirable hay grass. Blue grama grass (popularly though wrongly called "buffalo grass") is the most common upland grass. It provides an abundance of pasturage for stock and is very sustaining and fattening.

Some emmer (popularly called speltz) is grown in the county. In 1909 it was grown on 1,480 acres, yielding 36,712 bushels, but by 1919 it occupied only 711 acres, yielding 3,945 bushels. Some varieties of emmer are resistant to rust, others are quite susceptible. Although there is a prevailing notion that emmer is a drought-resistant crop, and that consequently it will outyield other feed crops, actual tests rate it as about equal to oats in amount of feed produced per acre.

Other field crops, such as buckwheat, vetch, Canadian field peas, and beans, are grown only to a small extent.

Garden vegetables, such as cabbage, tomatoes, parsnips, carrots, onions, radishes, lettuce, peas, and beans, thrive. All of them are consumed locally. Gardens that are located within the protection of a shelter belt of trees catch more snow in the winter and are less subject to drying winds in the summer, which greatly adds to their possible moisture supply. Fruits, such as the hardier varieties of apples, crabs, and plums, and strawberries can be grown within the protection of a shelter belt. Wild plums and wild grapes are common along the Souris River, and are not allowed to go to waste. Chokecherries and June berries are common in parts of the more sandy regions.

<sup>3</sup> See Appendix, page 973, for list of plants named in this report.

Practically the same method is used in growing all the small grains. As much of the land as possible is plowed in the fall, plowing continuing until the ground freezes. Plowing is done with riding, gang, or triple gang plows, 5 to 8 horses being used. Tractors are used to some extent in plowing and in cutting small grain and forage.

In the spring the land usually is harrowed twice before seeding and frequently once after seeding. Occasionally good results follow the harrowing of small grains after the crop is up, but this applies only to the heavier soils. The small grains are seeded in drills 6 inches apart, double and single disk and shoe drills being used, the double disk being most common. Weedy land often is disked before seeding, and sometimes is double-disked if the season is late, instead of plowing. The grain is cut with 7 or 8 foot binders and headers. The headed grain is stacked immediately, while bound grain is often threshed from the shock or stacked some time later. Threshing is usually done at a stipulated price per bushel by outfits owned by farmers. The neighboring farmers take turns in helping each other thresh. A large part of the grain is hauled direct to the nearest elevator; some is kept in granaries until later.

The values of farm products have fluctuated considerably in recent years. The census reports the value of cereals for 1909 at \$5,051,481 and for 1919 at only \$2,819,453. Hay and forage products, however, increased from \$372,811 in 1909 to \$1,452,801 in 1919. Vegetables also increased from \$96,210 in 1909 to \$180,062 in 1919. In 1909 the value of animals sold and slaughtered was \$460,033, dairy products, excluding home use, \$108,370, poultry and eggs \$127,706, and wool \$957. The value of animals sold and slaughtered in 1919 was not reported by the census. The value of dairy products in 1919, excluding home use, was \$642,376, poultry and eggs \$247,738, and wool \$27,225. There was a decrease in the value of cereals and a large increase in the value of hay, vegetables, and all livestock products, which indicates a general trend from small-grain farming to a more general type of farming, including the production of more hay and forage, cattle, dairy products, poultry, and eggs. The droughty years from 1917 to 1921, inclusive, have been, in large part, responsible for the change.

The three standard breeds of beef cattle, Shorthorn, Hereford, and Aberdeen Angus, are raised in the county. The dairy breeds of cattle are coming into the county and into this part of the State. Farmers are making a success with all of the dairy breeds, as well as with the dual-purpose or milk and meat breeds. Holstein, Guernsey, and Jersey are among the dairy breeds succeeding under these North Dakota conditions, while the Shorthorn and Red Polled dual-purpose breeds are popular.

The Souris River valley is especially desirable for cattle raising, because it furnishes an abundance of hay and pasture, as well as water and protection in the winter for the herds. The county has ample facilities for shipping the products of livestock farms. Cream-buying stations are located in most of the towns.

The Granville Cream Producers' Association was organized in June, 1921, and began operations on July 6. The total amount of business done in the first five months amounted to \$12,430.83. All profits from this business were returned to the patrons on the patronage basis. This organization marked a real beginning of the dairy industry

in McHenry County, and it is probable that other associations will be formed as the dairy business increases.

The Percheron seems to be the most popular breed of horses in the county, although Belgian, Shire, and Clydesdale horses are found equally satisfactory in similar regions in the State. Purebred sires are used, and most farmers take pride in breeding their horses to a high standard. According to the census, there were 11,859 horses and 78 mules in the county in January, 1920.

There are a number of flocks of sheep in the county. The common practice is to pasture them on soils too sandy for cultivation and then winter them elsewhere. In some parts of the county trouble has been experienced with the coyote, but this is a difficulty that can be controlled. In 1919, 12,280 pounds of wool were clipped.

Hogs are produced only on a small scale and are used principally for home use. In January, 1920, there were 6,302 hogs, and the number is increasing since corn is becoming a more important crop. Duroc-Jersey, Poland-China, and Chester White are the principal breeds.

Turkeys have proved very profitable in recent years, and their number is rapidly increasing. A large part of northern North Dakota has been infested with grasshoppers the last few years, and the turkey has been very useful in controlling the pest.

The table below, giving various statistics relating to farm lands and farm tenure, was compiled from the reports of the Bureau of the Census.

*Statistics relating to farms, 1890 to 1920.*

Census year.	Assessed value of farm land per acre.	Proportion of total area in farms.	Average size of farms.	Number of farms.	Proportion of farms operated by—		
					Owners.	Tenants.	Managers.
	<i>Dollars.</i>	<i>Per cent.</i>	<i>Acres.</i>		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
1890		14.2	262	324	99.7	0.3	0.0
1900	7.06	21.9	240	1,104	96.6	2.8	.6
1910	23.67	72.6	376.5	2,329	87.8	11.9	.3
1920	25.79	76.3	439.7	2,097	73.3	25.5	1.2

From the table it is seen that the average land values more than trebled from 1900 to 1910, but advanced only slightly from 1910 to 1920. The proportion of the total area in farms has steadily increased. The number of farms has decreased since 1910, while the average acreage per farm has increased. In general this change is due to a series of droughty years from 1917 to 1921, inclusive, causing a number of homesteaders to sell their land to neighboring farmers. The period 1900 to 1910 was one of great prosperity, and land values and farm buildings increased until about 1915. Of late years comparatively little building has been done. Land values vary from a few dollars to \$65 an acre and are about what they were in 1916. The land values given in this report for the various soil types are based on prices prevailing in 1921, the year in which the survey was completed.

SOILS.

McHenry County lies toward the western edge of a climatic zone which has been favorable to the development of a very important group of black soils. This belt of soils extends in a north and south

direction and includes more than half of North Dakota and the eastern third of South Dakota. The climatic conditions of the region have perpetuated the treeless plains and favored a heavy grass vegetation. The moisture supply is sufficient to permit the accumulation of large quantities of black organic matter in the surface soil, but is too low to leach the entire soil layer. Carbonates occur sparingly in the surface soil, but are found in great abundance in the subsoil.

The soil profile that prevails over the greater part of the well-drained upland of the county is fairly uniform in its characteristics and may be regarded as mature under the prevailing climatic conditions. The surface soil, which varies in depth from 7 to 18 inches, with an average depth of 12 inches, has a very dark grayish brown color and a loose friable structure. This is underlain by a granular, rather compact material, usually heavier in texture than the surface soil. The color becomes lighter with increasing depth, changing from a dark brown to a lighter brown. At an average depth of about 20 inches this is underlain by a loose, floury, highly calcareous material, which is prevailingly a light olive gray in color, but light yellowish gray in places. The group of soils characterized by this profile include the various members of the Barnes and the Pierce series, the latter being differentiated from the Barnes on account of its open gravelly subsoil.

The average soil profile described above covers the greater part of the upland area, and though a considerable range is found in the thickness of the several layers, the exceptional occurrences are not widely developed. The intermediate layer is variable in thickness and is entirely absent in places, and the almost black surface soil passes immediately into the light olive gray material.

Another group of black soils includes those that have developed under conditions of poor drainage, resulting in the formation of deep black surface soils underlain by gray or mottled highly calcareous subsoils. With this group may be placed the Fargo series of the lake and the river terraces, and the Maple and the Lamoure series of the poorly drained flood plains.

The Rogers series includes light-colored highly calcareous and alkali soils developed in undrained depressions and old lake beds.

The Gannett and the Cass series are characterized by black soils underlain by sandy or gravelly subsoils. The Gannett soils occur in poorly drained or depressed areas and associated with Dunesand and Valentine sand. The material within the 3-foot section is usually thoroughly leached. The Cass soils occur on stream bottoms and may be moderately or highly calcareous.

The soils of the Valentine series have been developed on accumulations of wind-blown sand that has ceased to move and has become covered with grass. The lime carbonate content is too low to cause effervescence with acid.

The characteristics mentioned above have been imparted to the soil by the great soil-forming processes, such as leaching, oxidation, and the accumulation of organic matter, and no account has been taken of the characteristics due to the composition and manner of accumulation of the material from which the soils have been developed. In the following pages the differentiation into series includes a consideration of the parent material.

The soils of McHenry County are derived from glacial drift, either weathered in the position in which it was left by the ice, or transported and redeposited in the beds of glacial lakes, in terraces along glacial streams, or, in later times, on the flood plains of existing streams. So little time has elapsed, geologically, since the last ice sheet withdrew and since glacial Lake Souris was drained, that the drift surface and lake bed have been only slightly affected by erosion and are still much as they were left at the close of the glacial period. The drift of this region was deposited by the Dakota lobe of the great continental ice sheet during the Wisconsin stage of ice invasion. The drift varies in thickness from several feet to possibly 200 feet or more. It varies widely in composition, being made up of silt, clay, sand, gravel, and bowlders, and is derived from such rock materials as granite, limestone, shale, sandstone, basalt, schist, and gneiss—the various granites being the most abundant.

The soils of McHenry County, with respect to the mode of accumulation of the material, may be classed into four main groups—glacial soils, glacial-lake soils, river-terrace soils, and river flood plain soils.

The glacial soils comprise the soils developed upon glacial drift which escaped modification by water after being deposited by the last ice invasion. These soils occupy the higher elevations and are situated in the southern and western parts of the county. They contain more or less fragmental rock material, mostly granite bowlders. In general, the topography is undulating to gently rolling. The southwest corner of the county is rolling, with sharp morainic hillocks; north of Round Lake the topography is usually characterized by large dome-shaped hills; in the region of Velva, adjoining the Souris River bottom, the topography is rolling to steep. The glacial or drift soils have a high content of lime. They include the soils of the Barnes and Pierce series.

The glacial-lake soils are those that occupy old lake beds or depressed areas with no outlet. The old Lake Souris bed, which at present has no distinct shore lines, is classed in this group. In general, it occupied the stone-free land in the northern half of the county. A line from Falsen to the northwest corner of the county and from Falsen to Karlsruhe and then to Smoky Lake, would, in a general way, indicate the western and southern boundary. The topography is level to gently undulating. In the glacial-lake group of soils are included the Fargo, Rogers, Valentine, Gannett, and Maple series. Also considerable areas of Dunesand and Peat and Muck are included.

The river-terrace soils are those that were formed largely during the various stages of overflow of rivers once emptying into glacial Lake Souris. They occupy high terraces adjoining the Souris River bottom and are extensively developed north and northeast of Karlsruhe. They constitute the Sioux series.

The river-flood plain soils are composed of alluvial sediments deposited largely after Lake Souris had receded. They include the Lamoure and Cass series.

The soils that are similar in origin, color, structure, and topography are classified in a soil series. Each series, therefore, consists of closely related soil types that differ from one another only in texture.

The surface soils of types of the Barnes series are very dark grayish brown to almost black in color. The upper subsoil is dark brown to brown and the lower subsoil is light olive gray or pale yellow and

highly calcareous. The surface soils rarely effervesce in hydrochloric acid, and the more sandy types may not show effervescence above 30 inches. The heavier loam types, however, usually show the presence of lime carbonate at 15 to 18 inches and locally on rolling to steep areas at 6 to 10 inches. In places lime concretions and streaks are noticeable, but as a rule the lime is uniformly distributed. The soils are derived from glacial till and occur in regions that have been subjected to very little erosion or leaching. They have a predominantly constructional topography and are well drained. The types of the Barnes series mapped in McHenry County are the Barnes silt loam, very fine sandy loam, fine sandy loam, sandy loam, and loam, the last named with a stone-free phase and a hilly phase.

The Pierce series includes types with dark-brown surface soils and a grayish-brown to yellowish-brown sandy or gravelly subsoil. The material of the subsoil is usually stratified or cross-bedded and the gravel is more or less rounded and waterworn. The series is usually developed on sharply rounded hills, lateral moraines, eskers, and kames. The topography insures free drainage. The Pierce sandy loam is mapped in McHenry County.

The types of the Sioux series have dark-brown to nearly black surface soils. The subsoil is lighter brown and generally grades into sand and gravel within the 3-foot depth. The types occupy river terraces and are well drained. The Sioux sandy loam, with two phases, and the loam are mapped in McHenry County.

The surface soils of the Valentine series are brown to rather dark brown; the subsoil is brown to light brown, often being slightly heavier than the surface soil. The lower subsoil commonly grades into yellowish-brown sand or fine sand. The soil material is of wind-laid origin, derived mainly from the deposits of the Tertiary Age. The Valentine soils are developed mainly in the old bed of Lake Souris. The lime content is very low. The topography is rather billowy to hummocky. The Valentine sand and fine sand are mapped in the county.

The Gannett soils are dark gray to almost black and contain much organic matter, the proportion in some places being almost enough to produce a muck. The subsoil is usually a grayish-brown to light-brown sandy loam or sand, which at lower depths passes into yellowish-brown sand or fine sand. The soils are developed in inclosed pockets or swales in the sand dunes or in the areas of Valentine soils, and represent wind-blown material mixed with fine wash from the hills and modified by the incorporation of organic matter. The areas are poorly drained and some are occupied by marshes or small lakes. Three types are mapped in this series, the sandy loam, fine sandy loam, and loam.

The types of the Maple series are characterized by dark-gray, brownish-gray to gray surface soils and a gray to light-gray subsoil. These soils occur along small streams, in old drainage ways or sloughs, and in elongated depressions. Four types are mapped in the county, the loam, fine sandy loam, very fine sandy loam, and silt loam.

The types of the Fargo series have dark-gray to almost black surface soils, rich in organic matter, and a dark-gray, olive-gray, or drab highly calcareous subsoil. The topography is level and characterized by small depressions, pot holes, and old lake beds which are

wet during a large part of the spring and early summer. Three types are mapped of this series, the silt loam, silty clay loam, and clay.

The types of the Rogers series occupy low-lying areas, such as sloughs and old lake beds, and contain more or less alkali. The soil is usually gray to light grayish brown, and the subsoil is brownish gray to olive gray and calcareous. Two types are mapped, the Rogers clay loam and Rogers silty clay.

The surface soils of the Lamoure series are typically dark brown to black. The subsoil varies from dark gray to olive gray or mottled brown and gray. The types are highly calcareous and are developed on overflow deposits from the sluggish Souris River and other streams. Drainage is usually poor in the clay members of the series. Five types are mapped, the Lamoure loam, fine sandy loam, silt loam, silty clay loam, and clay.

The Cass series, also derived from alluvium on the Souris River bottom and small streams, differs from the Lamoure series in that it is underlain by pure sand within the 30-inch depth. It is usually associated with Dunesand and the Valentine soils bordering the Souris River bottom. The soil is prevailingly calcareous but the subsoil in places is only slightly calcareous. The Cass sandy loam, silt loam, clay loam, and clay are mapped.

Dunesand is a light-brown to yellowish-brown, loose incoherent sand, occupying small steep hills, subject to movement by the wind. The greater part of the Dunesand was deposited in the waters of Lake Souris and has in more recent times been heaped into dunes by wind action.

The soil mapped as Peat and Muck consists of partly decomposed vegetable matter mixed with varying quantities of soil material and fragments of shells. It is usually kept wet the entire year by springs or seepage. It occupies for the most part rather sloping situations adjoining the Souris River bottom and is associated with soils of the Sioux series.

The following table gives the names and the actual and relative extent of the different soil types mapped in McHenry County:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Barnes loam .....	345,536	30.4	Maple silt loam .....	11,200	0.9
Hilly phase .....	14,528		Gannett fine sandy loam .....	10,624	.9
Stone-free phase .....	8,448		Sioux loam .....	10,112	.8
Sioux sandy loam .....	33,408	9.9	Pierce sandy loam .....	8,128	.7
Sandy-subsoil phase .....	73,216		Intermittent lakes <sup>1</sup> .....	8,000	.7
Compact phase .....	12,288		Fargo clay .....	7,424	.6
Barnes fine sandy loam .....	116,160	9.6	Gannett sandy loam .....	7,104	.6
Barnes very fine sandy loam .....	108,416	9.0	Lamoure loam .....	6,464	.5
Valentine sand .....	76,992	6.4	Lamouresilt loam .....	4,800	.4
Valentine finesand .....	67,072	5.6	Peat and Muck .....	4,608	.4
Barnes sandy loam .....	61,504	5.1	Lamoure fine sandy loam .....	3,776	.3
Lamoure clay .....	33,152	2.7	Cass clay loam .....	3,392	.3
Gannett loam .....	29,312	2.4	Maple fine sandy loam .....	3,264	.3
Maple loam .....	25,856	2.1	Cass clay .....	3,008	.3
Dunesand .....	22,016	1.9	Rogers silty clay .....	2,688	.2
Rogers clay loam .....	20,992	1.7	Cass sandy loam .....	2,432	.2
Barnes silt loam .....	19,456	1.6	Maple very fine sandy loam .....	2,176	.1
Fargo silty clay loam .....	14,720	1.2	Cass silt loam .....	1,024	.1
Lamoure silty clay loam .....	12,864	1.1			
Fargo silt loam .....	12,160	1.0	Total .....	1,208,320	.....

<sup>1</sup> These areas being dry at times and in part susceptible of reclamation are included with the land area of the county.

## BARNES SANDY LOAM.

The Barnes sandy loam is a dark-brown sandy loam passing at depths of 14 to 20 inches into brown to light-brown sandy loam, gradually merging into a lighter brown sandy loam until at 24 to 30 inches it passes into a brownish-yellow to greenish-yellow sandy clay to clay loam, continuing to 36 inches. The soil is usually not highly calcareous, but the lower subsoil in places shows a high content of lime. In the slightly lower or faintly depressed areas the type has the characteristic gray to olive-gray layer found in the Barnes fine sandy loam and very fine sandy loam types.

In the southern part of the county the type locally contains a few scattering stones and boulders and an occasional rather gravelly spot. The large area southeast of Deering has a few scattering stones and gravelly areas near areas of the Barnes loam, but is practically stone-free where it joins the Barnes fine sandy loam.

The type is developed principally northwest of Buffalo Lodge Lake, 4 to 12 miles northwest and southeast of Round Lake, east of Towner, and north, northwest, and south of Drake. Its topography is gently undulating to rolling. The strip northwest of Buffalo Lodge Lake is gently undulating to slightly rolling, and areas north of Round Lake take the form of large dome-shaped hills. The other areas near Drake and elsewhere are undulating to moderately rolling only.

The drainage is sufficient but not excessive. Practically all of the rainfall is immediately absorbed.

The principal crops are wheat, rye, oats, barley, corn, and potatoes. Wheat yields an average of about 12 bushels in good years, barley 18 bushels, oats 25 bushels, potatoes 100 bushels, and corn 30 bushels. In years of drought the average is reduced about one-half, except for corn and potatoes. Corn is being grown more extensively. During the long summer days of the growing season this soil, with its high sand content, absorbs more heat than the heavier types and therefore matures corn more rapidly. For this reason corn should occupy a greater acreage. In recent years of drought corn has yielded from 25 to 40 bushels per acre; these results, however, were obtained by good management, including at least four cultivations.

Probably the most undesirable feature of this type is its tendency to drift. In dry years there is danger of small grain crops being blown out. Manure or old straw piles are sometimes applied to prevent drifting. A rotation that avoids leaving the soil bare during the winter is often practiced. Rye is commonly drilled in the stubble on the more elevated land. This type is not generally so susceptible to drifting as the Barnes fine sandy loam.

The land of this type varies from \$15 to \$45 an acre, depending on improvements, distance from railroad, and susceptibility to drifting.

## BARNES FINE SANDY LOAM.

The surface soil of the Barnes fine sandy loam is a dark grayish brown to dark-brown fine sandy loam ranging from 8 to 20 inches in depth, with an average of about 14 inches. This changes gradually into dark-brown to brown fine sandy loam to fine sand, and this into light

brown, with slight olive cast, at 24 to 26 inches. Below this depth a slightly greenish brown to olive-gray, calcareous material extends to the 36-inch depth. In the slightly lower lying areas this type has a pale greenish gray color at 14 to 18 inches, passing into a slightly greenish light brown to greenish yellow at about 26 inches. The lower subsoil varies in texture from fine sandy loam to fine sand.

A variation occurs just south and east of Goose Lake in T. 157 N., R. 78 W., in parts of sections 14, 15, and 16. Here the dark brownish gray fine sandy loam passes at 12 to 14 inches into brownish-gray fine sandy loam, which gradually changes in color and texture until at 16 to 20 inches it is a very fine sandy loam of yellowish gray color, this passing at 18 to 27 inches into a light yellowish gray fine-textured silt loam. Another variation from the main type occurs in T. 158 N., R. 79 W., in section 19 and parts of sections south and southwest of section 19. Here the surface soil is a dark-gray fine sandy loam having a higher content of organic matter. The topography is very gently undulating to almost flat. The subsoil at about 20 inches is a light yellowish gray to pale greenish yellow fine sandy loam, considerably heavier than the average. This soil is affected only slightly by drifting and is better suited for general farming than the typical soil. Practically all the type is stone free, except an area in the southeastern part of the county, which contains a few scattered stones and some gravel.

The Barnes fine sandy loam is largely developed northwest of Buffalo Lodge Lake, extending to the northwest corner of the county into Bottineau County. Other areas lie southeast of Bantry, south of Smoky Lake, and elsewhere.

The topography, in general, is gently undulating to faintly billowed. A few areas south of Smoky Lake, an area northwest of Denbigh, and a few areas in the southeastern part of the county, are gently rolling to rolling. The area northwest of Denbigh in the region of White Rock Hill is rolling, and in places it is over 100 feet above the surrounding country. A few scattering bowlders and small gravel fragments are found on White Rock Hill.

Owing to the sandy nature and comparatively level surface of the type, all rainfall is rapidly absorbed. In general this type has a tendency to drift badly. Frequently wheat or rye are blown out in early spring, especially in fields in close proximity to the Valentine soils.

Although not as good a soil as the Barnes very fine sandy loam, the Barnes fine sandy loam is a desirable type. Probably 85 per cent of it is in cultivation. Crop yields in general are slightly lower than on the Barnes very fine sandy loam, yet in some seasons this type produces more than the heavier textured Barnes soils.

Russian thistle, wild oats, pigeon grass, tumbling mustard, and sunflower are the more troublesome weeds. They are kept in check most effectively by growing cultivated crops.

Land values on this type average between \$20 and \$30 an acre. The poorer areas, which lie in the zone of gradation to the Valentine fine sand, sell as low as \$14 an acre, while the very best improved areas, where drifting is not so marked, are held at \$45 an acre.

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

*Mechanical analyses of Barnes fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
351832	Soil, 0 to 18 inches.....	0.6	3.0	4.5	49.0	22.4	16.3	4.0
351833	Subsurface, 18 to 26 inches.	.4	2.6	3.7	49.6	24.8	15.0	3.8
351834	Subsoil, 26 to 40 inches....	.0	.9	1.7	57.0	22.8	13.0	4.6

BARNES VERY FINE SANDY LOAM.

The surface soil of the Barnes very fine sandy loam is a dark-brown to dark grayish brown very fine sandy loam, 12 to 16 inches deep. The upper subsoil is a slightly lighter brown very fine sandy loam, which gradually becomes lighter, until at 18 to 22 inches it is olive-brown to olive-yellow very fine sandy loam. The lower subsoil, from 26 or 30 inches to 36 inches or more is a faint olive yellow to pale-yellow very fine sandy loam. In a few places the dark-colored surface soil material may be as shallow as 8 inches and in others may reach a maximum of 24 inches.

In some places the surface soil closely approaches a silt loam in texture. This is noticeable 2 or 3 miles south of Bantry and 2 or 3 miles north of Upham. In slightly depressed areas the material has a pale olive gray color at 14 to 18 inches, this passing into olive yellow at 20 to 24 inches and faint olive yellow to pale yellow below 30 inches. This variation occurs where the surface is slightly billowy or where a depressed strip lies 2 or 3 feet below the adjacent soil.

The content of organic matter of the surface soil is high. Both soil and subsoil are free from boulders and contain very little gravel. In places tests show the soil to contain some lime, and the subsoil is highly calcareous.

The Barnes very fine sandy loam is the third most extensive type in the county. It is developed principally in the north-central part of the county, between Towner and Upham. The topography is gently undulating to nearly level. Drainage is largely effected by percolation through the porous subsoil or into depressed areas of the Fargo or Maple soils. The soil and subsoil are fairly retentive of moisture, and with proper tillage methods crops withstand drought exceedingly well.

The type is one of the most desirable soils in the county. It is very easy to cultivate and does not form clods. About 96 per cent of the type is in cultivation. While the surface soil is shifted more or less by wind in the plowed fields, no appreciable damage is done. Wheat, the principal crop, ordinarily yields about 13 bushels per acre, but yields as high as 40 bushels are reported. Oats ordinarily yield about 30 bushels, rye 15 bushels, barley 22 bushels, corn 20 to 35 bushels, and potatoes 60 to 150 bushels per acre. A very small proportion of the land is fertilized with barnyard manure. Comparatively little hay is grown, although brome grass, millet, and sweet clover do well. Alfalfa does well when not winterkilled.

The farms in general are well improved, with large barns, windmills, silos, sheds, granaries, and the characteristic cottonwood grove on two or three sides of the homestead.

The most common noxious weeds present on this type are wild oats, Russian thistle, pigeon grass, tumbling mustard, and wild rose. These can be largely eradicated by growing such crops as potatoes, corn, and millet.

Land of this type sells for \$25 to \$40 an acre. A few of the highly improved farms are held for as much as \$65 an acre.

#### BARNES LOAM.

The Barnes loam is a dark-brown loam with a high content of silt and organic matter, passing at 7 inches into a slightly lighter brown loam and at 8 to 15 inches into a brown, light-brown, or olive-brown silty clay loam to clay loam. This grades at 16 to 20 inches into an olive-brown to olive-yellow silty clay, silty clay loam, to clay loam, which continues to the 36-inch depth. In most places the surface soil is calcareous, and the subsoil is uniformly high in lime, which may appear in the form of concretions or in streaks of lime concentration. Small bowlders and gravel are more or less abundant on the surface and throughout the soil section, but not abundant enough to impair the agricultural value. The larger bowlders have practically all been picked up and placed in large piles in small depressions or on quarter-section or half-section lines. The bowlders average the size of a water pail and vary from 10 to 50 cords to the square mile, usually averaging about 30 cords.

On the gently sloping Missouri Plateau in the southwestern part of the county, which is traversed by a number of small drainage ways, the soil is somewhat heavier than elsewhere. It consists of dark-brown loam 6 to 8 inches deep, light-brown to slightly reddish or rusty-brown silty clay loam to clay loam to 12 or 14 inches, and light olive brown to olive-gray silty clay or silty clay loam to 36 inches. A slightly reddish or rusty-brown color is noticed at 6 to 10 inches in a few areas south of Drake and elsewhere, but this variation forms only a small proportion of the total area mapped as the Barnes loam. The Barnes loam here varies from the typical in that the surface soil is shallower and the olive-yellow subsoil lies nearer the surface. More gravel is mixed with the soil and subsoil, although not enough to impair its agricultural value. The ridge position, however, causes the crops to be more seriously affected by drought than on the surrounding areas of the typical soil.

Several small areas of sandy loam are included in the type, usually on slopes of sharp hillocks. Small gravelly spots which usually have less organic matter are also common in similar places.

The Barnes loam is the most extensive soil type in the county, occupying approximately one-third of the entire area. It occupies the southern and western parts of the county, lying south of a curved line extending in a southeasterly direction from 5 miles below the northwest corner of the county to 8½ miles north of the southeast corner of the county.

The topography is gently undulating to moderately rolling, the greater part being undulating. The more gently undulating areas occupy considerable stretches north and south of Velva and in the

northwestern part of the county. In the extreme southwestern part the topography is rolling to sharply rolling, with numerous depressed areas, most of which are intermittent drainage courses. North of Balfour the topography is rolling.

Drainage is sufficient but not excessive. The greater part of the run-off accumulates in the depressed areas of the Fargo soils.

Approximately 80 per cent of the type is in cultivation. The soil is easy to cultivate and does not bake or crack on drying. It is retentive of moisture, but an ordinary rain will not penetrate as deep as in the sandy types. In droughty years the lower subsoil often becomes very compact in places.

The crops common to the region are successfully grown, wheat predominating in acreage. (Pl. XXXII, fig. 1.) In average good years wheat yields about 13 bushels, oats 30 bushels, barley 20 bushels, winter rye 15 bushels, potatoes 100 bushels, and corn 35 bushels. A field of potatoes is shown in Plate XXXII, figure 2. Corn is grown mostly for forage and silage, but more is being husked than formerly. Alfalfa has been grown successfully where the seed bed was well prepared and hardy varieties were sown. Brome grass, western rye grass, timothy, and especially millet are grown with fair success, the yields averaging about 1 ton per acre. The more abundant weed pests are wild oats, Russian thistle, pigeon grass, wild rose, sunflower, and tumbling mustard.

In general, the farms on this type are well improved. Good water is obtained at 20 to 80 feet. None of the farms are over 10 miles from a railroad and by far the greater part of the type lies within 5 miles of a railroad.

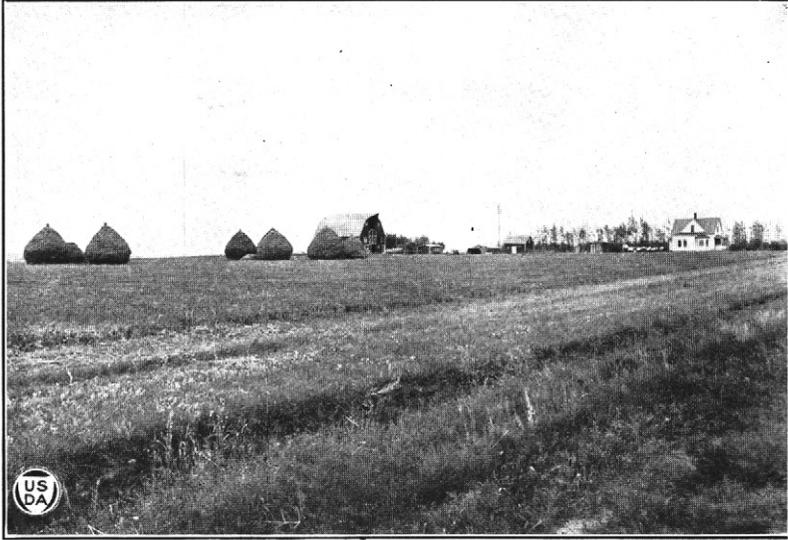
Land values vary from \$20 to \$60 an acre. Unimproved land lying at some distance from a railroad can be bought as low as \$20, while the most modern improved farms are valued at \$60 an acre. The average selling price is about \$35 an acre.

*Barnes loam, stone-free phase.*—The surface soil of the Barnes loam, stone-free phase, is a dark-brown to dark grayish brown loam, in places approaching a silt loam in texture. It passes at 6 to 9 inches into brown silty clay loam and at about 12 to 14 inches into light-brown to light olive brown silty clay to clay and at 20 to 24 inches into olive-gray to olive-yellow silty clay loam to silt loam which is highly calcareous. At 30 to 40 inches the color is olive yellow to pale yellow.

The heavy subsoil layer varies in depth and thickness. In places it begins at 6 inches while in other places it is encountered at 18 inches, but invariably the lower subsoil is free from compaction. In a few areas in the extreme southern part of the county near Cottonwood Lake no compact layer appears within the 3-foot profile.

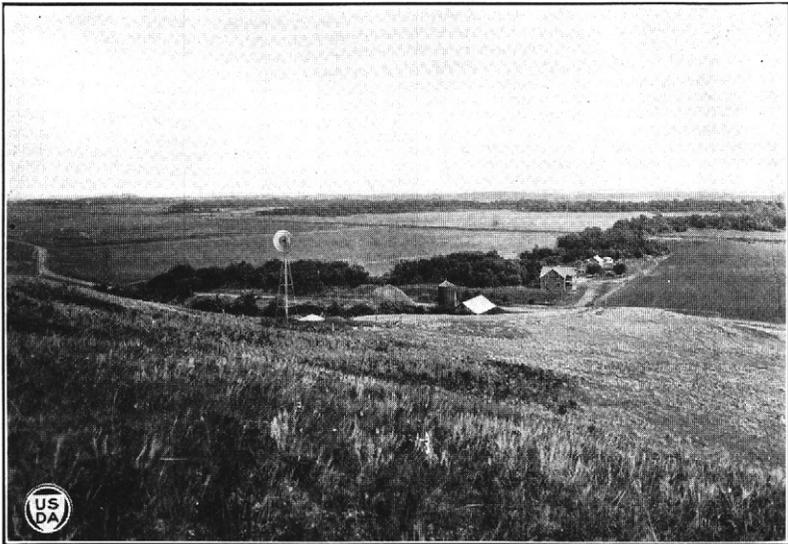
The topography is gently undulating to almost level. The larger areas are developed northwest of Upham along Cut Bank Creek and Deep River. Many small areas are associated with the Barnes very fine sandy loam and occupy faint depressions or old lake beds. These areas are slightly heavier in texture than adjoining soils and do not contain any coarse material, such as coarse sand or gravel. The subsoil is usually less compact and impervious than the larger areas near Cut Bank Creek and Deep River.

The phase as a whole is of high agricultural value and about 90 per cent of it is in cultivation. Corn, potatoes, wheat, rye, and oats



**FIG. 1.—WELL-IMPROVED FARMSTEAD ON THE BETTER TYPE OF LAND.**

Note the well-stacked grain, good barn and house, and smaller farm buildings. The soil is the Barnes loam.



**FIG. 2.—TYPE OF BUILDINGS ON WELL-IMPROVED STOCK FARM.**

Soil in the foreground is the Barnes loam, hilly phase. In the middle distance is the Souris River bottom, occupied by soils of the Lamoure series. The fringe of forest follows the course of a small intermittent stream emptying into the Souris River across the flats.

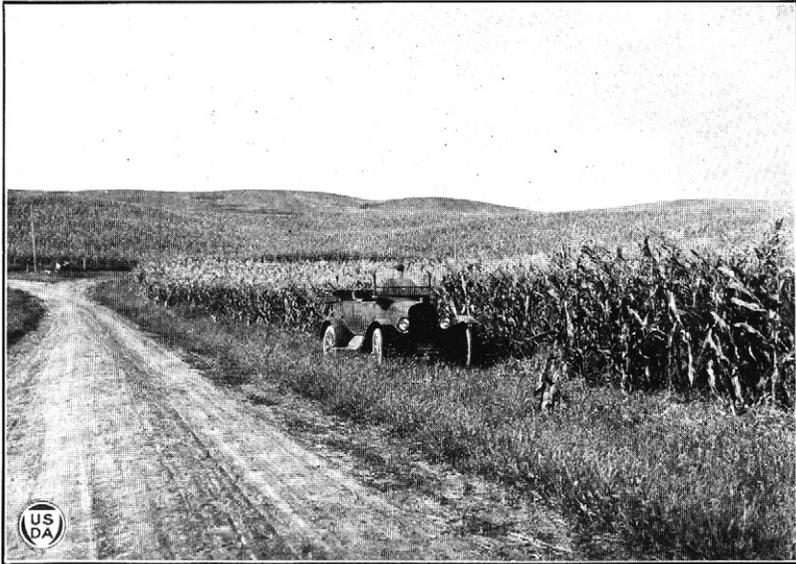


FIG. 1.—FIELD OF FODDER CORN, SHOWING VIGOROUS GROWTH.

The soil in the foreground is the Lamoure silty clay loam and in the background Barnes loam.



FIG. 2.—EIGHTY-ACRE FIELD OF SWEET CLOVER (*MELILOTUS ALBA*).

The standing bundles show that the crop makes good growth. The soil is the Barnes fine sandy loam. This crop was cut for seed, but a binder is commonly used in harvesting the crop for hay.



FIG. 1.—GROUP OF WHEAT STACKS ON BARNES LOAM.  
The variety is Marquis. The crop was harvested with a header.



FIG. 2.—FIELD OF EARLY OHIO POTATOES ON THE BARNES LOAM.

PHOTOS BY N. DAK. AGR. EXPT. STA.

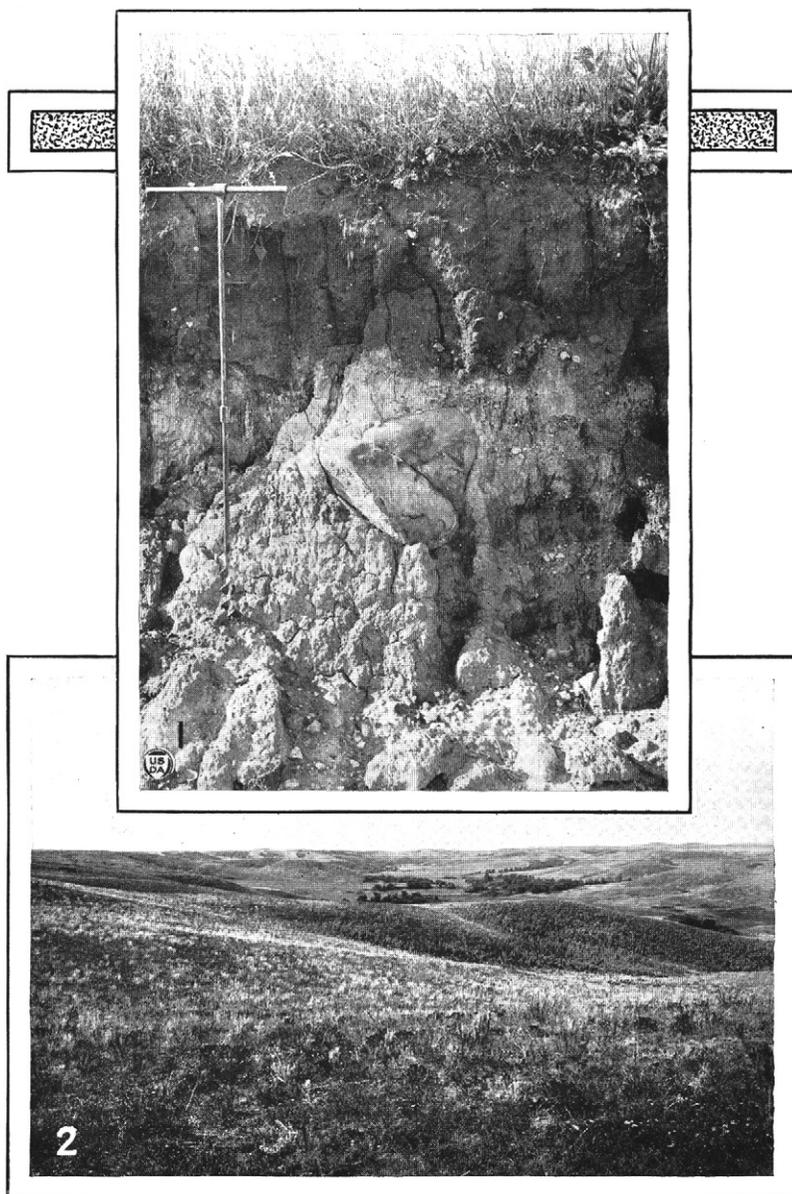


FIG. 1.—SOIL SECTION OF THE BARNES LOAM, HILLY PHASE.

Note light color of subsoil and substratum, caused by high lime content.

FIG. 2.—TOPOGRAPHY OF THE BARNES LOAM, HILLY PHASE.

Land as rough as this should be regarded as nonarable and should be used only for grazing.

are the principal crops grown. Yields compare very favorably with those of the Barnes very fine sandy loam and the typical Barnes loam. Land values range from \$25 to \$45 an acre.

*Barnes loam, hilly phase.*—The Barnes loam, hilly phase, has a surface soil of brown to grayish-brown loam passing at 6 to 12 inches into light-brown to olive-gray clay loam and sometimes sandy clay. The subsoil has a characteristic greenish-yellow cast, is highly calcareous, contains numerous lime concretions, and has scattering quantities of gravel with some glacial boulders from the surface to the substratum. (See Pl. XXXIII, fig. 1.) The surface boulders are more conspicuous; they have not been removed, as on the typical soil.

The surface is sharply rolling to steep and includes dome-shaped crests. Erosion has been comparatively inactive since the glacial period. (See Pl. XXXIII, fig. 2.) Near Velva, where the phase is typically developed, these slopes rise from 40 to 130 feet or more above the adjacent valley. A few steep hills are also mapped southeast and northeast of Granville and elsewhere.

Some of the lower slopes are in cultivation but these do not exceed 10 per cent of the total area. The phase is used principally for pasture and supports a luxuriant and highly succulent growth of native grasses. Blue grama grass is the most common and probably the most nutritious and fattening of the native grasses on the unbroken Barnes soils. Wild rye, cord grass, porcupine grass, slender wheat grass, barnyard grass, and pigeon grass are common, with numerous weeds and flowers, the more common of which are broomweed, golden aster, little sage, white sage, Canada anemone, purple cone flower, colomia, wild liquorice, lead plant, ground plum, goldenrod, and prairie thistle. Wolfberry or buckbush, elm, dogwood, green ash, and balsam poplar are found on some of the slopes. Land of this type sells at \$10 to \$20 an acre.

#### BARNES SILT LOAM.

The surface soil of the Barnes silt loam is a very dark grayish brown to almost black friable silt loam containing a high content of organic matter. It passes at 14 to 16 inches into a lighter brown, gradually getting lighter in color with depth until at 20 to 22 inches the color is brownish gray to olive yellow, and at 25 to 27 inches a pale yellow extending to 36 inches or deeper. The subsoil is usually a silt loam to silty clay loam in texture and invariably highly calcareous. Where this type is associated with the Barnes very fine sandy loam, the subsoil in places approaches a very fine sandy loam in texture. It is free of stones, and contains gravel only here and there in very small quantities. It is not susceptible to drifting.

This type is most extensively developed northwest and west of Upham and east and southeast of Towner.

The topography ranges from level to gently undulating. In places the soil material lies almost exactly as it was deposited at the close of the glacial period. The drainage is usually sufficient to take care of the rainfall.

This is one of the most desirable soil types in the county. About 90 per cent is in cultivation. Probably 70 to 80 per cent is devoted to small grains and about 10 per cent to tame hay and forage crops. In good years with proper tillage methods, yields of 20 bushels of

wheat, 40 bushels of oats, 25 bushels of barley, and 35 bushels of corn are obtained, but the average yields are lower. Corn is usually cut for forage or silage.

Most farms on this type are well improved. The buildings are substantial, well built, and well kept. Large barns, a silo or two, windmills, and windbreaks of cottonwood are common improvements. Good water is plentiful, the wells ordinarily ranging in depth from 20 to 60 feet.

Fairly improved farms on this type sell at about \$30 or \$35, and highly improved farms sell at \$50 to \$65 an acre.

#### PIERCE SANDY LOAM.

The Pierce sandy loam is a dark-brown to brown sandy loam usually passing at 4 to 8 inches into light-brown sandy loam to sand, which contains some small gravel, and this at 10 to 12 inches into light-brown sand and gravel, which continues to undetermined depths. On some of the higher crests or steep slopes the gravel and sandy material is exposed at the surface. Fairly large rounded stones are found here and there. The subsoil is usually gravelly, stratified, or cross-bedded, the gravel being more or less rounded and waterworn. The gravel usually has an incrustation of highly calcareous material on its lower surface when found in place. This subsoil material is used in road building. In a few areas of undulating topography the subsoil contains less gravel and more sand than typical.

The Pierce sandy loam represents soil material laid down by the melting glacier, usually in the shape of irregular crests or ridges or hills, or in the form of lateral moraines, kames, or eskers. The topography insures free drainage, which, combined with a porous and leachy subsoil, renders the soil droughty and uncertain for general farm crops. Some areas are sharply rolling while others are high but gently undulating. One of the larger areas southeast of Karlsruhe has an undulating surface and differs from the Sioux sandy loam only in that it occupies a considerably higher elevation and has more irregularities.

The type is used most commonly for pasture. Land of this sort can be bought at \$5 to \$10 an acre.

#### SIoux SANDY LOAM.

The Sioux sandy loam is a dark-brown sandy loam passing at 6 to 8 inches into slightly lighter brown sandy loam and gradually becoming lighter brown with increase in depth until at an average depth of 20 inches it consists of sand and gravel in varying proportions, the material extending without marked change to indefinite depths. In places the gravelly subsoil begins at depths of 30 or 35 inches.

This type is developed along the Souris River on terraces rising 20 to 70 feet above the first bottom. The topography is usually level or gently sloping. The type is very droughty owing to its porous and gravelly subsoil. The gravel beds in some places extend 80 feet or more below the surface and are invariably a source of springs or seepage at the edge of the first bottom. This sand and gravel is excellent road-building material, and has been used by the Great

Northern Railway in large quantities for ballast. At various depths in the subsoil the lower surfaces of the rounded gravel and stones have incrustations of lime and sand varying from one-sixteenth to one-eighth inch in thickness.

Probably about 40 per cent of the type is in cultivation. Corn, oats, rye, and wheat are the principal crops; the yields are inferior to those on the Barnes soils. Care must be taken to prevent drifting, and on newly broken land small-grain crops are in danger of being blown out. Many fields that were formerly cultivated have been allowed to revert to grass and weeds. The more common native plants are little sage, white sage, porcupine grass, purple cone flower, prairie thistle, and cactus. Wild barley, wild oats, wild rye, pigeon grass, Russian thistle, and wormwood are common on cultivated land. The type makes good pasture in spring, but in summer and fall it is seriously affected by dry weather.

The productive capacity of the soil varies with its power to hold water, the crop yields being higher where the soil and subsoil are heavier in texture, but always the porous nature of the type is responsible for drought at some time during the summer and the yields are thereby diminished. The soil is not quite so desirable as the Sioux loam.

Land values average between \$8 and \$12 an acre when unimproved. A few improved farms near towns are held at higher prices.

*Sioux sandy loam, sandy-subsoil phase.*—The soil of the sandy-subsoil phase is a dark-brown sandy loam containing a relatively high content of sand. At 7 or 8 inches it is lighter brown and at an average depth of 18 inches it is a light-brown sandy loam to sand, which usually becomes coarser with increase in depth. At 36 inches it is a light-brown to yellowish-brown rather coarse sand containing very little or no gravel. The subsoil is slightly calcareous, effervescing with acid only in spots in the lower subsoil. The entire profile is stone-free and very loose and incoherent in structure.

This soil is developed most extensively along Wintering River, northeast of Karlsruhe. The topography is almost flat to faintly billowy. The soil has a tendency to drift, and crops are sometimes blown out, but this danger occurs only in spring until wheat or rye attains a few inches in height. Surface water escapes rapidly through the porous subsoil.

The agricultural value of this land is rather low. Probably 75 per cent of this soil has been cultivated, but much of it has been allowed to revert to native grass and weeds. Brome grass, slender wheat grass, western rye grass, and millet are the best tame grasses.

A few of the lower lying areas have been used for the production of sweet clover. Rye does well in average years and is the leading crop. It is frequently drilled in on stubble land in the fall. Yields of rye average about 10 bushels per acre, when not burnt out by hot winds. Corn and potatoes do fairly well, except in extremely dry years.

The soil is naturally droughty owing to the loose, incoherent nature of soil and subsoil. The water table is higher than in many other soils and water is found in abundance usually at 8 to 12 feet and not lower than 20 or 25 feet.

This phase sells at \$8 to \$18 an acre, depending on improvements and the distance from railroads.

*Sioux sandy loam, compact phase.*—The compact phase differs from the Sioux sandy loam in that it has a more compact structure and has a higher content of silt, clay, and organic matter. When plowed it seldom is drifted by the wind, while the typical sandy loam is always susceptible to drifting. The surface soil is a dark-brown, compact, rather coarse sandy loam, 6 to 8 inches deep. The subsoil is a brown to rather light brown heavy sandy loam to loam, containing some small gravel, passing at 12 to 14 inches into a light-brown loam or sandy loam and at 16 to 20 inches into gravelly and sandy material which extends to 36 inches or more. The substratum consists of heavy beds of gravelly material.

The principal areas lie on high terraces adjoining the Souris River bottom between Velva and Towner. The topography is almost flat to gently sloping.

This phase has about the same agricultural value as the Sioux loam. About 65 per cent of it is in cultivation and produces fair yields considering its droughty nature. Oats, wheat, corn, and rye are the principal crops. The yields average less than on the adjoining Barnes soils, but are slightly higher than on the typical Sioux sandy loam. This land can be bought at \$15 to \$18 an acre.

#### SIoux LOAM.

The surface soil of the Sioux loam is a dark-brown loam, with a small proportion of rather coarse sand and gravel. The subsoil, beginning at about 6 to 8 inches, is a lighter brown heavy loam to light clay loam in which coarse sand and gravel become more abundant so that it can not be penetrated with a soil auger at depths ranging from 12 to 26 inches. The gravelly subsoil is composed of sand, gravel, and small rounded stones, mainly of various granites, basalt, schist, and gneiss, with a few of limestone. (Pl. XXXIV, fig. 1.) In the lower subsoil the gravel usually is incrustated with calcareous material. The gravelly subsoil is exposed on many small mounds.

The Sioux loam is developed in strips on gently sloping terraces bordering old drainage ways at elevations somewhat lower than the contiguous glacial types. These areas occur principally east and north of Deering, west and northwest of Granville, and southeast of Falsen. Some of these areas approach in character the Sioux sandy loam, compact phase, and the boundary lines between these soils are often arbitrary. This soil seldom drifts.

The gravelly nature of the subsoil makes this type droughty. On a few low-lying areas, however, where the water table is close to the surface, crops do not seem to suffer from drought any more than on adjoining finer textured types.

About 75 per cent of the type is in cultivation. The crops common to the region are grown, but the yields are usually lower than on the associated Barnes soils. Land values range from \$15 to \$25 an acre.

#### VALENTINE SAND.

The surface soil of the Valentine sand is a brown to grayish-brown sand considerably coarser than the Valentine fine sand and usually containing less organic matter. At 10 to 18 inches the soil passes

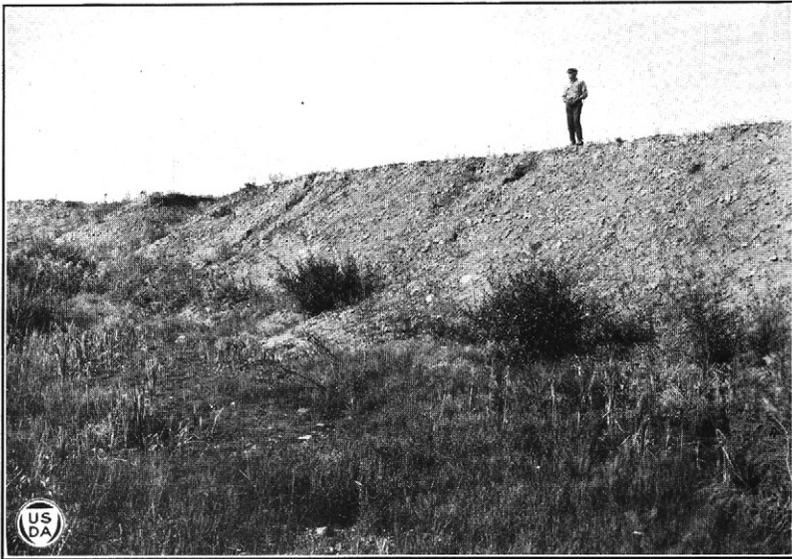


FIG. 1.—CHARACTERISTIC SUBSOIL MATERIAL OF THE SIOUX LOAM.  
This exposure is in a gravel pit between Falsen and Karlsruhe.

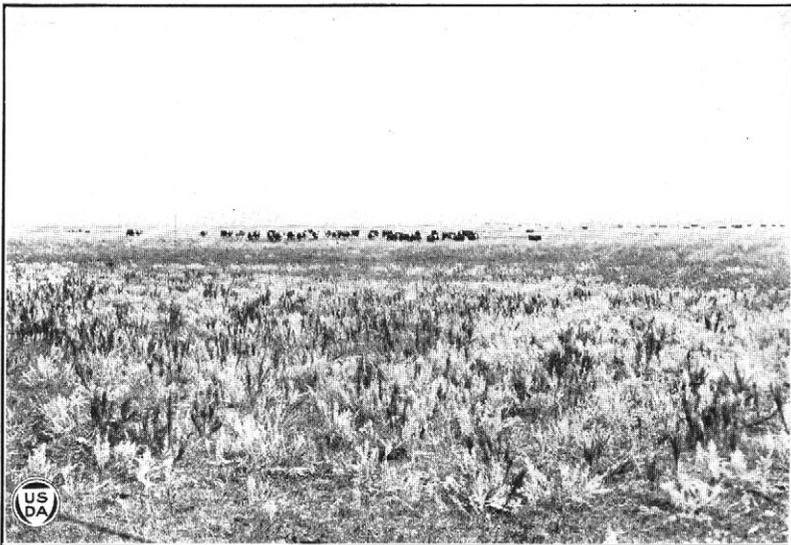


FIG. 2.—CATTLE GRAZING ON THE VALENTINE SAND.  
This type of soil drifts badly if cleared of its native vegetation, and should be kept in pasture.  
It affords good pasturage until late summer.



FIG. 1.—A SHEEP RANCH ON THE VALENTINE SAND.



FIG. 2.—FORAGE CROPS ON THE LAMOURE SILT LOAM.

Sudan grass in shocks in foreground, millet in field beyond, and potatoes in distance. This shows the practicability of diversification on this soil.

PHOTOS BY N. DAK. AGR. EXPT. STA.

into the subsoil, consisting of light-brown to yellowish-brown sand, which continues to indefinite depths. All of the type is stone free. Numerous variations due to wind action occur, although the type has less tendency to drift than the Valentine fine sand.

The larger areas of the type are situated from 6 to 10 miles north and 6 to 15 miles northwest of Towner, 1 to 6 miles south and southeast of Denbigh, and northwest and southeast of Lake George.

The topography ranges from sharply billowy to almost flat. The local variations range from 2 to 8 feet in height, but the general elevation is remarkably uniform. A few areas are mapped on higher elevations, as on Rose Bud Hill, 6 miles southwest of Bantry, and 6 miles slightly southwest of Denbigh. Drainage is effected by rapid percolation through the sandy subsoil.

Owing to its sandy nature and tendency to drift, the type is used for pasture. (Pl. XXXIV, fig. 2, and Pl. XXXV, fig. 1.) It is usually more droughty than the Valentine fine sand, but affords a good stand of the several native grasses, and practically the same shrubs, such as buckbush, dwarf willow, and rose. Pasturage is good until the dry weather of late summer appears. The water table is rather high, and good water can be obtained at depths ranging from 8 to 20 feet below the surface. Land of this type sells for \$3 to \$8 an acre.

#### VALENTINE FINE SAND.

The Valentine fine sand consists of a brown to grayish-brown fine sand or loamy fine sand, passing at about 15 or 20 inches into a light-brown to yellowish-brown fine sand, which continues to indefinite depths without change. The darker surface color is due to a relatively large content of organic matter. In places there is little difference in color from the surface to several feet below, while other borings show a color change nearer the surface. These variations are due to wind action. In a few instances the material at 30 to 40 inches shows some effervescence with hydrochloric acid. A few areas really consist of very fine sandy loam, but are too small to justify separation. Such areas are found in secs. 12 and 13, T. 158 N., R. 75 W., and in a few other places in association with the Barnes fine sandy loam.

The larger areas of the type are situated 5 to 12 miles north of Buffalo Lodge Lake, between that lake and Denbigh, and 5 to 12 miles south and southeast of Towner.

The Valentine fine sand has a characteristic billowy to sharply billowy topography with variations in relief of 2 to 8 feet. Part of the modification by wind has taken place since the sod was first broken, which has resulted in many abandoned fields that now support a growth of wild rye, sunflower, wormwood, horseweed, Russian thistle, wild oats, cord grass, porcupine grass, pigeon grass, and wild rose. The larger virgin areas, however, support a good stand of native grasses, with some weeds, small clumps of poplar, and dwarf willow.

This type affords fair grazing in spring and summer. Close grazing by sheep is not advisable, as this has a tendency to cause drifting. At present very little of the type is in cultivation. Rye and sweet clover are the crops best adapted to this soil. It is unwise to break the sod in areas in which the hummocky topography is strongly

developed, and in most places the extreme tendency of the soil to drift would indicate that the land should be left in its native state. Land of this type sells at about \$3 to \$10 an acre.

#### GANNETT SANDY LOAM.

The Gannett sandy loam is a dark-gray to brownish-gray sandy loam passing at about 12 to 16 inches into light-brown, grayish-brown, to yellowish-brown sandy loam, and at 15 to 18 inches into brown to olive-brown sand, which continues to depths of 36 inches or more.

This type is associated with the Valentine sand and occupies shallow depressions or swales, usually small in extent. The topography is faintly billowy to flat, but water rarely stands on the surface, as drainage through the porous subsoil is free.

Practically all of the type is in pasture. Its sandy texture and its occurrence in small areas make it inferior to the Gannett loam for producing hay, but it affords good grazing. Dwarf and other willows, and poplar, or aspen, grow in scattered patches. The native grasses are the same as on the Gannett loam. The type is valued at about \$7 to \$12 an acre.

#### GANNETT FINE SANDY LOAM.

The Gannett fine sandy loam is a dark-gray to dark brownish gray fine sandy loam passing at about 12 to 15 inches into a light grayish brown and at 15 to 18 inches into light-brown to yellowish-brown sand, which continues to the 36-inch depth. In places the lower subsoil is browner than typical and in others it has a light brownish gray color.

This soil is developed in depressions or swales, either with the Valentine soils, or immediately bordering areas of Gannett loam, but occupying slightly higher elevations. The surface is faintly billowy. The water table is high, and plenty of water is available for stock.

The type is used almost entirely for pasture or hay. The hay yields are less variable than on the loam type, the yields averaging one-fourth to 1 ton per acre. Rye, brome grass, western rye grass, and sweet clover can be grown to advantage. This soil, when dry, has a tendency to drift, and care must be taken to prevent drifting in cultivated fields. The land is valued at \$8 to \$15 an acre.

#### GANNETT LOAM.

The surface soil of the Gannett loam is a gray or dark-gray to slightly brownish gray loam 12 to 15 inches deep. The subsoil has a layer of light brown to yellowish-brown sandy loam, 3 to 5 inches thick, passing into a light-brown to yellowish-brown clear sand to fine sand which continues to depths well below 36 inches. The depth to the sand varies locally from 14 to 30 inches. In places the sand underlying the loam is mottled with rather large splotches of gray, yellowish gray, yellowish brown, or rusty brown.

In some of the smaller areas the soil grades from loam to sandy loam, and some of the larger areas include faintly billowy patches of sandy loam too small to be separated on the map. The lower areas in some places occupy small potholes, in which the soil grades from silty clay loam to clay. These are likewise too small to separate. A few

of the larger patches of low-lying heavy soils were included with the Fargo and Rogers soils. Irregular bumpy areas or "buffalo wallows" are numerous but are seldom over 20 or 30 yards in width.

The principal areas of this type lie west of Smoky Lake. Numerous small areas are associated with the Valentine sand and fine sand. Most of the Gannett loam is utilized for the production of wild hay, with some smaller areas in pasture. Hay yields from 1 to 2½ tons per acre. The native vegetation includes reed grass, false redtop, tall manna grass, slough sedge, bur reed, barnyard grass, northern drop-seed, camas, water parsnip, wild timothy, bluestem, and Canadian anemone. Small clumps of willows grow in the lower areas. The pastures on this soil supply excellent grazing throughout the growing season. The type is not used for cultivated crops because of inadequate drainage. Land of this kind can be bought at \$10 to \$30 an acre.

The following table shows the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Gannett loam:

*Mechanical analyses of Gannett loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
351879	Soil, 0 to 14 inches .....	2.0	4.6	9.2	39.8	6.0	23.2	15.2
351880	Subsurface, 14 to 18 inches .....	.2	4.3	10.0	47.7	10.6	14.3	12.8
351881	Subsoil, 18 to 40 inches.....	.3	2.8	8.6	66.6	14.0	4.6	3.0

MAPLE FINE SANDY LOAM.

The Maple fine sandy loam is a gray to dark-gray fine sandy loam passing at 12 to 15 inches into a light-gray to olive-gray clay loam or sandy clay which grades at 24 inches into a gray, olive-gray, or brownish-gray fine sand, usually containing large light-brown to rusty-brown mottlings. This description applies to the low-lying areas. In places the type is a gray to dark-gray fine sandy loam passing at depths varying from 10 to 20 inches into a rather dark layer which at one time was the surface and later covered with drifting sand. In some borings the gray to light-gray fine sandy loam continues to depths of 20 to 28 inches and then passes into light-brown to yellowish-brown fine sand with large light-brown, brown, and gray mottlings. The more sandy subsoil is common near areas of the Barnes fine sandy loam and the Valentine soils. The lower subsoil is usually more calcareous than in the Gannett soils associated with the Valentine types.

This type is developed in small flat to faintly billowy depressions or old lake beds. It supports native grasses like those on the very fine sandy loam and is used largely for hay and pasture. Some of the small narrow areas, where drainage is adequate, are in cultivation. Land of this type sells at \$10 to \$12 an acre.

MAPLE VERY FINE SANDY LOAM.

The Maple very fine sandy loam consists of a dark-gray very fine sandy loam passing at a depth of 10 to 15 inches into a light-gray very fine sandy loam to silty clay loam which grades into a light-gray

to olive-gray very fine sandy loam at depths varying from 24 to 30 inches. The lower subsoil is usually an olive-yellow very fine sandy loam to very fine sand, mottled locally with light gray to rusty brown.

This soil is developed in small glacial-lake beds or depressions and is associated with the Barnes very fine sandy loam. It occurs in the northeastern part of the county, mainly between Towner and Upham. It is poorly drained, and most of the surface water escapes through percolation into the sandy substratum.

It supports various native grasses, such as wild barley, hollow stem, slender wheat grass, reed grass, wild timothy, northern drop-seed, false redtop, and such weeds as long-rooted smartweed, gum weed, and Russian thistle.

Areas not too wet are used for hay, some are in pasture, and a few of the better-drained areas are in cultivation. In droughty years these low-lying areas, if sufficiently drained, produce larger yields than the surrounding Barnes very fine sandy loam. In wet years the Maple fine sandy loam and Maple very fine sandy loam can not be used for cultivated crops.

Land of this type is inextensive and is usually sold in connection with the Barnes very fine sandy loam. It tends to reduce somewhat the value of farms in which it is included. When sold separately it brings \$15 or \$20 an acre.

The table below gives the results of mechanical analyses of samples of the soil, subsurface, and 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.
		<i>Per cent.</i>						
351895	Soil, 0 to 16 inches.....	0.2	0.6	0.6	40.3	37.7	15.8	4.8
351896	Subsurface, 16 to 28 inches....	.0	.2	.2	39.7	39.3	10.4	10.3
351897	Subsoil, 28 to 40 inches....	.0	.0	.4	57.4	33.7	4.1	4.5

#### MAPLE LOAM.

The Maple loam is a gray to dark brownish gray loam passing at 12 to 16 inches into a light-gray loam to silt loam and at 18 to 26 inches into a rather heavy loam to silty clay loam. The subsoil below 30 inches usually is a dark-brown to light-brown sandy loam. Near areas of the Barnes sandy loam, the lower subsoil passes abruptly into brown to rusty-brown sand at 28 to 30 inches. The subsoil is calcareous and in places contains fragments of thin shells.

The type occupies 2.1 per cent of the area of the county. It is developed in glacial-lake beds, sloughs, and depressions, and along a very few sluggish creeks. The surface is almost level to slightly billowy. In places there are numerous bumpy irregular areas, or "buffalo wallows," which make the harvesting of hay difficult. The type is used almost entirely for hay and pasture. Hay yields vary from 1 to 2 tons per acre.

The wet and cold nature of the soil in early spring prevents the use of the larger areas for cultivated crops, but on the smaller areas

that are not too low, cultivated crops are grown successfully. The more common native grasses and weeds include wild barley, slender wheat grass, false redtop, tall manna grass, bur reed, river bulrush, hollow stem, water plantain, long-rooted smartweed, northern drop-seed, sedges, camas, and water parsnip. This land is worth around \$15 an acre.

The results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Maple loam are given in the following table:

*Mechanical analyses of Maple loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
3518101	Soil, 0 to 15 inches.....	0.0	8.5	13.6	36.4	6.4	23.4	11.7
3518102	Subsurface, 15 to 28 inches	.2	3.6	10.5	35.5	5.7	25.3	19.0
3518103	Subsoil, 28 to 40 inches.....	.6	8.1	16.5	55.0	5.0	9.4	5.5

MAPLE SILT LOAM.

The Maple silt loam consists of gray, brownish-gray, to dark-gray peaty material underlain at 1 to 4 inches by gray to slightly bluish gray or mouse-colored silt loam. In large areas this silt loam continues to 36 inches while in smaller areas it passes at 18 to 26 inches into lighter gray silt loam with a brownish tinge and containing numerous small thin shell fragments. Some borings show a very light gray to almost white strongly calcareous layer of silt loam to silty clay loam at about 18 to 24 inches. In othersituations, usually where associated with the Gannett soils, the material below 20 to 30 inches is light-brown to yellowish-brown sand. These areas were not extensive enough to map as Gannett silt loam and are included in the Maple silt loam.

The Maple silt loam is developed in old lake beds, depressions, and sloughs, and is associated with the Barnes type. The topography is nearly flat, but the surface is generally covered with "buffalo wallows."

Probably about 40 per cent of the type is too uneven to allow the use of mowing machines, although where the irregularities have been smoothed mowers can be used. Hay yields average about 1 to 2½ tons per acre. Smaller areas, used for pasture, usually remain moist enough to provide excellent grazing throughout the summer. The vegetation includes bur reed, water parsnip, northern drop-seed, spike rush, camas, hollow stem, evening primrose, false redtop, tall manna grass, reed grass, various sedges, mints, and many other plants. Many small clumps of willow grow along the edges of the depressions. Land values range from \$10 to \$18 an acre.

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

*Mechanical analyses of Maple silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
351877	Soil, 0 to 26 inches.....	2.2	3.4	3.4	6.6	4.6	51.3	28.6
351878	Subsoil, 26 to 40 inches.....	.8	4.6	4.8	8.4	4.0	33.0	44.0

## FARGO SILT LOAM.

The Fargo silt loam is covered with a layer, 1 to 2 inches thick, of loose organic matter. Below this the soil is a dark-gray to almost black silt loam passing at 6 to 8 inches into a silty clay loam to silty clay, which grades at 18 to 30 inches into a heavy, plastic, dark-gray to olive-gray clay. In places the lower subsoil remains a silty clay to silty clay loam to the 36-inch depth. In many very small areas the soil texture ranges from loam to heavy silt loam.

In the extreme southwestern part of the county many of the areas average a silt loam to a depth of 15 to 25 inches, passing below into dark-colored silty clay loam containing numerous small, thin shell fragments. These areas are often covered with water the greater part of the year, and are therefore of little agricultural value.

This type is developed in small, low-lying or depressed areas which are prevailing almost flat. Owing to the fact that water accumulates in many of these areas, probably 40 per cent are not used for hay or other crops. The long-rooted smartweed, lamb's quarter, and gum weed are the most common weeds on these areas, but some false aster, marsh yellow cress, and golden dock are found in the southwest corner of the county. Hollow stem, reed grass, water grass, slough sedge, and wild barley are the more important for hay. These areas are usually so small it would be difficult to determine a definite land value.

## FARGO SILTY CLAY LOAM.

The surface soil of the Fargo silty clay loam usually has a covering of 1 to 2½ inches of decayed organic matter or mucky material, passing into a dark-gray to almost black silty clay loam to silty clay which extends to 6 or 8 inches. The subsoil is heavy, plastic, dark-gray to almost black clay which becomes lighter gray at 15 or 20 inches and below 28 to 32 inches changes to an olive-gray to olive-drab clay containing lime concretions. This description applies to the smaller areas of the type, which in the aggregate form the great part of its area. In larger areas the surface soil is deeper and the gray color prevails to greater depths.

This soil is developed in practically all parts of the county in numerous sloughs, potholes, or small lake beds. It is usually too wet in spring to be cultivated or seeded to grain, except when the preceding summer has been dry and the winter of only moderate snowfall. Practically all of the type, however, is uncultivated. It is used, where possible, for the production of wild hay. The principal native grasses are wild barley, hollow stem, tall manna grass, water grass, witch grass, reed grass, slough sedge, and various other slough grasses.

Where too wet for grass the characteristic weed growth includes long-rooted smartweed, water plantain, lamb's quarter, and gum weed. Hay yields in the more favorable situations average around  $1\frac{1}{2}$  tons per acre. The value of this land is about \$15 to \$20 an acre.

#### FARGO CLAY.

The surface soil of the Fargo clay consists of one-half to 1 inch of organic matter or mucky material passing into a dark-gray to black heavy plastic clay, usually crumbly when dry. At 10 to 15 inches the subsoil passes from a dark to a slightly lighter gray and at 18 to 20 inches into a greenish gray, the color usually becoming lighter with depth. In places the soil is uniformly dark gray to about 28 inches and below that is gray or drab to the 36-inch depth.

The Fargo clay is inextensive. The more prominent areas are in the southwestern part of the county, about 7 miles south of Bergen. The type occupies low-lying sloughs and old lake beds. Practically all of it is very wet in spring and unfit for cultivation. It is used for hay and pasture.

The principal native grasses are salt grass, wild barley, hollow stem, tall manna grass, slough grass, water grass, hair grass, and bur reed. The most common weeds are the long-rooted smartweed, lamb's quarter, and gum weed. Some of the lower lying areas contain reeds and bulrushes.

Land of this type can be bought for \$10 to \$12 an acre. However, where it occurs in small areas associated with the Barnes loam and is used for hay alone its value would be about \$15 to \$20 an acre.

#### ROGERS CLAY LOAM.

The Rogers clay loam is a gray to light grayish brown clay loam, with a depth of 8 to 15 inches, passing into light-gray, brownish, yellowish, or greenish-gray clay loam to clay, which is very plastic and sticky when wet, and exceedingly hard and tough when dry. In places coarse sand to sandy clay is present below a depth of 26 inches. A few areas are very sandy, the soil consisting of light clay loam, and the subsoil of a succession of sandy layers of different textures. A few areas are mapped on the northeast and southwest slopes of intermittent lakes, where, in dry years, large quantities of alkali soil are blown from 50 to 100 yards up the slopes. Deposits of this kind range from 6 to 30 inches in depth. The type contains large quantities of alkali salts and includes barren spots which are white in dry weather.

The Rogers clay loam is typically developed in low swales or sloughs and old lake beds. It is covered with water in the spring or early summer, and even when it appears dry it is very treacherous to drive over with team or car.

Practically all the type is used for pasture and hay. It supports a growth of salt grass, wild barley, and gum weed, with reeds in the lower areas. Hay yields average about one-half ton per acre.

Owing to the high content of alkali salts and to poor drainage conditions, the agricultural value of this soil is low. It can be purchased for \$2 to \$10 an acre.

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

*Mechanical analyses of Rogers clay loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
351801	Soil, 0 to 15 inches .....	0.8	3.3	0.9	26.8	25.2	22.0	21.0
351802	Subsoil, 15 to 40 inches ....	.2	.9	1.3	13.6	15.9	33.3	34.9

ROGERS SILTY CLAY.

The Rogers silty clay is a dark-gray, brownish-gray, to slightly greenish gray silty clay loam to silty clay, passing at 7 to 12 inches into a greenish-gray or light olive drab, plastic, stiff, impervious clay. The lower subsoil varies from greenish gray to greenish yellow and has a moderate content of lime carbonate.

The Rogers silty clay occupies slightly higher elevations than the Rogers clay loam. The larger areas are mapped close to the Wintering River bottoms. They occupy terracelike situations, usually 2 to 4 feet above the lower lying soils, but are subject to overflow in the spring of wet years. Alkali spots are not nearly so noticeable as on the Rogers clay loam.

This type is used for hay and pasture, and practically all of it can be used for hay if not pastured. The principal grasses are wild barley, salt grass, and slender wheat grass. Hay yields usually range from one-half to 1 ton per acre. Land of this type is valued at \$8 to \$12 an acre.

LAMOURE FINE SANDY LOAM.

The Lamoure fine sandy loam is a dark-gray to dark grayish brown fine sandy loam, passing at 15 to 22 inches into dark-gray silty clay loam, which passes at 24 to 30 inches into a lighter gray to olive-gray silty clay loam. The texture is lighter where the olive-gray color prevails. The subsoil, however, is variable in texture and color owing to the numerous water channels and old stages of overflow. The surface soil is rich in organic matter, and the subsoil is noticeably calcareous.

The surface is nearly level, except where stream channels and abandoned channels break it. The drainage is fairly good. The type lies from 5 to 10 feet above the streams, and overflows are exceptional.

The larger areas lie along Willow Creek in the northeastern part of the county. The areas mapped along the small drains in the southwestern part are narrow and include small patches of loam and clay loam.

This soil is very productive, but since the relatively small areas make the cultivation of large fields impossible, the type is used largely for pasture and hay land. Where farmed, as in the northeastern part of the county, corn, wheat, and oats are the principal crops, and the land is valued at \$18 to \$25 an acre. In the southwestern part of the county the land is held at \$15 to \$18 an acre.

## LAMOURE LOAM.

The surface soil of the Lamoure loam consists of 6 to 10 inches of dark-gray to dark grayish brown loam, containing varying proportions of sand. The subsoil is dark-gray silty clay loam passing at depths of 16 to 20 inches into a lighter gray silty clay loam to clay, which continues to the 36-inch depth. The lower subsoil has a gray to light-gray color, similar to that of the Maple loam. Many small areas of Lamoure clay loam and Lamoure fine sandy loam are included with the loam, the areas being too small to separate on a map of the scale used in the present survey.

The larger areas of the type lie along Wintering River northeast of Karlsruhe. Small strips occur along Egg Creek, Spring Creek, and some of the small creeks south of Voltaire in the western and south-western part of the county.

This type is cut by numerous windings of the creeks, and the topography is naturally uneven. The soil is usually too wet in spring to allow cultivation, and practically all of it is used as hay or pasture land. It has no forest growth, but thick patches of rose and buckbush are common.

The type is valued at about \$12 to \$15 an acre. A few of the larger areas with good improvements are valued at \$20 to \$25 an acre.

## LAMOURE SILT LOAM.

The surface soil of the Lamoure silt loam is a dark-gray to dark grayish brown silt loam usually containing considerable fine and very fine sand. It is underlain at 10 to 16 inches by grayish-brown to olive-gray heavy silt loam to silty clay loam passing at about 22 to 26 inches into heavy silty clay loam to clay, locally splotched or streaked with light gray. The subsoil below 30 inches and the substratum to 40 inches is olive-gray in color, highly calcareous, and in places lighter in texture than the upper subsoil. Uncultivated areas usually have about an inch of dark-brown peaty material on the surface.

The type is fairly level. The areas are traversed by many abandoned channels, some of which contain water the entire year. It is rarely overflowed, and the drainage is for the most part good. The principal areas of this type are in the Souris River bottoms, extending from the west county line through Velva to about 3 miles north of Falsen.

From 50 to 60 per cent of the type is in cultivation. The uncultivated parts ordinarily are covered with a scattering growth of trees and shrubs. The trees include elm, dogwood, red haw, boxelder, ash, bur oak, wild plum, and willow. Some areas include patches covered with a thick growth of rosebushes and buckbush. On some areas the native grasses are cut for hay; others are used for pasture.

Corn, wheat, oats, barley, and potatoes are the principal crops. Certain hay crops also succeed. (Pl. XXXV, fig. 2.) The yields average about the same as on near-by areas of Barnes loam, but are higher in droughty years. Vegetables do exceedingly well.

Land of this type generally is valued at \$20 to \$30 an acre, and when well improved it is held at \$35 to \$45 or more.

## LAMOURE SILTY CLAY LOAM.

The surface soil of the Lamoure silty clay loam is a dark brownish gray to almost black silty clay loam, 10 to 15 inches deep. The subsoil is a dark-gray silty clay to silty clay loam changing to an olive-gray color at about 20 inches. At a depth of 26 inches there is a 6-inch layer that has a distinctly olive-gray to light olive gray color and a relatively high content of very fine sand. In places this olive-gray layer appears near the surface.

This type occurs principally along the Souris River between Towner and Velva. Some fair-sized areas lie on small creeks northwest of Granville, Cut Bank Creek west of Upham, and Willow Creek in the northeastern part of the county. The topography is more uneven than that of the Lamoure clay. Abandoned river channels are numerous and many of them hold water the entire year. In the Souris River bottom the type occupies higher lands or natural levees near the river or some of the more recently vacated channels. The level gradually decreases as the Lamoure clay is approached.

Corn and other crops adapted to the region do well on this type along the Souris River. Wheat yields 10 to 12 bushels in dry years and 20 to 45 bushels in favorable years. It is sometimes damaged by rust, owing to its rank growth. About 60 per cent of the type is in cultivation along the Souris River, but areas along the small creeks northwest of Granville and elsewhere are used chiefly for the production of hay and for pasture. Trees, such as bur oak, elm, ash, dogwood, boxelder, wild plum, willow, and red haw, are common in scattering patches along the Souris River.

Land values on this type along the Souris River range from \$25 to \$35 an acre, and areas along the small streams from \$20 to \$25 an acre.

## LAMOURE CLAY.

The Lamoure clay is a dark-brown, dark-gray, to almost black, heavy, plastic clay, passing at 6 to 10 inches into a slightly lighter gray which is usually streaked or mottled with grayish calcareous material. Generally at 10 to 15 inches the dark-gray clay becomes tougher and more plastic. The subsoil effervesces freely with hydrochloric acid. A dark-brown to black peaty or mucky layer, one-half inch to 3 inches thick, commonly covers the surface. The surface is flat and the water table is high, and consequently the greater part of the type does not dry out sufficiently to allow its use for cultivated crops. At present about 3 per cent is in cultivation and the rest is used almost exclusively for hay production. Yields in droughty years average about 1 ton per acre, and in more favorable years 2 tons or more, and yields of as much as 4 tons have been reported. Native grasses, such as hollow stem, slough sedge, feather grass, hair grass, tall manna grass, false reedtop, reed grass, little bluestem, wild timothy, wild barley and witch grass, constitute the bulk of the hay. Isolated patches of rosebushes occur along the Souris River. In some of the areas, which may contain 10 to 15 acres, the bushes are very thick and 4 to 6 feet high. Buckbush or wolfberry is also common along the river. Scattering patches of forest, principally of bur oak, wild plum, elm, dogwood, red haw, boxelder, and ash grow around many of the river bends.

The type consists of deposits laid down by the waters of the sluggish Souris River upon low flood plains. It is most extensively developed east of Upham in the northern part of the county, where the areas attain a width of 2 to 3 miles. In comparatively narrow bottoms the type normally occupies that part more distant from the river and receives the run-off from the upland. The escape of this water is in many places prevented by the slight natural levee at the river bank, and haying is often delayed by the wet condition of the land. Overflow of the whole bottom is very rare.

Land of this type usually sells at \$15 to \$20 an acre, and the more desirable locations, with improvements, are held for \$25 an acre.

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

*Mechanical analyses of Lamoure clay.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
351822	Soil, 0 to 20 inches.....	1.4	11.6	4.3	6.2	1.6	42.8	32.2
351823	Subsoil, 20 to 40 inches.....	1.6	19.6	8.9	11.8	1.7	32.1	24.2

CASS SANDY LOAM.

The Cass sandy loam is a brown to dark-brown rather coarse sandy loam which passes at 8 to 12 inches into a light-brown sandy loam and this into a light-brown to yellowish-brown sand at depths of 14 to 18 inches. In a few areas lying near areas of Dunesand pure sand is encountered at depths of 7 to 10 inches and continues to indefinite depths.

The topography is faintly billowy. In some of the lower lying areas the soil is a silt loam. Practically all the type is used as hay or pasture land. Small clumps of willows grow in the lower areas. Rosebushes and buckbush are common. Land of this type sells for about \$10 to \$15 an acre.

CASS SILT LOAM.

The surface soil of the Cass silt loam is a dark-brown or dark grayish brown silt loam containing a large proportion of organic matter and in places approaching the character of muck in an advanced stage of development. At 15 to 18 inches this highly organic soil passes into a dark-gray sandy loam which becomes lighter brown with depth, and grades at about 24 to 30 inches into a light-brown to yellowish-brown sand.

The surface is rather uneven and faintly hummocky or billowy, and in some small areas it is so bumpy with "buffalo wallows" that hay can not be cut. The soil is wet or moist throughout the year and supports an excellent stand of grasses of about the same species as those on the Lamoure clay. Small clumps of willows are common. The type is used as hay and pasture land. The larger areas are in the vicinity of the big marsh on the Souris River bottom about 8 miles north of Towner. Land of this type is valued at \$15 to \$20 an acre.

## CASS CLAY LOAM.

The Cass clay loam is a dark-gray, dark-brown, or almost black clay loam passing at 7 to 10 inches into a gray to dark-gray silty clay to clay loam, which grades into a sandy clay at 12 or 14 inches. Below depths ranging from 15 to 20 inches the subsoil is a fairly coarse, clean sand, of a pale yellowish brown to light-brown color. The clay loam texture is modified by considerable quantities of sand blown from near-by cultivated fields of the Sioux or Barnes soils.

The Cass clay loam is mapped along the Souris River, near the upland soils, between Towner and east of Upham. This type, which is used principally for the production of hay, sells for \$15 to \$18 an acre.

## CASS CLAY.

The surface soil of the Cass clay is a dark-brown to dark-gray or almost black clay, in most places covered with 1 or 2 inches of mucky material. The subsoil, beginning at 8 to 14 inches, is a dark-brown sandy clay, passing at 16 to 20 inches into brown to light-brown or yellowish-brown, clean, rather coarse sand, which continues to undetermined depths. The water table is usually 6 to 14 feet below the surface.

This soil type represents alluvial material deposited by flood waters of the Souris River over areas of sand. The Cass clay is fairly level, but in some areas it is faintly billowy. The upper limit of the sandy loam subsoil is variable lying at 16 inches in some borings while not 20 yards distant it may not appear above 25 inches.

This type is developed east of Upham and north of Towner. The greater part of it is used as hay or pasture land. The native grasses characteristic of the Lamoure clay produce similar yields of hay on this type. This land sells for \$15 to \$20 an acre.

## DUNESAND.

Dunesand is a loose, incoherent, brown to yellowish-brown sand to fine sand at the surface and continuing to varying depths. It occurs in sharply rolling to billowy hills ranging from 10 to 90 feet in height. The depressions intervening are usually moist and support a growth of various native grasses, while the hills usually support a very scanty growth of grass and weeds. Elm, chokecherry, aspen or poplar, and willow constitute the principal tree growth, which is confined to small isolated patches. Moisture seems to be abundant in the soil of lower areas, in which places oak trees attain a diameter of 20 inches or more. Wild rose, buckbush or wolfberry, wild olive or silverberry, June berry, and dwarf willow constitute the principal shrubs.

The principal areas are located from 6 to 16 miles north, northwest, and south of Towner, and south of Denbigh.

As this land is unfit for cultivation and affords very little grazing, its value is very low.

## PEAT AND MUCK.

Peat and Muck in this county consists of brown to very dark brown, partly decomposed vegetable matter mixed with varying

quantities of soil material and fragments of shells. It is kept wet and soggy by springs or seepage from the thick substratum of gravel, rock, and sand of the Sioux soils.

In places at depths below 20 inches a brown, light-brown, or yellowish-brown sand is present, the variation occurring near areas of Valentine sand, Dunesand, or the Sioux soils. Along contacts with the Sioux soils gravel may be present at 15 to 30 inches below the surface in a belt 20 or 30 yards wide. The larger areas are deep and show little change within 3 feet of the surface.

Where seepage is moderate, hay is a sure crop and yields of 2 tons or more per acre are frequently obtained. Where springs keep the areas very wet, the Peat and Muck has a bumpy, gently sloping topography and is used solely for pasture. Cattle do exceedingly well, as the grass remains tender and plentiful through the summer. The more common native plants are water sedge, water plantain, wild timothy, false reedtop, tall manna grass, various reeds, water parsnip, camas, and willow.

The Peat and Muck areas border the Souris River bottom, the larger ones being situated from 10 to 12 miles southwest of Towner, 8 miles north of Towner, and south of Denbigh. Land of this character is valued at about \$12 to \$18 an acre, the higher price being for areas from which it is practicable to harvest hay.

#### SUMMARY.

McHenry County is situated in the north-central part of North Dakota. It has an area of 1,888 square miles, or 1,208,320 acres.

It includes two topographic divisions—the drift plain which embraces part of the bed of Lake Souris, and the Missouri Plateau on the edge of which is found the Altamont moraine. That part of the drift plain which was temporarily covered by Lake Souris has a gently undulating topography, the remainder of the drift plain being undulating to hilly. The Missouri Plateau is gently undulating except where it carries the more rolling Altamont moraine.

The county is drained by the Souris River and its tributaries. A considerable part of the run-off drains into potholes, depressions, and lakes.

Prior to the settlement by whites, the Souris River was a highway of trade and travel among Indians. Settlement began about 1881. It proceeded rapidly after the Great Northern Railway was built in 1886 and the Minneapolis, St. Paul & Sault Ste. Marie Railway in 1891. The population in 1920 was 15,544 and is classed as rural. The largest town is Velva with a population of 836. Towner is the county seat with a population of 610. There are about 20 fair-sized towns in the county and a total of 27 shipping points. Transportation facilities are good. There are 178 miles of railroad in the county and 72 grain elevators. St. Paul and Minneapolis are the principal markets. The county has 119 active schools, including 10 accredited high schools.

The climate is subhumid. The mean annual precipitation is 16.03 inches, of which about 75 per cent falls during the growing season. The mean annual temperature is 37.3° F. and the extreme range is from -49° F. to 104° F. In summer the days are long, with cool nights. The winters are long and cold, but the cold is far less penetrating than in humid regions.

The agriculture consists largely in the production of small grains, principally wheat. In recent years, corn, potatoes, poultry, and dairy products have become more important. Land values range from \$2 to \$65 an acre.

The soils of the county are developed on glacial drift, glacial-lake deposits, river terraces, and flood plains. In all, 10 series, embracing 31 types and 4 type phases, exclusive of Peat and Muck and Dunesand, are mapped.

The Barnes series is the most extensive in the county. It includes 5 types and 2 phases. The soils are derived from glacial drift, are highly calcareous, and are stone-free except the Barnes loam. They are adapted to general farming, with about 95 per cent in cultivation. Wheat, rye, oats, barley, corn, and potatoes are the principal crops grown.

The Barnes very fine sandy loam is the third most extensive type in the county. Various small grains are grown most extensively. It seldom drifts. The Barnes fine sandy loam is subject to more or less drifting. It is practically all stone free. Grain farming is practiced. The Barnes sandy loam is a quick-growing soil, but is inclined to drift more or less.

The Barnes loam embraces approximately one-third of the area of the county. General farming is practiced, the small grains being most commonly grown. The stone-free phase is inextensive. It produces about the same yields as the loam and silt loam. The hilly phase is rolling to steep and is used mainly for pasture.

The Barnes silt loam is one of the most desirable soil types in the county and is practically all in cultivation. Small grains are grown and produce high yields.

The Pierce sandy loam is derived from glacial drift and has a rolling topography. It is a droughty soil and of low agricultural value.

The Sioux soils occupy high terraces along the Souris River or small streams and have a subsoil of sand or gravel. The Sioux loam is the most productive. The Sioux sandy loam and the sandy-subsoil phase are susceptible to drifting. The compact phase seldom drifts. These types are droughty and of low agricultural value.

The soils of the Valentine series are wind formed and easily drifted. They have a billowy to hummocky topography. The water table is high. The types mapped, the sand and the fine sand, have a low value and are used principally for grazing.

Three members of the Gannett series are mapped, the Gannett loam, fine sandy loam, and sandy loam. They occupy poorly drained areas and are associated with the Valentine soils. They are used almost entirely for hay or pasture because they drift badly when plowed. The Gannett loam is the more desirable type.

The Maple soils are mapped in sluggish stream channels, old drainage ways, and elongated depressions.

The types of the Fargo series occupy potholes, depressed areas, and old lake beds. They are wet in early spring and used almost entirely for hay and pasture. The Fargo silt loam, silty clay loam, and clay are mapped.

The Rogers clay loam and Rogers silty clay are light-colored soils more or less affected with alkali. They are used as hay and pasture land but their value is low. They are developed in old lake beds and sloughs.

The Lamoure and Cass types are first-bottom soils, but are rarely overflowed. They are dark-colored and calcareous. The types of the Cass series are differentiated from the Lamoure on the basis of their sandy subsoil.

The Lamoure clay occupies a large proportion of the Souris River bottoms, and nearly all of it is used for hay production. The Lamoure silty clay loam and silt loam are desirable soils for cultivated crops. The Lamoure loam is a more valuable type occurring along small drainage ways. It is used as hay and pasture land.

The Cass clay, clay loam, sandy loam, and silt loam are inextensive types and are used almost entirely for the production of hay. Small areas are in pasture.

Dunesand is composed of loose, incoherent sand, subject to drifting by the wind. It affords very little grazing and is almost valueless for agriculture.

Peat and Muck is a low-lying wet soil adjoining the Souris River bottom. The areas are kept wet by springs or seepage from gravel beds. They support a luxuriant growth of succulent grasses and are used principally for pasture.

#### APPENDIX—PLANT NAMES.

Many of the plants mentioned in this report have been identified by Prof. H. L. Walster, of the North Dakota Agricultural Experiment Station. The common names of the plants thus identified, with the corresponding botanical names, are as follows:

Balsam poplar ( <i>Populus balsamifera</i> ).	Long-rooted smartweed ( <i>Polygonum emersum</i> ).
Barnyard grass ( <i>Echinochloa crusgalli</i> ).	Northern drop-seed grass ( <i>Sporobolus heterolepis</i> ).
Blue grama grass ( <i>Bouteloua gracilis</i> ).	Pigeon grass ( <i>Chaetochloa lutescans</i> and <i>Chaetochloa viridis</i> ).
Bluestem ( <i>Andropogon scoparius</i> ).	Poplar ( <i>Populus tremuloides</i> ).
Broomweed ( <i>Gutierrezia sarathroë</i> ).	Porcupine grass ( <i>Stipa spartea</i> ).
Buckbush or wolfberry ( <i>Symphoricarpos occidentalis</i> ).	Prairie thistle ( <i>Carduus undulatus</i> ).
Bur oak ( <i>Quercus macrocarpa</i> ).	Purple cone flower ( <i>Breweria angustifolia</i> ).
Bur reed ( <i>Sparganium eurycarpum</i> ).	Red haw ( <i>Crataegus chrysoarpa</i> ).
Cactus ( <i>Opuntia</i> spp.).	Reed grass ( <i>Calamagrostis inxpansa</i> and <i>Calamagrostis montanensis</i> ).
Camas ( <i>Zygadenus chloranthus</i> ).	River bulrush ( <i>Scirpus fluviatilis</i> ).
Canada anemone ( <i>Anemone canadensis</i> ).	Russian thistle ( <i>Salsola tragus</i> ).
Chokecherry ( <i>Prunus virginiana</i> ).	Salt grass ( <i>Distichlis spicata</i> ).
Collomia ( <i>Collomia linearis</i> ).	Silverberry ( <i>Eleagnus argentea</i> ).
Cord grass ( <i>Spartina michauxiana</i> ).	Slender wheat grass ( <i>Agropyron tenerum</i> ).
Dogwood ( <i>Cornus stolonifera</i> ).	Slough sedge ( <i>Carex trichocarpa</i> ).
Dwarf willow ( <i>Salix</i> spp.).	Gum weed ( <i>Grindelia squarrosa</i> ).
Elm ( <i>Ulmus americana</i> ).	Spike rush ( <i>Eleocharis palustris</i> ).
Evening primrose ( <i>Oenothera biennis</i> ).	Sunflower ( <i>Helianthus maximiliani</i> ).
False aster ( <i>Bottonia asteroides</i> ).	Tall manna grass ( <i>Panicularia grandis</i> ).
False redtop ( <i>Poa palustris</i> ).	Tumbling mustard ( <i>Sisymbrium altissimum</i> ).
Feather grass ( <i>Stipa viridula</i> ).	Water parsnip ( <i>Sium cicutafolium</i> ).
Golden aster ( <i>Chrysopsis villosa</i> ).	Water plantain ( <i>Alisma plantago-aquatica</i> ).
Golden dock ( <i>Rumex persicarioides</i> ).	White sage ( <i>Artemisia gnaphaloides</i> ).
Goldenrod ( <i>Solidago missouriensis</i> and <i>Solidago rigida</i> ).	Wild barley ( <i>Hordeum jubatum</i> ).
Green ash ( <i>Frazinus lanceolata</i> ).	Wild licorice ( <i>Glycyrrhiza lepidota</i> ).
Green pigeon grass ( <i>Chaetochloa festucacea</i> ).	Wild oats ( <i>Avena fatua</i> ).
Ground plum ( <i>Astragalus crassicaepos</i> ).	Wild rose ( <i>Rosa pratincola</i> and <i>Rosa acicularis</i> ).
Hair grass ( <i>Agrostis hyemalis</i> ).	Wild rye ( <i>Elymus canadensis</i> ).
Hollow stem ( <i>Fumitinea festucacea</i> ).	Wild timothy ( <i>Muhlenbergia racemosa</i> ).
Horseweed ( <i>Leptilon canadense</i> ).	Witch grass ( <i>Panicum capillare</i> ).
June berry ( <i>Melanthera alnifolia</i> ).	Wormwood ( <i>Artemisia biennis</i> ).
Lamb's quarter ( <i>Chenopodium album</i> ).	Wolfberry or buckbush ( <i>Symphoricarpos occidentalis</i> ).
Lead plant ( <i>A. morpha canescens</i> ).	Yellow cress ( <i>Radicula palustris</i> ).
Little sage ( <i>Artemisia frigida</i> ).	

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