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Soil Survey
of
Cedar County, Nebraska

By

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and
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Nebraska Soil Survey

Bureau of Chemistry and Soils

In cooperation with the University of Nebraska State Soil Survey
Department of the Conservation and Survey Division

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COUNTY SURVEYED

Cedar County is in northeastern Nebraska and is separated from South Dakota by Missouri River. (Fig. 1.) Its greatest dimension from east to west is 24 miles and from north to south is 36 miles. It includes an area of 730 square miles, or 467,200 acres. Yankton, S. Dak., is opposite the northwestern corner of the county, across the river.

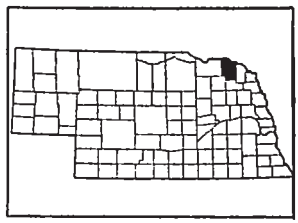

FIGURE 1.— Sketch map showing location of Cedar County, Nebr.

The county is at the northern edge of the loess-covered part of Nebraska. The general physiography is that of an eroded plain sloping toward the north and east.

About 80 per cent of the county is upland and the remainder is alluvial land, or terraces and flood plains along streams. The upland ranges from rolling to hilly, in a number of places being thoroughly dissected. The original plain surface remains only in the small flat areas on the highest parts of the divides in the southeastern part of the county. Except in the bluff section along Missouri River the drainage ways are not sharply cut, and the hills are well rounded. Drainage channels reach all parts of the upland, leaving no large flat undrained plain remnants or depressions. The roughest relief is in a belt from 3 to 4 miles wide bordering the alluvial land of Missouri River. The slopes here are steep, the cliffs are from 80 to 150 feet high, and the uneroded divides are narrow. The northern boundary of the uplands abuts directly on the first bottoms of Missouri River except for a distance of 1½ miles in the western corner of the county, along sec. 33, R. 2 E., T. 33 N., and for 1 mile along the bluffs west of Vermilion Ferry landing. In these places the river hugs the bluff line with no intervening bottom land.

The alluvial and colluvial lands occur chiefly along the larger streams in the upland. They are gently sloping or, in many places, nearly level. The alluvial belts lie between the bluffs and Missouri River and in narrow strips adjacent to the larger streams of the uplands. The first bottoms along the Missouri River are from 15 to 30 feet above the channel, and parts of them are subject to overflow. With the exception of a few sand ridges and knolls and a few depressions, the first bottoms are nearly level.

The elevation above sea level at Hartington is 1,382 feet, at Randolph 1,654 feet, at Laurel 1,473 feet, at Coleridge 1,552 feet, and at Yankton, S. Dak., 1,206 feet.[1] The general slope of the upland is north and east and of the Missouri River bottom land is southeast. Missouri River has a fall of about 1½ feet to the mile.

[1] GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. (Fourth edition.) U. S. Geol. Survey Bul. 274, 1072 p. 1906.

Cedar County is drained entirely by Missouri River and its tributaries. The drainage of the uplands is everywhere adequate and in many places excessive. All the streams are cutting rather than filling their channels. In the Missouri River bottoms natural drainage is in places inadequate, but artificial drainage has been established, and at the present time only a small proportion of the land is too wet for cultivation or for cutting hay.

The first permanent settlements in the area now included in Cedar County were made in 1857 at St. James and St. Helena. The early settlers came chiefly from Iowa, Missouri, and Illinois. Many came by boat from St. Louis, Mo. For many years settlement of the county progressed very slowly, in fact barely holding its own, for the reason that many of the first settlers, as in most new areas, took up the best land, located town sites, remained until the land was surveyed, then rented or sold out and moved away. For many years the number of departures equaled the number of arrivals. Fear of Indians was another deterrent in the early settlement of the county.

Cedar County was organized in 1857 and the boundaries were established, but they have been somewhat changed by subsequent legislation. The first seat of justice was at St. James; later St. Helena was the county seat; and now Hartington, which is also the largest town, is the county seat. The population of the county was 2,899 in 1880; 7,028 in 1889; 12,467 in 1900; 15,191 in 1910; and 16,225 in 1920. According to the 1930 Federal census report,[2] the population now numbers 16,427.

Hartington, in the central part of the county, has a population of 1,568; Randolph, in the southwestern part, has 1,145 inhabitants; and many small towns and villages are scattered throughout the county.

Cedar County is well supplied with transportation facilities, four railroad lines passing through the county and no farm lying more than 9 miles from a railroad. The public-road system is good. United States highways Nos. 81 and 20 serve the northwestern and southern parts of the county, respectively, and State highway No. 15 crosses the county in a north-south direction. Nos. 81 and 15 are graveled. There are 75 miles of improved road in the county, and the dirt roads are usually in good condition. Most of the roads follow section lines, except in the bluff area near Missouri River where they follow the valleys or the canyons. The bridges of the county are in good condition. A toll bridge leads to Yankton and a toll ferry to Vermilion, S. Dak.

Rural mail-delivery service and telephone lines reach all parts of the county. Educational facilities throughout the county are good. There are about 90 schools, or about 4 to the township.

Yankton, S. Dak., and Sioux City, Iowa, are the principal markets for the surplus grain and vegetable products of the county.

The well-water supply in most places is abundant, and the water is of very good quality. In the bluff section near Missouri River are many artesian wells, which have a strong flow for several years, but many of them fail after 8 or 10 years. The wells near the first-bottom land are from 150 to 175 feet deep and those 2 or 3 miles back in the uplands are from 200 to 250 feet deep.

[2] Soil survey reports are dated as of the year in which the field work was completed. Later census figures are given whenever possible.

Most of the trees in the county grow in the canyons in the bluff land, along streams, and in parts of the first-bottom land which are subject to overflow. Some of the most common trees in almost all parts of the county are boxelder, cottonwood, bur oak, honeylocust, red ash, green ash, red elm, and white elm. Trees found only in the Missouri River bottom are sand-bar willow, red oak, black walnut, Kentucky coffeetree, and silver maple. The natural vegetation of the uplands is bluestem and grama.

CLIMATE

The climate of Cedar County is typical of the plains of Nebraska. It is characterized by long, bright, moderately hot summers, during which many local thunderstorms occur, and by bright, cold, dry winters. Occasional high winds and hailstorms occur. The high winds in spring are very forceful but do little damage to buildings, though they cause great loss of soil moisture by drying out the soil. Tornadoes have occasionally passed through parts of the county.

Weather bureau records show that the average annual precipitation at Hartington is 27.88 inches, of which about 40 per cent falls during the three summer months. Approximately 80 per cent of the rain falls from April to October, inclusive. This distribution of the rainfall is very favorable for producing crops. There are wide variations in the amount of annual precipitation, that of the driest year being less than half that of the wettest year. When the annual precipitation is below a certain minimum, it is almost impossible to produce profitable crops during that year. The amount and distribution of annual rainfall are two of the most important factors in crop production in this part of the United States, as there is a close relationship between crop yields, total precipitation, and precipitation during the growing season.

The length of the frost-free season has considerable bearing on the production of certain farm crops, such as corn, vegetables, and fruit. Usually the crops require a longer time to mature in the wettest seasons, therefore the danger from frost is increased during such seasons. The average date of the last killing frost at Hartington is May 5 and that of the first is October 4. This gives an average frost-free season of 152 days. Frosts have occurred as late as May 24 and as early as September 12. It should be noted that the frost-free period is not necessarily the limit of the growing season, for as a rule the earliest fall frosts are too light to damage corn and the late spring frosts seldom affect any crop except vegetables and fruit.

January is the coldest month, with a mean temperature of 19.2° F., and July is the warmest, with a mean of 73.9°. The lowest temperature recorded is −38° in January. Extreme cold weather is often responsible for the winterkilling of many varieties of alfalfa and of winter wheat. During the summer the mercury usually reaches the 100° mark on several days each month. The highest temperature recorded is 108°, in July. In general, the long, warm, bright, sunshiny days of summer favor a very rapid growth of crops. The nights are fairly cool except during hot periods in July. Hot winds do not often strike this part of the State, but when they do both days and nights are very hot and dry.

Table 1, compiled from records of the Weather Bureau station at Hartington, gives data which may be taken as representative of the climatic conditions in Cedar County.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Hartington, Nebr.*

[Elevation, 1,309 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1894)	Total amount for the wettest year (1915)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	23.4	69	−33	0.93	1.00	0.75	6.5
January	19.2	62	−38	.73	.70	.46	6.8
February	21.0	75	−33	1.01	.55	3.70	9.5
Winter	21.2	75	−38	2.67	2.25	4.91	22.8
March	34.3	88	−17	1.30	.58	1.40	6.4
April	47.8	102	10	2.94	4.26	2.85	3.8
May	58.9	96	19	4.31	2.43	7.34	(1)
Spring	47.0	102	−17	8.55	7.27	11.59	10.2
June	68.5	102	35	4.38	1.15	5.01	.0
July	73.9	108	35	3.27	.58	10.24	.0
August	71.6	105	38	3.47	1.48	1.62	.0
Summer	71.3	108	35	11.12	3.21	16.87	.0
September	63.3	105	20	2.84	.55	4.51	.0
October	51.5	94	6	1.64	1.76	2.49	1.9
November	35.6	79	−9	1.06	.05	1.08	3.6
Fall	50.1	105	−9	5.54	2.36	8.08	5.5
Year	47.4	108	−38	27.88	15.9	41.45	38.5

[1] Trace.

AGRICULTURE

Cedar County was originally covered with a luxuriant growth of prairie grasses, and cattle grazing was naturally the first important industry. However, with the arrival of more settlers and the development of railroads, ranching was replaced to a great extent by farming. The early development of agriculture was slow, owing to the great distance to market centers and the ravages of insect pests. Grasshoppers were very destructive at times, but farmers sowed larger acreages of crops each year, determined to recuperate from the losses of former years. The early settlers had little capital to tide them over disastrous years and therefore had to endure great hardships until the next crop was produced. Many of the settlers were forced to leave the county between 1860 and 1880 because of these hardships.

A system of general agriculture prevails, consisting of the growing of grains, the raising of livestock, and the production of dairy and poultry products. The principal crops, named in the order of their acreage, are corn, oats, wild hay, alfalfa, wheat, barley, and potatoes. Hogs, cattle, horses, mules, and poultry are the principal kinds of livestock on the farms, and a few farmers keep small flocks of sheep.

Table 2, compiled from the Federal census reports, gives the acreage and production of the principal crops in 1879, 1889, 1899, 1909, 1919, and 1929 and shows the general trend of agriculture.

TABLE 2.—*Acreage and production of principal crops in Cedar County, Nebr., in stated years*

Crop	1879		1889		1899	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	6,524	217,161	41,566	1,540,620	113,091	3,651,480
Oats	3,212	59,722	13,884	322,133	34,530	1,096,160
Wheat	7,183	20.217	7,001	98,494	60,283	559,450
Rye	10	61	176	2,822	95	1,970
Barley	656	8,605	888	18 348	3,426	91,430
Flaxseed			3,570	30,540	1,279	7,670
Potatoes		23,747	699	62,375	748	68,264
		Tons		*Tons*		*Tons*
Wild hay	[1] 9,286	[1] 19,163	[1] 36,704	[1] 57,020	42,168	54,817
Alfalfa					332	938
Timothy						
Timothy and clover						
Coarse forage					469	1,296

Crop	1909		1919		1929[2]	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	141,520	5,277,544	137,070	4,550,313	167,681	6,081,733
Oats	74,535	2,138,903	91,863	2,669,842	86,931	3,059,368
Wheat	5,017	67,277	6,352	44,953	2,016	45,650
Rye	108	1,751	681	7,345	1,043	18,931
Barley	3,737	73,059	1,881	41,133	12,687	396,989
Flaxseed	250	1,260				
Potatoes	970	71,841	864	37,940		
		Tons		*Tons*		*Tons*
Wild hay	34,171	48,234	25,096	30,648	[1] 37,697	[1] 53,159
Alfalfa	2,968	7,877	20,663	42,149		
Timothy	3,083	4,742	590	683		
Timothy and clover	16,145	23,923	3,058	4,666		
Coarse forage	321	1,125	2,078	5,103		

[1] Preliminary figures, subject to correction. [2] All hay.

The figures show a fairly steady increase in the acreage of the principal crops. The wheat acreage has fluctuated considerably, and in 1899 it was nearly 10 times as great as in any census year before or since. The acreage in wild hay has decreased, this crop having been increasingly supplanted by cultivated grasses, especially alfalfa, since 1899.

Corn is the predominating crop, and on farms where it is not fed to livestock it is the chief cash crop. It occupies an acreage almost as large as that of all other crops combined. According to the Nebraska Agricultural Statistics, 1926, the 10-year average yield from 1916 to 1925 was 34 bushels. The highest yield was in 1923, with 42 bushels, and the lowest was in 1925, with 23 bushels. The average acre value of corn in 1926 was $15.64 for the county, and for the State was $10.54. Reid Yellow Dent is the leading variety of corn, with some Iowa Silvermine and Minnesota 13. Yellow corn seems to be more popular than white.

Oats rank second to corn in acreage, the ratio being nearly 2 acres of corn to 1 of oats. The 10-year average yield from 1916 to 1925 was 33.9 bushels, according to the Nebraska Agricultural Statistics. The acre value for the county was $7.20 in 1926 as compared with $8.28 for the State. The yield of oats depends on climatic conditions during the spring. Low amount of moisture, high temperature, and much windy weather at this season usually result in decreased yields.

In general, early seeding favors the highest yields, provided temperature and moisture conditions are normal. The crop does best on the finer-textured but not too sandy soils. The sandy soils are not well adapted to oats on account of the danger of the blowing sand injuring the roots and shoots of the tender plants. Most of the oats in Cedar County are cut with a binder and threshed from the field. The straw is usually stacked as it comes from the thresher, as it has a high feeding value and is used on many farms in place of hay for horse feed during the winter. Most of the grain is fed on the farms, mainly to work animals. Swedish Select and Kherson are the principal varieties of oats. Kherson does best on the heavy bottom-land soils.

In 1899 wheat ranked second in acreage to corn, but this was very unusual as normally very little wheat is sown. The Nebraska Agricultural Statistics show only 1,136 acres in wheat in 1926, and of this amount more than 82 per cent was of the spring varieties. The 10-year average yield from 1916 to 1925 was 15.8 bushels for winter wheat. No corresponding figures over the 10-year period are given for spring wheat. The average yield in 1926 was 10 bushels for both spring and winter wheat. In the same year the acre value of winter wheat in Cedar County was $11.70 and of spring wheat $11.20, and the acre values for the State were $15.09 for winter wheat and $16.69 for spring wheat. These figures show that Cedar County is much below the State average in yields of both spring and winter wheat. Most of the spring wheat is Marquis and varieties of durum, and the winter varieties are Turkey and Kanred.

Barley is often grown in place of oats in the crop rotation, and almost the entire production is fed to horses and hogs.

The hay crop has been of considerable importance since the early settlement of the county. Wild hay still occupies the leading acreage among the hay crops, but the area devoted to this crop has gradually decreased with the increase in grain and alfalfa production. The principal wild-hay grasses throughout the uplands and terraces are grama and bluestem. Throughout the areas of the sandy upland soils, stipa and needle grass predominate. Considerable marsh and swamp grasses occur throughout the bottom lands along Missouri River. Grama and bluestem afford the best pasturage and when cut for hay they yield about one-half ton to the acre. Bottom-land grasses yield from 1 to 1½ tons of hay to the acre, but this hay is coarser, is less nutritious, and has a lower market value than hay from the grasses on the uplands and terraces.

Alfalfa is rapidly becoming the principal tame-hay crop and will probably be the most important forage crop in the future. In 1909 only 2,968 acres were in alfalfa, and in 1924 the acreage was 22,908 or nearly eight times the acreage in 1909. The Nebraska Agricultural Statistics give the acre value of alfalfa as $28.20 for 1926. The total value of alfalfa in 1925 was $572,572, whereas the value of wild hay was only $183,227. Three cuttings of alfalfa are usually obtained. Most of the alfalfa is fed to cattle, horses, and hogs on the farms where it is produced. Many farmers turn hogs into the alfalfa fields during the summer months.

Potatoes are grown principally for home consumption and to supply local markets. In 1924 the acreage in potatoes was 538 and the total production was 60,820 bushels.

Other crops of minor importance are rye, flax, timothy, clover, and sorghums. Some truck crops are grown on the sandy bottom soils in the northwest part of the county.

Very little fruit is grown. Apples, plums, and cherries are the leading fruit trees. Some grapes are grown and produce fairly well.

Table 3, compiled from the Nebraska Agricultural Statistics, shows the comparative yields of the principal crops for three representative Nebraska counties and for the State. Kimball County is in the extreme western part of the State, Adams County is in the south-central part, and Cedar County is in the northeastern part. The average yields, especially of corn and oats, in Cedar County are above the average for the State and above the averages of either of the other two counties shown in the table.

TABLE 3.—*Average yields*[1] *per acre of crops for three counties in Nebraska and for the State*

	Winter wheat	Corn	Oats	Wild hay	Alfalfa
	Bushels	*Bushels*	*Bushels*	*Tons*	*Tons*
Kimball County	14.9	17.9	24.0	0.71	1.93
Adams County	12.2	22.7	28.4	.95	2.22
Cedar County	15.8	34.0	33.9	1.40	2.68
State	14.7	26.5	30.1	.94	2.42

[1] 10-year period, 1916–1925.

The 1925 census gives the total value of all livestock in Cedar County as $5,882,245 and the total value of all crops as $5,980,750. Among the livestock, swine hold first position in value and number. In 1925 there were 154,449 hogs having a total value of $2,562,201. In that year nearly every farm reported some hogs, the average number to the farm being about 70 head. All the hogs are of good breeds, chiefly Duroc-Jersey, Poland China, and Chester White, and there are several purebred herds in the county. The hogs are fattened on corn, either in feeding yards or by turning them into the fields in the fall to hog down the corn. Attention is given to vaccination and sanitation, and losses from cholera have been greatly reduced.

Cattle rank a close second to hogs in value, their value in 1925 being $2,000,335. By far the greater number of cattle are of beef types, generally of good quality. There are only a few purebred herds, but many purebred bulls have been introduced in recent years. Hereford and Shorthorn are the principal breeds of beef cattle. Most of the cattle are sold as feeders or stockers after coming off the summer range, though large numbers are fattened on corn on the farms where the animals are produced, or are fattened by local feeders.

Dairying recieves little attention. There are a few purebred dairy herds, chiefly of the Holstein breed. The 1925 census reports 353 farms having dairy cows and 1,746 farms having milk cows chiefly of the beef breeds. Most farmers have cream separators. The surplus dairy products are sold in the near-by towns, and from there part of the cream is later shipped to Sioux City, Iowa, and Yankton, S. Dak.

Horses are kept on every farm. Percheron and Belgian are the chief breeds. The 1925 census reports 14,691 horses and 1,135 mules in the county. Many farmers raise their own work animals. The horses are principally of medium draft type, ranging in weight from

1,000 to 1,600 pounds. The mules are of a slender type, weighing from 900 to 1,200 pounds.

In 1925 the total number of sheep was 4,875. These were on 69 farms, or an average of 70 sheep to a farm. The sheep are raised on the rough pasture land along the Missouri River bluffs. A few farmers ship in sheep in the fall to fatten.

Poultry is raised on all farms, and the sale of poultry and eggs constitutes an important source of farm income. The census of 1925 reports 253,322 chickens having a total value of $202,658. The value of eggs produced in 1924 was $240,879. Plymouth Rock, Leghorn, and Rhode Island Red are the leading breeds of chickens. Many farmers raise a few ducks, turkeys, and geese.

The average value of all farm property to the farm increased from $2,501 in 1880 to $27,056 in 1925. As a rule the farms in Cedar County are well improved and have a general appearance of prosperity. Most of the farm buildings are painted and kept in good repair, and most of the farms are fenced and cross fenced with barbed wire. Modern labor-saving implements are in general use, most of the farms being equipped with grain drills, binders, riding cultivators, plows, and disks, and the farms on which hay is produced are equipped with rakes, mowers, and other haying equipment. A few farmers have corn binders and hay balers. Tractors are operated on a few farms but are not in common use throughout the county. Many farmers own threshing machines and thresh the grain grown in the surrounding community. A few silos are filled every year, but they do not seem to be so popular as they were a few years ago.

Most of the farm work is done by the farmers and their families except during harvest, when additional help is required. Some help is required during corn-shucking time, but most of the crop is harvested by the farmers and local men. Wages range from $40 to $55 a month with board and room. During harvest, day laborers receive from $3 to $5. Corn shuckers receive from 6 to 8 cents a bushel.

The 1925 Federal census reports that the average labor cost to the farm was $314.50 on the 62.3 per cent of the farms reporting in 1924, and the average amount spent for feed on the 63.3 per cent of the farms reporting was $624.95. In the same year, expenditures for fertilizer (including lime) were reported on 18 farms, with an average of $143.83 to the farm.

According to the Federal censuses the number of farms in Cedar County has increased each decade, and the average size has remained almost constant. In 1880 there were 408 farms in the county, with an average of 205 acres to the farm, and in 1930 there were 2,193 farms, with an average of 204.5 acres. The percentage of the total area of the county in farms has increased from 17.8 per cent in 1880 to 95.3 per cent in 1930. In 1930, 50.9 per cent of the farms were operated by tenants, 47.8 per cent by owners, and 1.3 per cent by managers. Most of the tenants are share renters, and under the usual terms the tenant furnishes all equipment, labor, and seed and receives two-fifths of the crop. The pasture land is rented for cash, and the hay land rents for half the hay delivered on the track.

Land values, exclusive of improvements, range from $125 an acre for the best agricultural soils to $20 for soils suitable only for grazing.

Most of the farmers in Cedar County practice a corn and oats rotation, and many have added sweetclover to the rotation system.

The Nebraska Agricultural Statistics show that there were 1,763 acres of sweetclover in Cedar County in 1925. The acreage of alfalfa is rapidly increasing. Alfalfa builds up the nitrogen content of the soil but it also takes out the deep subsoil moisture. It has been found that in a 6-year-old alfalfa field most of the available subsoil moisture to a depth of 33 feet had been absorbed by the alfalfa roots and in a 2-year-old meadow to a depth of 25 feet.[3] It is a well-established fact that it is very difficult to produce a profitable stand of alfalfa on land that was previously in alfalfa. The second stand may be fair for two or three years but it runs out rapidly after the third year unless irrigation is practiced.

Crop cultivation in Cedar County is practically the same as in the other counties of northeastern Nebraska. Most of the corn is listed. The 2-row lister is used more than formerly. A few fields are planted in checkrows, but ordinarily the listed corn yields better. Corn is usually cultivated three times, but in some parts of the county obnoxious weeds force several additional cultivations and even hoeing.

Rape is generally planted with oats in the spring and is used for winter pasture, especially for horses.

Alfalfa, which requires a smooth, mellow seed bed, is sown on thoroughly plowed, disked, and harrowed oat-stubble ground, usually in the fall. Most of it is planted at a very slight depth with a press drill.

Erosion and loss of soil fertility present serious problems in Cedar County. The effects of soil erosion are very apparent, and the eroded areas are enlarging at an alarming rate.[4] Certain fields in which the stands are very thin and the crops are yellow and spindling have much lighter-colored soil than near-by areas that have good stands of green and thrifty crops. The thin stand and yellow color of the crops is a result of the removal of the black surface soil which has been washed away, together with its organic matter and nitrogen, as most of the organic matter in the soil lies within a depth of 1 foot from the surface. When the surface soil is removed, the crops must obtain their plant food from the subsoil and underlying material, both of which are very low in organic matter and nitrogen.

SOILS AND CROPS

Cedar County is too far north for the production of winter wheat and not far enough north for the profitable production of spring wheat, therefore the two main cereal crops are corn and oats. At present about 73.9 per cent of the farm land in the county is cultivated, and about 21.7 per cent is in pasture. In 1929 about 50.6 per cent of the cultivated land was planted to corn, 26.2 per cent was in oats, and 11.4 per cent was in hay, about equally divided between alfalfa and all other kinds of hay. Corn, the main crop, is grown in approximately all parts of the county, and oats and alfalfa are well distributed. The pasture land, however, occurs in the more restricted areas, mainly in the northwestern part of the county and along the Missouri River bluffs.

Most of the soils of Cedar County are prairie soils, which have dark surface soils, ranging from grayish brown on the slopes to very

[3] KIESSELBACH, T. A., RUSSEL, J. C., and ANDERSON, A. THE SIGNIFICANCE OF SUBSOIL MOISTURE IN ALFALFA PRODUCTION. Jour. Amer. Soc. Agron. 21: 241-268, illus. 1929.

[4] Information as to methods for the prevention of erosion may be obtained from the agronomy department of the University of Nebraska, Lincoln, Nebr.

dark grayish brown on the more level land. Most of the soils have friable, loose, mellow topsoils with friable granular single-grained subsoils which are somewhat lighter in color than the topsoils. The lower parts of the subsoils are almost invariably friable and light colored, ranging from light brown to light grayish yellow. This lower material is silty under the heavier surface soils, but under some of the sandy-textured surface soils it is medium or coarse sand. The organic matter extends to a depth ranging from a few inches to more than 2 feet. In all the soils most of the organic matter is contained in the upper foot of soil. Most of the soils are fertile and respond with good crop growth when the supply of water is sufficient. They are especially well supplied with mineral plant foods.

For ages these soils have supported a luxuriant growth of prairie grasses the roots of which have been continuously decaying, causing a large accumulation of organic matter in the surface soil to a depth of 1 foot. This organic matter, which is the cause of the very dark color of the surface layer, has many beneficial effects. It greatly increases the water-holding capacity of the surface soil, which is very desirable in this section of the State; it makes the soil more retentive of moisture; it helps to retard erosion; it increases and helps maintain desirable tilth; and it is the chief source of nitrogen, the one plant-food constituent which is rapidly being depleted in these soils. The dark color imparted by organic matter makes the soil more absorptive of the sun's heat. This heat is very helpful in early spring in germinating the seeds of cereals.

Under prevailing climatic conditions, the average annual precipitation of nearly 28 inches has been sufficient, on the more level upland areas and in the sandy-textured soils to leach the lime in the soil to a depth ranging from 3 to 4 feet. In most of the upland soils a lime zone or lime-concretion layer is formed at a depth ranging from 30 to 48 inches below the surface. The soils on the more rolling or rough land have been eroded to such an extent that their lime is near or at the surface, because the amount of rainfall absorbed on the steep slopes has not been sufficient to leach the lime as fast as erosion has removed the surface soil. The alluvial soils are generally very limy from the surface to great depths but they rarely have a definite lime zone. Some of the terrace soils are limy and some are lime free.

The heavier-textured soils have deeper, darker surface soils and a higher organic-matter content than the sandy-textured soils and have developed a very loose granular structure. This structure allows easy penetation of crop roots and of soil water; it gives the maximum feeding range of the crop roots; it allows good aeration which, in combination with the mineral constituents and carbonic acid and other acids from the organic matter, changes the raw vegetable matter and mineral elements in the soil to available plant food. Granular structure is important in maintaining good tilth, and tilth is a very important factor in control of erosion. In the sandy-textured soils the soil material is so sandy that a granular structure can not be formed except where the organic-matter content is very high, and in this county very few such areas exist. Water penetrates the sandy-textured soils very easily, in fact so easily that percolation is excessive.

The heavy-textured soils are best suited to all general farm crops, such as corn, oats, wheat, rye, alfalfa, and clover, and the sandy-textured soils are slightly better adapted to truck farming.

On the basis of their use, which bears a close relation to the texture and composition of the soil, the character and depth of the subsoil, surface features, and underdrainage, the soils of Cedar County may be divided into four major soil groups. The principal basis of this grouping is the similarity in agricultural value of the soils of the group as measured by crop production. These groups, regardless of their relative area, are arranged in the order of the crop-producing power of the soils.

The first two groups include soils that are used to greater or less extent for the production of farm crops; the last two are not suited for cultivated crops, by reason of conditions produced by topographic features, and are used only for grazing.

These groups are (1) well-drained farming soils, (2) poorly drained farming soils, (3) well-drained grazing soils, and (4) poorly drained grazing soils.

The well-drained farming soils include those soils that have fairly deep well-weathered surface soils and friable well-drained subsoils. The texture of the surface soils ranges from silt loam to fine sandy loam. The subsoils are for the most part heavier in texture than the surface soils. These soils occur on the smooth nearly level or rolling uplands and on high, well-drained terraces. They are productive and dominate the agriculture of the county.

The poorly drained farming soils occur in stream valleys, over recently deposited alluvium. The surface soils are dark colored and range in texture from sandy loam to heavy clay. The subsoils of some of these soils are sandy and gravelly, others are heavy clays. As a result of a high water table and frequent floodings, these soils are, or formerly were, poorly drained. They are now partly drained and range widely in productiveness in different places. The better-drained areas return good crop yields in dry years.

The well-drained grazing soils have shallow surface soils overlying raw parent materials. These soils are badly eroded and many exposures of the underlying materials may be seen on hillsides. Only a small area of these soils is cultivated, the greater part being used only for grazing. Small areas of the deeper soils return fair crop yields.

The poorly drained grazing soils include the poorly drained soils of the flat or basinlike depressions on the upland and one very sandy soil of the river bottoms. On account of poor drainage these soils have a low value for farming.

In the following pages each soil type in the county is described and discussed. The most important soil of each series is described first, and the minor soils are compared with it. The descriptions are of the soils as they appear in a plowed field, and only those features which are of interest to the farmers will be discussed in this section. In the section entitled "Soils and Their Interpretation" the soils are described more in detail for persons interested in soils from a scientific point of view. Many of the soils are very productive but they occupy such a small area that they will not be discussed as thoroughly as some of the more extensive soils. The soil map accompanying this report shows the distribution of the various soils in Cedar County. Table 4 shows their acreage and proportionate extent.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in Cedar County, Nebr.*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Moody silt loam	81,920	17.5	Shelby sandy loam	17,536	3.7
Moody silt loam, deep phase	30,912	6.6	Cass very fine sandy loam	4,096	.9
Moody very fine sandy loam	81,280	17.4	Cass fine sandy loam	832	.2
Moody very fine sandy loam, deep phase	27,136	5.8	Cass sandy loam	1,408	.3
Moody fine sandy loam	9,024	1.9	Cass silty clay loam	704	.1
Moody fine sandy loam, deep phase	3,520	.8	Cass clay loam	832	.2
Shelby loam	9,536	2.0	Cass clay	4,224	.9
Hall very fine sandy loam	19,776	4.2	Lamoure clay loam	6,016	1.3
Hall silt loam	2,496	.5	Lamoure clay	1,984	.4
Waukesha very fine sandy loam	7,424	1.6	Lamoure silt loam	8,256	1.8
Waukesha silt loam	3,520	.8	Lamoure very fine sandy loam	4,096	.9
Judson silt loam	2,368	.5	Wabash very fine sandy loam	20,800	4.4
Bloomington very fine sandy loam	7,168	1.5	Wabash silt loam	7,744	1.7
Bloomington very fine sandy loam, terrace phase	8,640	1.8	Crofton silt loam	20,864	4.5
Dickinson fine sandy loam	22,080	4.7	Knox silt loam	6,720	1.4
Dickinson fine sandy loam, bench phase	7,744	1.7	Shelby gravelly sandy loam	14,720	3.1
Dickinson fine sandy loam, calcareous-subsoil phase	8,768	1.9	Sogn loam	1,280	.3
Dickinson very fine sandy loam, calcareous-subsoil phase	1,344	.3	Boyd clay loam	576	.1
Dickinson sandy loam	8,000	1.7	Sarpy loamy sand	1,216	.3
			Scott silt loam	128	.1
			Fillmore silt loam, alkali phase	448	.1
			Muck	64	.1
			Total	467,200	

WELL-DRAINED FARMING SOILS

LOAMY-TEXTURED SOILS

In Cedar County the most extensive and also the most important well-drained farming soils are those of the Moody series, and they occupy 50 per cent of the total area of the county. The prosperity of the county depends on the profits derived from these soils. Other soils in this subgroup are soils of the Hall, Waukesha, Judson, and Bloomington series and the loam of the Shelby series. The Hall, Waukesha, and Judson soils are terrace soils. They are more productive than the Moody soils, but because of their occurrence either as very small areas or as areas which are badly cut by streams they are not so easily or profitably handled as the large areas of Moody soils. Acre for acre the Judson, Waukesha, or Hall soils outyield any soil of the Moody series. A farm which includes a large proportion of these soils is more desirable than one composed entirely of Moody soils, but where the terrace soils occur as narrow strips only along large drainage ways they are usually in native grass and are used for hay land or pasture.

Crop yields on these soils vary from year to year and with methods of handling, but assuming that all soils have equally good care and the crops are handled equally well, in an average year the silt loam soils of each series will outyield the very fine sandy loam soils by 2 or more bushels of oats and about 2 bushels of corn. In grain production the terrace soils will outyield the upland soils from 1 to 5 bushels, and in hay production from one-half to 1½ tons. The Judson soils will slightly outyield all other soils of the group, and the Waukesha rank next, followed closely by the Hall soils. All these soils are planted largely to corn and oats, with a very small acreage in wheat and barley. A larger proportion of the terrace soils than of the upland soils is in alfalfa and wild hay, partly because the terrace soils are so badly cut through by meandering stream channels, in places

making cultivation difficult, and partly because the alfalfa roots can reach subsurface drainage water more readily and thus produce a much better crop than on the upland soils. Fruit trees and vegetable crops seem to grow about equally well on all these soils.

The Bloomington soils are not so uniform in quality as the Moody soils. Where the soils are deep they are fully equal to the Moody soils in agricultural value and they produce only slightly lower yields. Shelby loam is productive, but as it occurs in very rolling areas the land is difficult to handle and is susceptible to erosion.

Comparing the yields of the Moody soils and their phases, the silt loam produces about 2 bushels more of corn and oats than the very fine sandy loam, and about 4 bushels more than the fine sandy loam, and the deep phases produce about 2 bushels more than the typical soils.

Moody silt loam.—Moody silt loam, including its deep phase, is the most extensive soil and probably the best upland soil in the county. It occupies a large part of the southern half of the county. It has an unusually wide range of crop adaptations, the crops grown including not only corn, oats, alfalfa, wheat, barley, clovers, and timothy, but orchard crops, chiefly apples, plums, and cherries, also grapes and various vegetables. In Cedar County, Moody silt loam is developed on the gently rolling hills of mild relief, where the slope is sufficient to insure excellent drainage but not so steep as to cause serious erosion.

The surface soil, to a depth of 12 or 14 inches, consists of dark grayish-brown loose friable crumblike silt loam with a high content of organic matter which decreases rapidly below a depth ranging from 8 to 12 inches, and the soil gradually becomes lighter in color. The subsoil also has a granular or crumblike structure and is friable, but the granules are larger than in the surface soil and the material is slightly more compact though not so compact as to interfere with rapid penetration of crop roots or the percolation of soil water. This layer contains much lime in the lower part, generally between depths of 24 and 36 inches. Most of the lime occurs as large hollow concretions about the size of a small marble, and some is disseminated through the soil material in finely divided form. Below the subsoil, at a depth of about 30 inches, is a loose yellow silty material which continues to a great depth. As many crop roots feed to depths ranging from 5 to 8 feet and alfalfa roots feed to depths ranging from 15 to 25 feet, this lower stratum is important, not so much for its organic-matter content and mineral constituents as for its moisture supply. If this layer were lacking or very shallow, the crop roots could not obtain sufficient water from the surface soil and upper part of the subsoil to endure the long dry spells which frequently occur in this region.

In average years Moody silt loam yields from 30 to 40 bushels of corn to the acre, from 35 to 45 bushels of oats, from 15 to 18 bushels of wheat, and from 1½ to 2 tons of alfalfa.

Moody silt loam, deep phase.—The deep phase of Moody silt loam differs from typical Moody silt loam in that it has a deeper surface soil, contains more organic matter, and has a slightly more compact subsoil. The lime layer in most of the areas also occurs at a much greater depth, in some places being from 3 to 4 feet below the surface. This soil occurs on some of the very slightly rolling or undulating hills in the southern half of the county. Inasmuch as the

surface relief is mild, areas of this soil are almost ideal for maximum agricultural utilization and approximately 98 per cent of the land is under cultivation. The surface features allow the use of modern machinery and favor the absorption of a high percentage of the yearly rainfall. This deep soil supports a wider diversification of profitable crops than do most of the other soils, not only because of its mild surface relief but because the soil characteristics are very favorable to the different kinds of crops.

Moody very fine sandy loam.—Moody very fine sandy loam occurs in all parts of the county, occupying hills which are slightly more rolling than those covered by Moody silt loam. The surface soil is a little looser and more sandy than that of the silt loam, the soil contains more lime, and the lime is nearer to the surface. This soil can be farmed under a wider range of moisture conditions without destroying its good tilth, and although in ordinary years it does not produce quite such high yields as the silt loam, in very dry years it produces as much or even more. This is because the crop roots are able to take the moisture more completely from the sandy soils than from the heavier soils, and the crops respond more quickly to the few light showers that come during dry periods. Probably about 80 per cent of this soil is cultivated and the rest is in pasture.

Moody very fine sandy loam, deep phase.—The deep phase of Moody very fine sandy loam has a deeper surface soil and a slightly more compact subsoil than the typical soil. It contains more organic matter and less lime, and the lime occurs at much greater depth, in most places being from 30 to 40 inches below the surface. This deep soil occupies very slightly rolling or undulating hills and occurs in all parts of the county. It is a more desirable soil than typical Moody very fine sandy loam. About 70 per cent of it is farmed and the rest is in pasture.

Moody fine sandy loam.—Moody fine sandy loam differs from Moody very fine sandy loam in that both its surface soil and subsoil are sandier, looser, and more friable. This soil is much less extensive than the other Moody soils and occurs in numerous small scattered areas. It does not produce such high yields as either the silt loam or very fine sandy loam members of the Moody series.

Moody fine sandy loam, deep phase.—Moody fine sandy loam, deep phase, occupies the more nearly level areas adjoining or near areas of typical Moody fine sandy loam. This deep soil has a deeper surface soil and a slightly more compact subsoil than the typical soil and is a better farming soil as it produces higher yields and does not erode so rapidly.

Shelby loam.—The surface soil of Shelby loam, to a depth of 8 or 10 inches, is very dark grayish-brown loose friable loam containing a few large pebbles about one-eighth inch in diameter. The subsoil is more compact, in most places being of silt loam texture or heavier, and it is generally of a mottled gray and olive color. It contains much soft lime and some large gravel. The soil material varies in texture below a depth of 20 inches. It may be heavy or sandy or it may have several alternately heavy and sandy layers. Below a depth ranging from 36 to 48 inches is a light-yellow loose layer which in some places is very sandy and in other places heavy.

Shelby loam includes a total area of 14.9 square miles in Cedar County. The largest areas are in the central part of the county, north of Hartington. About 55 per cent of this soil is cultivated, and the remainder is in pasture. All the land is rather rolling, and the less rolling areas are farmed. The pasture land is rather rough and badly cut up by stream channels, and the slopes to the bottom of the channels are very steep. Most of the cultivated soil produces fair yields of corn.

Hall very fine sandy loam.—Hall very fine sandy loam has a very dark loose surface soil, about 14 inches thick, which feels almost as heavy as loam. It works up very mealy with the plow, disk, or cultivator and can be worked under a wide range of moisture conditions without impairing its physical structure. The subsoil is grayish-brown more or less compact heavy silt loam or clay loam which breaks into large clods when brought up with a shovel. The material in this layer is noticeably heavier than in the subsoils of the upland soils and of the other terrace soils, but it is rarely so heavy that it interferes with the rapid penetration of crop roots or of percolating water. At a depth of about 36 inches lime occurs, and the soil material at this depth and below is loose, friable, and is much lighter in color than the subsoil.

Several areas of this soil near the central-eastern part of the county have a fine sandy loam texture, and the soil is more friable than the typical soil in all layers. It contains an abundance of lime in the lower part of the subsoil, but it does not contain so much organic matter as the typical soil, and, owing to this and to its lower moisture-holding capacity, it does not produce such high crop yields. Another variation occupies an area of about 5 square miles near St. Helena in the northern part of the county. The dark-colored very fine sandy loam surface soil is about 12 inches thick and is underlain by a grayish-brown mellow layer of similar texture. The heaviest layer, which is between depths of 18 and 30 inches, is grayish-yellow firm but not compact very fine sandy loam. Below this layer the texture of the soil material is slightly lighter. At a depth of about 5 feet below the surface the soil is underlain by rotten rock. This included soil is very similar in agricultural value to typical Hall very fine sandy loam.

Hall silt loam.—The surface soil of Hall silt loam is very dark grayish-brown smooth silt loam, from 10 to 14 inches thick. The upper part of the subsoil is brown slightly compact silty clay loam. Below an average depth of 18 inches the material gradually becomes lighter in color and looser, and lime is abundant below a depth of 2 feet. The largest areas of this soil are in T. 29 N., R. 3 E., where it occurs on broad smooth terraces. Although the soil is not sufficiently extensive to be agriculturally important it is a productive soil and is highly prized for general farming. Average crop yields are slightly higher than on Hall very fine sandy loam. Corn yields from 30 to 60 bushels to the acre and oats from 35 to 40 bushels.

Waukesha very fine sandy loam.—The surface soil of Waukesha very fine sandy loam is very dark grayish-brown very fine sandy loam ranging in thickness from 12 to 15 inches and in all respects is very similar to the surface soil of Hall very fine sandy loam. The subsoil,

however, is loam or heavy silt loam. Although the subsoil has no extremely heavy or compact layer, the texture is everywhere heavier than that of the surface soil. The color of the subsoil is lighter than that of the surface soil. Below the subsoil, at a depth ranging from 30 to 60 inches from the surface, is light-brown very fine sandy loam.

This soil does not contain a large amount of lime at any depth, but it is not sour and applications of lime would not be profitable. That it does not have the accumulation of lime in the subsoil common to the other mature soils of the county is due either to the leached condition of the parent material, from which the lime was removed at an early stage of development, or to subsequent leaching as a result of conditions very favorable to subsoil drainage.

This soil occurs on the higher terraces in about the same topographic position as the Hall soils. Its aggregate area is 11.6 square miles.

Waukesha silt loam.—The surface soil of Waukesha silt loam is friable silt loam to an average depth of 15 inches. It contains a large proportion of organic matter and when wet appears almost black. The upper part of the subsoil is brown heavy silt loam or silty clay loam, and the lower part is more friable heavy silt loam. No lime occurs within several feet of the surface. In this respect the soil differs from Hall silt loam.

Waukesha silt loam occurs on terraces at about the same elevation as Waukesha very fine sandy loam. The subsoil is very retentive of moisture and the elevated position of the soil insures adequate drainage. Consequently crops do well in both wet and dry seasons. In agricultural value there is only a very slight difference between this soil and Waukesha very fine sandy loam. The silt loam pulls heavier on the plow, but in ordinary seasons it produces slightly higher yields than the very fine sandy loam.

Judson silt loam.—The largest areas of Judson silt loam are near Schremp School in the northwestern part of the county and near Sunnyside School in the eastern part. This is a young soil, having developed from material recently removed from the uplands by surface wash and deposited near the base of the more gradual slopes, along narrow valleys, or on gently sloping terraces. The deposits are very dark, having been removed chiefly from dark-colored upland soils, and they are uniformly dark to a considerable depth. The soil to a depth ranging from 3 to 5 feet is also nearly uniform in texture being loose and friable silt loam, with no development of layers as in the other soils. If lime was ever present in the material, it soon leached out. This is probably the most productive soil in the county, and it is particularly adapted to corn.

Bloomington very fine sandy loam.—The surface soil of Bloomington very fine sandy loam is very dark grayish-brown very fine sandy loam ranging from 10 to 16 inches in thickness. It is underlain by a lighter-colored shallow subsoil which lies directly on Niobrara chalk rock. In most places the chalk rock is not more than 3 feet below the surface.

This soil occurs on colluvial slopes. It is most extensive in the vicinity of St. Helena and north of Hartington. About 70 per cent of the soil is cultivated, the other 30 per cent being too close to deep drainage ways to be profitably handled. It produces about the same crops, and yields are about the same as on Moody sandy loam. As

plant roots are unable to penetrate very far into the chalk rock, crop yields are less than on soils with thicker subsoils.

Bloomington very fine sandy loam, terrace phase.—Bloomington very fine sandy loam, terrace phase, has a very pronounced black surface soil which is friable and very easily worked. It allows rapid penetration of water and plant roots, is high in organic matter, and is in most places thicker than the average surface soil of the uplands, though it ranges in thickness from 8 to 20 inches. The texture averages very fine sandy loam but is slightly heavier in places and in a few places is silt loam. Large bowlders ranging up to 5 feet in diameter are scattered over the surface. The subsoil is pronounced yellowish-brown soft silty material which is heavier than the material above. Along road cuts a gray layer is apparent between the black surface soil and the yellow subsoil, but when this gray material is crushed or broken the color changes to yellow. The subsoil is underlain at a depth ranging from 5 to 6 feet by unweathered or only slightly weathered soft Niobrara chalk rock. The soil is very limy, in some places lime being present from the surface to great depths.

This is a very good corn and alfalfa soil, but about one-half of it is still in grass, largely owing to the difficulty experienced in cultivating the soil on account of the bowlders on the surface. This soil produces about the same grain and hay yields as Hall silt loam. The native grass on the virgin prairie is very thick and is of excellent quality.

SANDY-TEXTURED SOILS

With the well-drained farming soils are included a number of soils with dark-colored sandy loam surface soils and loose sandy subsoils. These soils are farmed to a considerable extent, but their sandy texture renders them less suitable for certain crops than soils with heavier subsoils. Owing to their porous subsoils, leaching has taken place to a greater depth than in the loamy-textured soils and lime has been removed to a depth of many feet over the greater part of the area covered by these soils.

More than two-thirds of the cultivated area of these soils is farmed to corn, and most of the remainder is sown to oats, alfalfa, and clover. In ordinary years crop yields are less than on the heavier soils of the county, but in very dry years, during which only a few light rains fall, the sandy-textured soils stand the drought better than the heavier soils. There is some risk in planting oats on the sandy soils because the tender oat shoots may be seriously injured in early spring by wind-blown sand. Corn is not harmed so much by the blowing sand, as it does not come up until after the season of the severest windstorms. The rougher areas of these soils are used for pasture land, and they produce a very good quality and large quantities of grass.

The sandy-textured subgroup includes the Dickinson soils and Shelby sandy loam. The Dickinson soils are the most extensive and most important agriculturally, the Shelby sandy loam being used only for pasture land. A very characteristic feature of the Dickinson soils is their position. As a general rule they occur as long narrow strips, from one-eighth to 1 mile wide and from one-half mile to 2

miles long, on slopes and ridges which extend in a northwest-southeast direction. Shelby sandy loam occupies the rougher areas and the ridges and the Dickinson soils occupy the slopes and more nearly level areas. The Shelby soil is of glacial origin and the Dickinson soils are derived from outwash sands, possibly lowland sands.

Dickinson fine sandy loam.—Dickinson fine sandy loam occurs mainly in the northwestern part of the county on slopes and smooth rolling hills. It is easily distinguished from soils of the heavier-textured group by the sandy texture of all layers. The surface layer consists of very dark grayish-brown loose mellow friable fine sandy loam, about a foot thick with a high content of organic matter. This soil can be farmed under a wide range of moisture conditions with no harmful effects to the structure. The upper subsoil layer is about 2 feet thick and consists of dark yellowish-brown medium sand or fine sand, which is looser and more friable than the material above and does not interfere with rapid percolation of rain water. The lower subsoil layer consists of grayish-yellow coarse sand which is very loose and porous. This soil does not contain lime in any of the layers.

Dickinson fine sandy loam averages slightly less productive than the Moody sandy soils, but in some seasons it may produce as well or better. The average yield of corn ranges in different years from 20 to 30 bushels to the acre. Corn is the principal crop as the small grains are often injured in early spring by drifting sand. Oats average from 25 to 35 bushels. Very little wheat is grown as average yields of this grain are low.

Dickinson fine sandy loam, bench phase.—Dickinson fine sandy loam, bench phase, differs from typical Dickinson fine sandy loam only in position. It occurs on nearly level or slightly undulating areas near large streams. This topographic feature gives it an advantage in retaining moisture, and, owing to this, the bench phase produces from 3 to 5 bushels more corn and oats to the acre than the typical soil.

Crop yields on this soil range from 25 to 33 bushels of corn to the acre, from 30 to 40 bushels of oats, from 10 to 15 bushels of wheat or rye, and from 1 to 1½ tons of alfalfa.

Dickinson fine sandy loam, calcareous-subsoil phase.—The calcareous-subsoil phase of Dickinson fine sandy loam covers considerable areas in the northwestern part of the county, mainly in precincts Nos. 1, 2, 3, and 4. This soil differs from the typical soil in being less thoroughly leached, lime occurring in the subsoil at a depth ranging from 36 to 48 inches below the surface. In all other respects it closely resembles typical Dickinson fine sandy loam and has about the same agricultural value. On account of its less leached condition this soil should maintain its productiveness longer than the typical soil and should be better adapted to such crops as alfalfa which requires large amounts of lime.

Dickinson very fine sandy loam, calcareous-subsoil phase.—The calcareous-subsoil phase of Dickinson very fine sandy loam is similar to the corresponding phase of Dickinson fine sandy loam except in texture, both surface soil and subsoil containing a larger proportion of very fine sand than of fine sand. The color and depth of the surface soil and the lime content of the subsoil of both phases are similar. Very little difference could be observed in the productiveness of the

two soils. The largest body of this soil is just east of the center of precinct No. 4, and two smaller bodies are in precinct No. 5.

Dickinson sandy loam.—Dickinson sandy loam is similar to Dickinson fine sandy loam except in texture. The sand constituent of the surface soil and, in most places, of the subsoil is largely of the medium instead of the fine and very fine grades. This coarser texture favors more rapid percolation of water through the soil, and as a result productiveness is somewhat reduced. The difference in productiveness, however, is very slight, being estimated not to exceed 2 bushels of corn and oats to the acre in favor of the very fine sandy loam.

Shelby sandy loam.—The surface soil of Shelby sandy loam is dark grayish-brown sandy loam containing a small proportion of gravel and small glacial bowlders. The upper part of the subsoil is brown sandy loam or sand containing about the same amount of gravel as the surface soil. The subsoil below a depth of 2 feet is loose brown or yellowish-brown sand containing as much or more gravel than the layers above. In places the lower part of the subsoil is a mass of sand and gravel.

Areas of this soil are rolling or sharply rolling. In most places the agricultural value is impaired by the slope of the land, and in a number of small areas erosion has exposed the gravelly sand.

About half of the total area of this soil is in cultivation. Corn yields from 20 to 30 bushels to the acre, oats from 25 to 35 bushels, and wheat from 12 to 15 bushels.

POORLY DRAINED FARMING SOILS

LIGHT-TEXTURED SOILS

The light-textured soils of the group of poorly drained farming soils have a rather wide range in character and agricultural value. These soils occur in the lower bottoms of Missouri River. Their surface soils may range in texture from sands to clays but all are underlain at a slight depth by subsoils which are coarser in texture than the surface soils, in most places being coarse sand and gravel. Although the subsoils are porous and drain rapidly, the water table under the greater part of the area of these soils is near the surface. All the soils are subject to inundation whenever the streams overflow their shallow channels.

The light-textured poorly drained soils include six soils of the Cass series, ranging in the texture of the surface soil from very fine sandy loam to clay. These soils have very dark grayish-brown surface soils about 10 inches thick, and the subsoils are gray medium or coarse sand which is very loose and incoherent. Of these soils, Cass very fine sandy loam produces the highest yields, followed by the fine sandy loam and the sandy loam. These three soils are well adapted to truck growing. The profits derived from crops grown on Cass fine sandy loam are often greater than from crops grown on some of the higher-priced terrace and upland soils.

Water never stands for any great length of time on the Cass soils, as it percolates through the sand layer as fast as it falls on the surface. Although these light-textured soils do not hold so great an amount of water as the heavy-textured soils, they do not lose so much through evaporation, because the surface soils of the Cass soils never crack open as do those of the heavy-textured soils.

Cass very fine sandy loam.—Of the Cass soils the very fine sandy loam is the most valuable agriculturally. The dark-colored surface soil ranges in thickness from 8 to 12 inches. Below this there is, in many places, a very fine sandy loam upper subsoil layer extending to a depth ranging from 18 to 25 inches below the surface. This is underlain typically by gray incoherent sand and gravel. Over a considerable part of the areas occupied by this soil, however, the subsoil consists of alternating layers of very fine sand and very fine sandy loam. The average texture is heavier than that of the surface soil, but water passes readily through the stratified material.

Cass very fine sandy loam occurs in a number of irregular areas in the lower bottoms along Missouri River. The surface of these areas is prevailingly flat except where relieved by old stream channels, sloughs, and low ridges. Natural drainage of the soil is poor, but in most places drainage by ditches is sufficient to render the soil suitable for farming in average years. In very wet seasons, however, the water table is near the surface and the soil remains too wet for successful farming.

Corn and oats are the principal crops grown, with alfalfa in the better-drained areas. This soil is adapted to a wide range of truck crops, but the lack of transportation facilities and markets discourages an extensive development of the trucking industry.

Cass fine sandy loam.—Cass fine sandy loam occurs in a few narrow strips in the Missouri River bottom. This soil differs from Cass very fine sandy loam in having a slightly coarser sand texture. It occurs on sandy ridges that are subject to wind erosion. About half of this soil is under cultivation and produces yields slightly lower than those obtained on Cass very fine sandy loam.

Cass sandy loam.—Cass sandy loam differs from Cass very fine sandy loam mainly in having a larger proportion of medium and coarse sand in both the surface soil and subsoil. As a result of the coarser texture the soil is looser and more porous. This soil occurs in a few areas near the Missouri River channel. The largest body is north of Wynot.

Only about one-third of the land is in cultivation. Its agricultural value is lower than that of Cass very fine sandy loam and averages slightly lower than that of Cass fine sandy loam. The uncultivated part of the land is covered by willows and other bottom-land trees and shrubs.

Cass silty clay loam.—Cass silty clay loam occurs in a few small areas in the northeastern corner of the county. The color of the surface soil ranges from dark grayish brown to grayish brown. The subsoil consists of alternating layers of fine sandy loam, fine sand, and in places silt loam. Drainage is fairly good, and the greater part of the land is in cultivation. Corn and oats are the principal crops, corn in different years yielding from 25 to 40 bushels to the acre and oats from 30 to 45 bushels. Yields are lowered in seasons of high rainfall.

Cass clay loam.—Cass clay loam differs from Cass silty clay loam in the texture of the surface soil. The subsoil has about the same texture and porosity as that of the silty clay loam. Crop yields are very slightly lower on the clay loam. This soil covers only a small total acreage. The largest area is southeast of Green Island Bottom School.

Cass clay.—Cass clay is an unproductive soil, and practically all of it is covered with trees, mostly willows or oaks. It is a very recent soil, as not more than 50 years ago Missouri River flowed over the areas now occupied by this soil. The olive-brown surface soil, which ranges from 10 to 15 inches in thickness, is very sticky and soggy when wet. When dry it cracks and the surface soil, to a depth of one-half inch, curls up. The subsoil is light-brown loose fine rather silty material which is underlain at a depth ranging from 4 to 5 feet by loose friable sandy loam.

HEAVY-TEXTURED SOILS

Among the poorly drained farming soils the heavy-textured soils include those soils having black surface soils and heavy, mottled, poorly drained subsoils. These soils occur in scattered areas over the Missouri River bottom and along the larger streams of the county. The soils of two series, the Lamoure and the Wabash, make up this subgroup, the difference on which they are separated into series being mainly in their content of lime. The Lamoure soils contain lime and most of them have mottled lower subsoil layers which denote poor drainage, and the Wabash soils do not contain lime except, possibly, at very great depths.

Lamoure clay loam.—Most of the Lamoure clay loam occurs along Middle Logan Creek in the southern part of the county, in a belt ranging up to a mile or more in width extending along both sides of the creek almost continuously from the east county line to about 10 miles northwest. The town of Laurel is on the widest and largest area of this soil.

The surface soil of Lamoure clay loam is black clay loam from 10 to 16 inches thick and is very heavy as compared to the surface soils of the upland or terrace soils. The subsoil is mottled gray and brown heavy silty clay loam containing much lime. This layer is poorly drained, as is indicated by the gray color and the many rust-colored splotches. At a depth ranging from 3 to 4 feet is a light-gray layer very high in lime. This layer is more compact than the corresponding layer in any of the upland or terrace soils, and for this reason the underdrainage of the soil is poor.

This soil is more difficult to farm than the sandier-textured soils. When wet it is very sticky and gums up on the plow. When dry it becomes hard and cracks, and the cracks allow great loss of soil moisture by evaporation. In years when the precipitation is neither too plentiful nor too light, the soil produces very high yields, owing to the high organic-matter content of the deep surface soil.

In several places where open drainage ditches have been plowed through the fields and connected to the large drainage ditch northwest of Laurel, increased crop yields have been obtained. Because of the poor drainage, more than two-thirds of this soil is still covered by its natural vegetation or is in meadow. Practically all the area east of Laurel is in meadow. The meadowlands produce good hay, yielding from 1 to 1½ tons to the acre, and they make very good pasture land.

Lamoure clay.—Lamoure clay occurs exclusively along Missouri River. It is readily distinguished from the lighter-textured soils by its cracked surface when dry and its soggy appearance after heavy

rains. The surface soil is heavier than that of Lamoure clay loam, and it is not so dark colored. The subsoil also is heavier. These two layers of Lamoure clay are about as thick as the corresponding layers of Lamoure clay loam. The lower subsoil layers are very similar in both soils. Both soils contain about equal amounts of lime, in places being limy from the surface to a depth of several feet.

This soil has better underdrainage than Lamoure clay loam, probably because it is nearer Missouri River and the percolating water soon reaches the river. Most of the land is farmed, mainly to oats and corn. It produces from 30 to 45 bushels of oats and from 25 to 40 bushels of corn to the acre.

Lamoure silt loam.—The surface soil of Lamoure silt loam ranges from 10 to 14 inches in thickness and is similar to the surface soil of Hall silt loam. The subsoil is similar to the subsoils of the other Lamoure soils except that it is much lighter in texture. Below a depth ranging from 3 to 4 feet the material is loose and rather friable and in most places is mottled gray and brown, with many rust-colored iron stains which indicate poor drainage. This material is very high in lime.

Lamoure silt loam occupies small areas throughout the lowlands of the county. Only about half of the total area is farmed, the rest being so badly cut by small stream channels that it is suitable only for pasture land. This soil produces slightly lower hay yields than Lamoure clay loam, but over a period of years it produces higher yields of other crops than either the clay or clay loam members of the Lamoure series.

Lamoure very fine sandy loam.—Lamoure very fine sandy loam occurs mainly in the Missouri River bottom. The surface soil is very dark grayish brown and is rather sandy as compared with other Lamoure soils. The subsoil, begining at a depth ranging from 8 to 11 inches, is very light colored in the upper part and is as sandy as the surface soil. At a depth ranging from 14 to 18 inches grayish-brown rather plastic clay loam material containing much lime occurs. At a slightly greater depth this material changes to a more friable soil which allows rapid percolation of soil water.

This soil is better drained than any other soil of the Lamoure series. About 90 per cent of it is farmed, mainly to corn, and the remainder is in pasture. It produces about the same yields as Lamoure silt loam.

Wabash very fine sandy loam.—Wabash very fine sandy loam has a deep black friable very fine sandy loam surface soil about 16 inches thick. The subsoil is slightly more compact but it, too, is loose and friable. It is dark in color and extends to a depth ranging from 3 to 4 feet, below which is slightly lighter-colored material. A mottling in the lower part of the subsoil and iron stains in most places indicate slow subsoil drainage. No lime occurs in this soil at any depth.

Where drainage is not deficient the land is very productive, ranking among the best soils of the county. A large proportion of the area of this soil is farmed, but some low bottoms are so badly cut by stream channels that they can not be handled easily and so are left with their natural vegetation. Corn on the better land yields from 30 to 40 bushels to the acre, oats from 40 to 45 bushels, and alfalfa about 2 tons.

Wabash silt loam.—Wabash silt loam has a siltier surface soil and a slightly heavier subsoil than Wabash very fine sandy loam, but in other respects the two soils are very similiar. Yields are slightly higher on the silt loam, but the sandier soil can be plowed under a wider range of moisture conditions. This soil like the very fine sandy loam contains no large amount of lime in either the surface soil or the subsoil, but the presence of sufficient lime is indicated by the vigorous growth of alfalfa.

WELL-DRAINED GRAZING SOILS

The well-drained grazing soils on eroded areas have had their agricultural value seriously impaired by erosion. The rapid removal of the surface material has left the soils thin, and the raw parent material is near the surface. Five soils—Crofton silt loam, Knox silt loam, Shelby gravelly sandy loam, Sogn loam, and Boyd clay loam—comprise this group. The Crofton and Knox soils are underlain by loose floury silt, the Shelby soil by stony and gravelly glacial drift, the Sogn soil by white chalk rock, and the Boyd soil by shale. All these soils are thin, have sharply rolling surface relief, and are of low agricultural value. Only a small proportion of their acreage is cultivated, and the remainder is used for pasture.

Crofton silt loam.—Crofton silt loam, like some of the Moody soils, is not fully developed because of erosion. It occupies rather steep slopes and narrow ridges within areas of Moody silt loam and resembles that soil except that its topsoil averages much thinner. Run-off has been sufficiently rapid and continuous to remove, or nearly remove, the dark-colored topsoil, but in few places has it greatly affected the subsoil layer, in which there is an abundance of concretionary lime.

The topsoil, in most places, consists of 6 or 8 inches of very dark grayish-brown mellow silt loam. This is underlain by about 12 inches of light grayish-brown friable silt containing numerous hard lime concretions, similar to those in the upper subsoil layer of the Moody soils. Beneath the concretionary layer is the parent material, consisting of loose grayish-yellow or almost white silt which continues to depths exceeding 12 or 15 feet. The parent material, although very limy, contains only a few lime concretions.

Owing to its unfavorable surface relief, Crofton silt loam, as a whole, is not suited to crop production and probably not more than 5 per cent of it is under cultivation in Cedar County. It supports a luxuriant grass cover and is used chiefly for grazing. Corn and alfalfa are the principal crops on the cultivated areas of the soil. Alfalfa yields about the same as on Moody silt loam, but the yields of corn average about 10 per cent lower than on that soil.

Knox silt loam.—Knox silt loam is the most severely eroded of the silty upland soils. It occupies steeply sloping or very rough land, where more or less constant erosion has removed the topsoil and upper part of the subsoil to below the layer in which concretionary lime occurs. The rapid run-off has kept the unweathered and limy parent silt at or within a few inches of the surface and the entire profile is very light in color.

The largest areas of Knox silt loam border the Missouri River bluffs, where the land is so badly cut by erosion that it is used almost exclusively for pasture and timberland.

The soil consists of grayish-brown or light grayish-brown loose mellow silt loam, underlain at a depth of 6 or 8 inches by loose light grayish-yellow or almost white silty parent material similar to that from which the Moody and Crofton soils have developed. Lime is abundant from the surface downward, occurring chiefly in finely divided form.

Knox silt loam differs from the Moody and Crofton soils chiefly in that its topsoil is thinner and lighter-colored and in that hard lime concretions occur in few places in such abundance in its subsoil. If either the Moody or Crofton soils on steep slopes are neglected and erosion is allowed to proceed unhindered, they will eventually become Knox soil.

Knox silt loam is better adapted to grass than to a cultivated crop, as the grass tends to check erosion. Most of the soil is in virgin sod and should remain in sod. A few small areas are cultivated, but yields on them are only from one-third to one-half as large as on Moody silt loam. A larger proportion of oats than corn is planted as fields seeded to oats are less subject to erosion. Knox silt loam is a very strong fruit soil and is well adapted to apples, grapes, and blackberries. However, fruit production in Cedar County is not practiced on a commercial scale to a great extent owing to the danger of late spring frosts.

Shelby gravelly sandy loam.—Shelby gravelly sandy loam occurs on sharp ridges and steep slopes. Most of the ridges have a very pronounced northwest-southeast direction. Large bowlders are scattered over the surface. The surface soil is very dark grayish-brown very loose friable gravelly sandy loam, ranging from 4 to 14 inches in thickness but averaging about 8 inches. The subsoil ranges from a few inches to 2 feet in thickness and varies in texture from sandy loam to heavy clay loam. The subsoil contains gravel and is underlain by loose gravel which in many places lies at a depth of only 26 inches from the surface.

More than 95 per cent of this soil is in pasture. The grass is of good quality, but on most of this soil the stand is lighter than on any other upland soil in the county. On the more gradual slopes the grass is plentiful.

Sogn loam.—Sogn loam occurs in small areas, mainly on hilltops or steep slopes where erosion has removed almost all the soil material, leaving the raw or only slightly weathered Niobrara chalk exposed in places. This soil is readily recognized by its white color. Where Sogn loam occurs on colluvial slopes the soil material is from 2 to 3 feet thick.

This is an unproductive soil, and is farmed only in small areas within large cultivated fields of other soils. Crops planted on this soil soon wilt and die because the roots are unable to penetrate the soil material. In some places grass grows, but most of the areas are barren.

Boyd clay loam.—The surface soil of Boyd clay loam is black heavy clay loam which cracks badly on drying. It is comparatively high in organic matter but contains less than some of the other upland soils that are much lighter in color. The subsoil is more plastic and heavier textured than the surface soil and in most places is mottled black and gray clay. It becomes very hard when dry, but roots penetrate it without difficulty and water is able to percolate through to lower depths. The subsoil contains an abundance of lime, occurring mostly

as concretions and very large splotches. At a depth of 4 feet the Pierre shale is reached. This is a black or slate-colored flaky material having a soapy, slippery feel when wet.

This soil includes a total area of less than 1 square mile. The largest bodies are in section 22 of precinct No. 4 and section 31 of precinct No. 2. More than 90 per cent of the soil is farmed, and the rest is in pasture. This is a good agricultural soil, although it is harder to handle than other upland soils. It is better suited to wheat and oats than to corn, but it produces good yields of all crops, ranking with Moody very fine sandy loam in crop yields.

POORLY DRAINED GRAZING SOILS

The poorly drained grazing soils occur in the Missouri River bottoms or in flat or depressed areas where drainage is so restricted that water stands over the surface for some time after rains. As a result of poor drainage these soils are of low agricultural value or nearly worthless. The soils included in this group are Sarpy loamy sand in the Missouri River bottom, Scott silt loam and Fillmore silt loam, alkali phase, in the upland depressions, and a small area of muck in a creek valley.

Sarpy loamy sand.—Sarpy loamy sand has a yellowish-brown surface soil about 8 inches thick, below which is light-gray fine sand which continues to a depth of several feet. Areas of this soil are not so flat as are other bottom soils because they are cut in many places by old stream channels and also include numerous sand mounds. This soil occurs on several of the small islands in Missouri River and in narrow strips along the river. A very small acreage is farmed, and most of the soil is covered with willows. The small farmed areas are planted to corn and cane, which do not produce very profitable yields.

Scott silt loam.—Scott silt loam has a thin dark friable surface layer with a high content of organic matter, underlain by a subsurface layer of gray floury friable silty material. This material resembles white alkali and is so called by many farmers, but it has no harmful qualities, being simply material leached of its iron and organic matter. The combined thickness of the surface and subsurface layers ranges from less than 8 to about 12 inches. The subsoil is very stiff almost impervious clay which continues to a depth ranging from 5 to 6 feet. The material of this layer in most places is dark gray with many rust-brown iron stains. It is underlain by loose friable light grayish-brown or yellow material similar to that underlying the Moody and Knox soils.

Scott silt loam is considered nearly valueless. It occupies basin-like depressions locally called "lagoons" or "buffalo wallows." Run-off water drains into them, and underdrainage is very poor, water often standing on the land for several months at a time. Only a few very small areas are mapped in the county, the larger ones being on the line between precincts 13 and 14, west and northwest of Logan View School.

This soil is very difficult to farm as it is sticky and slippery when wet and hard and rough surfaced when dry. It is best suited for grazing and hay production. The vegetation consists of sedges, grama, and western wheatgrass. The native grasses yield from one-half to 1 ton of hay to the acre. During long droughts the vegetation suffers from lack of moisture, as the soil cracks badly on drying and evaporation becomes excessive.

Fillmore silt loam, alkali phase.—Fillmore silt loam, alkali phase, has a very dark grayish-brown or almost black heavy silt loam surface soil, underlain by a dark-colored dense heavy claypan. Below this is lighter-colored heavy but more friable material. Lime in most places occurs at a depth of about 40 inches below the surface. As a result of poor drainage a concentration of salts has taken place in the surface layer, which is not characteristic of typical Fillmore silt loam. These salts, together with standing water, have killed vegetation over a large part of the land, which, as a result, has been given the name "alkali flats." This soil differs from Scott silt loam in having a deeper and darker-colored surface soil and a better-drained subsoil.

Less than 1 square mile of this soil is mapped. It occurs in flat or basinlike areas on the upland. It is of low agricultural value but is more productive than Scott silt loam. A small part of the land is used in the production of wheat, but the greater part is not cultivated, being used only for pasture.

Muck.—Muck is of minor importance in Cedar County. One area occurs about 3 miles northwest of Laurel in the valley of Parent Creek. Muck consists of more or less decomposed vegetable matter mixed with the mineral constituents of the soil. It is spongy or slightly plastic when wet but loose and friable when dry. This land is poorly drained and very little of it is under cultivation. With proper drainage muck can be made to produce fair crops of corn, and it is naturally adapted to celery, onions, and cabbage.

SOILS AND THEIR INTERPRETATION

Cedar County is in the Great Plains region and is west of the dividing line between soils with carbonate accumulation, on the west, and those without carbonate accumulation, on the east. Most of the soils in the county are prairie soils and in virgin condition are covered with a heavy growth of prairie grasses. The climate of this region is such that grasses are the dominant vegetation, and they have left their influence on the soil by giving it high organic-matter content, with the resulting dark color.

When soils are very young or just beginning to form, the parent material or geologic formation is the controlling factor in determining soil characteristics. This material is gradually changed by the soil-forming processes such as oxidation, leaching, aeration, and the accumulation of organic matter. The degree of this change depends on three main factors, namely, the character of the parent material from which the soil must develop, the soil-forming processes, controlled mainly by climate and vegetation, acting on these formations, and the length of time the processes have acted without disturbance.

The soil-forming processes are nearly the same over all parts of Cedar County. The wide differences in the soil characteristics must therefore be owing to the parent materials, to the time during which the soil-forming processes have acted, or to both. The parent materials have caused some of the soils to have very sandy layers and some to have silty layers. Where the processes have acted without disturbance for a long period of time mature soils have been developed. Immature soils have developed where the parent material has been resistant to soil-forming processes, where erosion has been active, where drainage has been poor, or where a combination of these factors has occurred.

The surface layers of the mature soils developed on the smooth, well-drained uplands in this county are dark, ranging in color from grayish brown on the slopes to very dark grayish brown on the more level land. Most of the soils have loose friable A horizons and lighter-colored and slightly more compact B horizons. The parent material is almost invariably friable and light colored. It consists of loess except in the northwest fourth of the county and on a ridge extending from the northwest part to the east-central part of the county. In those areas the parent material is glacial material and materials which are known to geologists as Loveland sands. The influence of the parent material on the soils of this county will be discussed more in detail with the different soil groups.

The precipitation has been sufficient to leach the carbonates to a depth ranging from 3 to 4 feet in such areas of the mature loams and silt loams as have not been disturbed by erosion. Many of the sandy soils have had their carbonates leached to a depth ranging from 3 to 6 feet. On some of the steep slopes water absorption has not been sufficient to leach the carbonates as fast as erosion is removing the surface soil, and carbonates may occur on the surface or at a depth ranging from 10 to 14 inches.

The Moody soils are the dominant soils of Cedar County. A profile of Moody silt loam, deep phase, will be described as representative of these soils. This soil occurs on the nearly level or slightly undulating uplands in the southern part of the county. It has not been disturbed to a great extent by erosion, and the soil-forming processes have been working uninterruptedly for a long time.

A sample of Moody silt loam, deep phase, was examined in a pit 1,050 feet east of the west quarter line in sec. 30, T. 31 N., R. 1 E. The profile showed the following layers: A_1, 0 to 1½ inches, dustlike very dark grayish-brown or black silt loam containing considerable very fine sand. The upper inch of this layer is lighter in color than the lower half inch which is grayish brown and is laminated. The laminæ are well developed and have a faint sprinkling of gray over their surfaces and are gray to a slight extent internally. A_2, 1½ to 8 inches, very dark grayish-brown or black silt loam. This layer consists primarily of soft, distinct, irregular rounded granules, one-eighth inch in diameter, which break apart without additional loose material. Numerous small round insect casts appear both in clusters ranging from 25 to 50 individuals and singly in narrow short channel ways. The soil particles become considerably lighter in color, generally grayish brown, when crushed. The gray sprinkling is less pronounced than in the layer above. A few scatterings of coarse sand grains occur in this layer. B_1, 8 to 22 inches, grayish-brown heavy silt loam with a pronounced brown tinge. The material of this layer ranges from coarsely granular to cloddy, and the structure units are indefinite and soft. There is some evidence of boring structure. The crushed material is light grayish brown in color. This is probably the most compact layer in the profile, but the compaction is discernible only by comparison with the layers above and below. B_2, 22 to 42 inches, is the same as the layer above except a little lighter in color on both natural and crushed surfaces. This layer seems to have a slightly more definite boring structure and is a little more friable than the layer above. B_3, 42 to 56 inches, yellowish-brown silt loam which is very porous owing to the presence of small root

holes. This material is very calcareous, the carbonates occurring as numerous hard, hollow concretions from one-eighth to one-half inch in diameter and also in disseminated form. This layer is the carbonate zone or at least the zone of carbonate concretion. The material is stained with pale rust brown and locally by a black coloration. Most of the rust-brown color occurs along root-hair channels, but some occurs in vague splotches. C_1, 56 to 66 inches, has the same material as the layer above, but this layer contains practically no lime-carbonate concretions. The carbonate is very abundant in disseminated form and there are a few soft splotches. This layer has a more pronouced pale rust-brown staining than the layer above. Very few roots were observed at this depth. The material is loess, little altered by the soil-forming processes. Below this is the underlying drift. As a rule the loess covering in the Moody soils is thicker than shown here and drift lies 10 or more feet below the surface.

Table 5 gives the hydrogen-ion values of samples of soil taken at various depths from the profile of Moody silt loam, deep phase, described. The determinations were made electrometrically, the hydrogen electrode being used.

TABLE 5.—*Hydrogen-ion determinations of Moody silt loam, deep phase, in Cedar County, Nebr.*

[1:2 soil-water ratio]

Depth	pH value[1]	Depth	pH value[1]	Depth	pH value[1]
Inches		*Inches*		*Inches*	
0–1½	6.04	34–38	7.04	59–63	8.56
3–7	6.29	46–50	8.36	68–72	8.58
15–19	6.69				

[1] Average of 8 determinations.

The typical Moody soils occur on the rolling hills of the upland. These soils are similar to the deep phase of Moody silt loam except that their dark-colored surface soils are not so thick. These soils, as exposed in a deep road cut, show several interesting features. The outstanding characteristic is the carbonate-concretion zone, the concretions being very conspicuous in size, number, and distribution. Most of them are rounded and are from one-eighth to one-half inch in diameter; some are from 1 to 1½ inches long and are thin, with almost right-angled bends or joints; others resemble broken limestone chips. Most of the concretions do not have a solid center. Some have a very small void space in the center, and others are hollow shells. The outside covering of all the concretions is much whiter and softer than the remaining part, which is dark gray and has the hardness of orthoclase feldspar. The outside coating has about the hardness of talc. The solid concretions are composed of the same material as the coatings of the hollow concretions, but the hollow concretions are more easily crushed than the solid ones. There seems to be no definite place of occurrence of the hollow concretions or of the solid ones, and the number of concretions varies from place to place and with the texture of the soil. They are most abundant in the B_3 layer, where in many places they are 2 inches or less apart. They are distributed in such a way that the line between the concretion zone and the limeless layer above is rather definite. The lower boundary is not definite, as the concretions gradually decrease in number, but

not in size, with depth. This concretion zone ranges from 8 to 25 inches in thickness and generally occurs at a depth ranging from 8 to 20 inches below the surface of the ground. There is no definite relationship between the depth at which this zone occurs and the surface relief. In most, but not all, instances it is nearest the surface on the hilltops. On the hillsides it may be near the surface in one place and may lie at considerable depth in another. Other characteristic features of these soils are the dark olive-gray B horizons and the light grayish-yellow C horizons.

Crofton silt loam, as mapped in Cedar County, includes areas in which the typical Moody soils have been subjected to such continuous erosion that the dark-colored topsoil has been almost or entirely removed. The underlying B horizon, with its high content of lime concretions, is either within a few inches of the surface or is exposed.

The Waukesha soils differ from the corresponding soil types of the Moody series in that their A horizons are deeper, in most places being about 30 inches thick. In other characteristics the soils are very similar. The Waukesha soils occupy terrace positions.

The Hall, Fillmore, Scott, and Boyd soils have characteristic compact B horizons. All have black friable A horizons and all except the Boyd soils have light grayish-yellow parent materials. The Boyd parent material is slightly weathered Pierre shale. All these soils except the Scott contain carbonate in the B_3 layers. Fillmore silt loam, alkali phase, contains a very slight amount of alkali in the A horizon, about 320 parts of soluble salts per 100,000 parts of dry soil.

The Hall soils occupy nearly flat or very slightly undulating terraces. In a profile of Hall very fine sandy loam observed in a pit 800 feet north of the southwest corner of sec. 14, T. 32 N., R. 2 E., the only difference that could be instantly observed between this and the profile of Moody silt loam, deep phase, was the heavier B horizon in the Hall soil. This horizon shows numerous cracks and cleavage planes and the soil material feels much denser and more compact than that in the B horizon of the Moody soil.

The Hall profile shows the following layers: A_1, 0 to 2 inches, dustlike single-grained black very fine sandy loam containing numerous grass roots. A_2, 2 to 14 inches, with the same color and texture as layer above. This layer has some small cubical or angular structure particles, but much of the material has a single-grained structure. B_1, 14 to 33 inches, very dark grayish-brown heavy silt loam. This is the compact layer in which the material is slightly plastic when wet and medium hard when dry. It contains many small insect casts and some insect borings. When exposed to the weather the material breaks into large rather firm clods, about 4 inches in diameter, which in turn break into smaller clods having no definite soil structure. B_2, 33 to 38 inches, light grayish-brown friable silt loam. This layer is cloddy like the layer above, but the material is much looser and more friable. There is a definite color change between this layer and the layer above. B_3, 38 to 55 inches, yellowish-brown very friable loesslike silt loam. This is the lime-carbonate zone. The carbonate occurs in as many forms as in the Moody soils. C_1, 55 to 77 inches, light grayish-yellow silty loess. Carbonate is visible in this layer, mostly in disseminated form.

Some areas of Hall soils mapped in Cedar County differ somewhat from this profile, principally in the thickness of the A horizon and

the compactness of the B horizon. The A horizon ranges from 10 to 20 inches in thickness, and in some places the B horizon is only slightly more compact than the A horizon which is poorly developed because of erosion. In the vicinity of St. Helena a few areas of soil occur which are similar to the Moody soils but which were separated from those soils on the basis of physical characteristics, and they have been included with the Hall series. These soils occur on what seems to be Missouri River loess on an old high bench which has been very badly dissected by drainage ways. These areas are more gently undulating than the surrounding areas of Moody soils. The outstanding characteristic of these included soils is the very gradual change in color from a deep black A horizon, through a dark grayish-brown B horizon, to a light grayish-yellow C horizon. The layers are indistinct and all the material is very loose and friable and has a single-grained structure. Another characteristic is the occurrence of disseminated carbonate beginning at a depth of 18 or 20 inches and continuing to great depths. A zone of carbonate accumulation occurs at a depth ranging from 3 to 4 feet.

Knox silt loam is the only member of the Knox series in Cedar County. It occupies, in general, steeper slopes and sharper ridges than any other loess-derived soil and occurs chiefly in the Missouri River bluff section where the land is badly dissected by drainage ways.

The soil differs from the Moody and Crofton soils in that it consists largely of unweathered or only slightly weathered loess. Excessive and rather constant erosion has prevented the accumulation of much organic material in the surface soil and has removed the weathered soil material almost as fast as it has formed. The A horizon in few places exceeds 6 or 8 inches in thickness and is prevailingly grayish brown or light grayish brown. It rests directly on unweathered loess. The soil is highly calcareous from the surface downward. It differs from Crofton silt loam in the lighter color of its topsoil and in that it contains no noticeably developed B horizon.

The Dickinson and Shelby soils are poorly developed owing to the resistant character of their sandy parent materials. The Dickinson soils are developed from Loveland sands and the Shelby soils from the Kansan or Nebraskan glaciation, or from both. All the soils of these series have formed under conditions of good surface and internal drainage. The Shelby soils show some poorly drained layers but these were probably deposited during glaciation. Percolating waters have removed the readily soluble salts from the weathered soil layers of the Dickinson soils. The Shelby soils have a zone of carbonate accumulation. Percolating waters, however, have not been sufficiently abundant to carry any of the finer-textured surface soil particles into the lower soil layers, probably owing to the slow weathering of all the soil material. In the Dickinson soils, the subsoils are lighter textured than the surface soils. In the Shelby soils the subsoils may be heavier, but this is owing to the deposition layers in the glacial material.

Dickinson fine sandy loam occurs on the smooth rolling hills and on nearly level benches. A characteristic feature of a profile of this soil and also of all soils of the series, is the color of the layers, which changes with depth from very dark grayish brown in the surface layer to yellowish brown or brown in the subsoil and to light grayish brown in the parent material. There is very little evidence of organic

matter below a depth of 12 inches. The material throughout the entire profile is loose and friable and becomes coarser with depth. Banks along the roadside do not slough off like the sand banks of the sand hills.

Following is a profile description of a sample of Dickinson fine sandy loam exposed in a pit along highway No. 15, 1,120 feet north of the southeast corner of sec. 13, T. 32 N., R. 1 W.: A_1, 0 to 1 inch, loose fluffy very light grayish-brown fine sandy loam containing many gray medium sand particles. This layer and the layer below contain an abundance of grass roots and are fairly well supplied with organic matter. A_2, 1 to 12 inches, loose incoherent very dark grayish-brown fine sandy loam containing much reddish-brown medium or coarse sand and gray fine sand. The sand grains are rounded and most of them are quartz. There is a slight horizontal breakage along large clods of the soil mass. These clods are about 5 inches in diameter, irregular in shape, and easily crushed. B_1, 12 to 26 inches, single-grained dark yellowish-brown medium or fine sand containing very little organic matter and few roots. The material in this layer is very friable. C_1, 26 to 54 inches. This layer differs from the one above in color, being light yellowish brown. C_2, 54 to 80 inches, the parent material of grayish-yellow coarse sand containing very few roots and no lime. Each layer shows a gradual transition to the layer below. Very little gray sand is noticeable below the second layer, and there is no breakage of the soil mass below this layer. Small gravel, 3 millimeters or larger in diameter, are scattered throughout the soil mass.

The calcareous phases of the Dickinson soils have slightly heavier B horizons than the typical soils, and carbonate accumulations occur at depths ranging from 38 to 49 inches. In all other respects the phases are similar to the typical soils.

The Shelby soils contain a larger amount of gravel in many of the layers. The surface soils are dark colored, very similar to the surface soils of the Dickinson soils. The subsoils are mottled gray, are medium compact, and are very high in carbonate which generally occurs in large soft splotches. The C horizons generally contain much more gravel than in the Dickinson soils.

The Cass and Sarpy soils are bottom-land soils which are not normally developed, owing both to the sandy and gravelly parent material and to the poor drainage conditions under which they have formed. The Cass soils have very dark surface soils and gray sandy subsoils. The Sarpy soils have light-colored surface soils and gray gravelly subsoils.

The soils that are poorly developed owing to lack of time for development are the Wabash soils on the bottom land, Judson silt loam on the terraces, and Sogn loam on the upland. These soils have not developed definite soil horizons, but in time they may develop layers as they have fair to good drainage and are weathering from silty material. The Wabash and Judson soils are lime free and have deep black surface soils with good granulation. There is very little color or textural change within the soil profiles of these soils. The Sogn soil has a shallow black surface soil and may have a thin subsoil, or this layer may be lacking. The parent material is Niobrara chalk rock. The poor development of this soil is owing partly to erosion, as it erodes readily and very little surface material has accumulated on the parent rock.

SUMMARY

Cedar County is in northeastern Nebraska, on the eastern slope of the Great Plains region. The surface relief ranges from hilly to very hilly except along the river bottoms. The county is adequately drained by streams that flow into the Missouri River.

The area of the county is 730 square miles. The population, according to the 1930 census, is 16,427. Hartington is the county seat and largest town.

The climate of Cedar County is well suited to the growing of all the main cereal crops, except wheat, and to the raising of livestock. The average annual precipitation is 27.88 inches, most of which comes during the growing season, from April to September. There is very little crop loss due to frost, but there is some danger of drought.

Agriculture in Cedar County consists mainly in the growing of corn, oats, and alfalfa, which rank in acreage in the order named, and in the raising and feeding of hogs and cattle. For the 10-year period 1916 to 1925 the average yield of corn was 34 bushels, of oats 33.9 bushels, and of alfalfa 2.7 tons to the acre.

The Federal census of 1925 reports the value of all crops in Cedar County as $5,980,750 and the value of all domestic animals as $5,882,245.

In 1930 the average size of farms was 204.5 acres. In the same year 95.3 per cent of the area of the county was in farms, and a large proportion of this was improved land. About half the farms are operated by owners and the other half by tenants.

Cedar County lies in that part of the Great Plains region where the precipitation has not been sufficient to leach the carbonates to a depth greater than 3 or 4 feet in the mature soils. All the soils show the influence of the natural vegetation and of weathering under the prevailing climatic conditions. The most striking feature of the mature soils is the dark color of the surface layers, the result of a decaying grass vegetation. Another characteristic of the mature soils is the arrangement and character of the soil layers. A thin dustlike surface layer composed largely of fine mineral particles and organic matter in various stages of decay is underlain by a dark layer of loose imperfectly granular material, below which is a lighter-colored layer which is very slightly heavier and which has a carbonate concretion zone in the lower part. Underlying this is the loose friable light-colored loesslike parent material.

The poorly developed soils have developed under conditions that have retarded plant growth and decay. They occur on the steeper hill slopes, in areas of loose incoherent sand, and as recent alluvial deposits.

In this county 40 soil types and phases, which are included in 17 soil series, and muck have been mapped. The soils on the upland are grouped in the Moody, Knox, Crofton, Dickinson, Shelby, Bloomington, Scott, Sogn, Boyd, and Fillmore series; those on the terraces in the Waukesha, Hall, and Judson series; and those on the bottoms in the Lamoure, Wabash, Cass, and Sarpy series.

The Moody soils are the dominant soils in Cedar County, half the area of the county being occupied by them. They are very good agricultural soils and are adapted to all the cereal crops of the region, as well as to hay, fruit trees, and garden crops.

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[PUBLIC RESOLUTION No. 9]

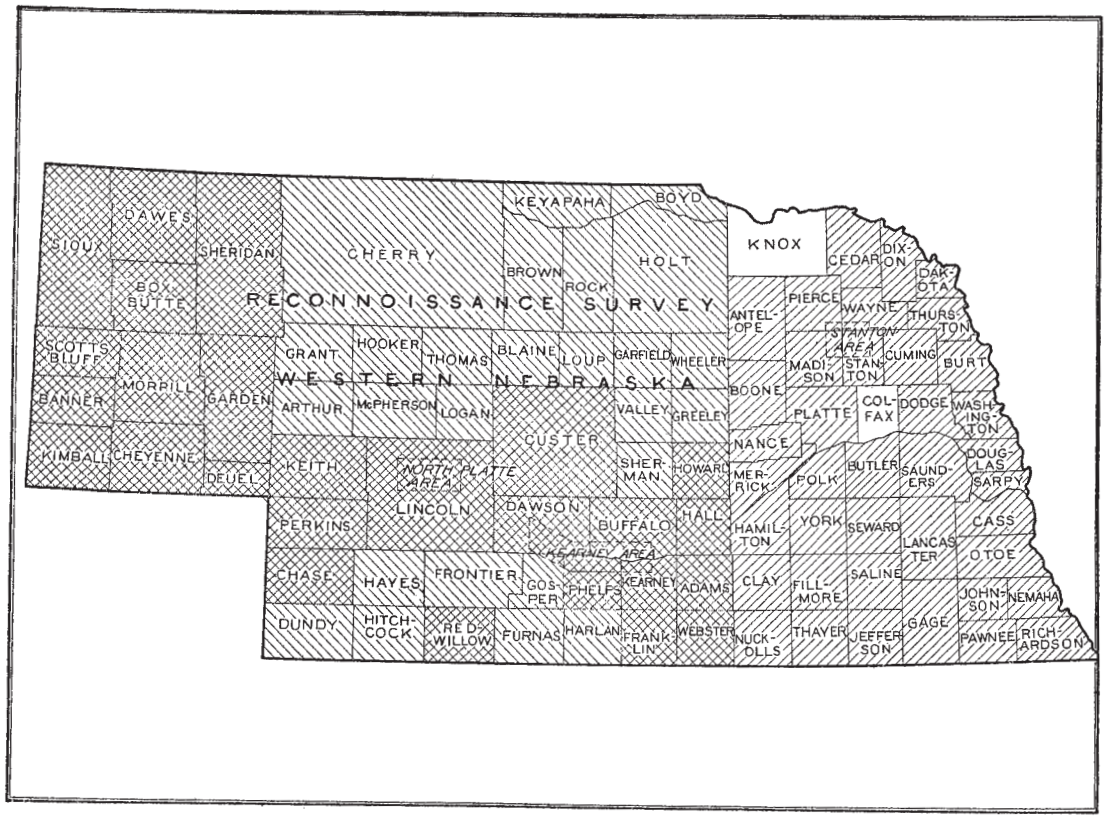
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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

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

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in Nebraska, shown by shading

U. S. GOVERNMENT PRINTING OFFICE: 1932

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