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Soil Survey
of
Colfax County, Nebraska

By

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and
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Nebraska Soil Survey

Bureau of Chemistry and Soils

In Cooperation with the
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CONTENTS

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By A. W. GOKE, in Charge, W. J. MORAN and F. A. HAYES, United States Department of Agriculture, and E. A. NIESCHMIDT, Nebraska Soil Survey

COUNTY SURVEYED

Colfax County is in east-central Nebraska (fig. 1). Schuyler, the county seat, is about 60 miles northwest of Omaha. The county is almost rectangular in shape. It is 18 miles wide from east to west and averages 22 miles in length from north to south. The southern boundary is formed by the south bank of Platte River. The county comprises 405 square miles, or 259,200 acres.

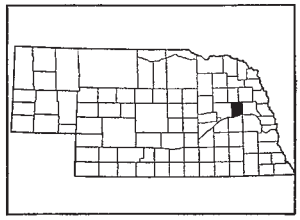

FIGURE 1.—Sketch map showing location of Colfax County, Nebr.

The area included in Colfax County is part of a great loess-mantled plain, on which minor relief has been produced by stream erosion. For convenience in reference, the county may be described as including parts of two physiographic divisions; namely, the eroded loess-covered plain which occupies the northern three fifths and comprises all the upland in the county, and a lower flat or gently undulating valley which occupies the southern two fifths and is known in the Nebraska surveys as the Platte plain. The boundary between these two divisions crosses the southern part of the county in a general northeast-southwest direction, and it is fairly straight except where minor stream valleys extend from the Platte plain into the upland.

The eroded plain, or upland, ranges from almost level to strongly rolling, and it is cut by numerous streams, with their strips of alluvial land. The comparatively level parts of the upland are the less-eroded remnants of the old plain, and they occupy only the higher divides. The largest remnants are in Midland and Maple Creek Precincts in the central and east-central parts, and in Wilson Precinct, southeast of Leigh in the northwestern part of the county, where they occupy the greater part of the upland. Elsewhere the remnants, although numerous, are confined to comparatively narrow divides and comprise a small part of the total upland surface. In numerous places along the edges of the old-plain remnants, and locally in their interiors, small drainage ways have cut narrow shallow valleys with rather steep sides.

Throughout that part of the upland where the original surface of the loess plain has been removed by erosion, a strongly rolling surface relief has been produced. The drainage pattern is dendritic, the slopes to the larger streams are long and gradual, and most of the divides are well rounded. Many of the valleys near the heads of major and secondary drainage channels are narrow and

steep-sided, but they become broader and their slopes become more gradual downstream.

The alluvial land within the eroded plain, including the flood plains and terraces, occurs in fairly continuous strips from one eighth to about three fourths of a mile wide along the larger upland streams. The widest developments are along Middle Fork Maple Creek and East Fork Maple Creek.

The surface of the alluvial land is in general flat, though locally it may be modified by slight depressions and old or present stream channels. The flood plains occupy the lowest positions and are from 3 to 8 feet above normal flow of the streams. The terraces, which are small and few, are from 5 to 15 feet above the flood plains and from 30 to 75 feet below the adjoining upland. Most of the slopes from the flood plains to the terraces are short and steep, but those from the terraces to the upland are long and gradual.

The second physiographic division, the Platte plain, constitutes the valley of Platte River, the broad alluvial belt which comprises the southern two fifths of the county. The general surface of the Platte plain is similar to that of the alluvial land throughout the eroded loess-plain division, but the range in relief is greater and most of the land lies at a lower level.

Terraces, or bench lands, which occupy about 50 percent of the Platte plain, occur at several distinct levels. One of the highest benches is between the bottom lands along Platte River and Shell Creek in the southwestern part of the county, known in the Nebraska surveys as the Shell Creek Terrace. That part occurring in Colfax County comprises about 29 square miles and is triangular in shape, being about 4 miles wide along the western boundary and tapering to a point 2 miles north of Schuyler in the south-central part. The surface of this terrace lies from 40 to 80 feet above the channel of Platte River and from 50 to 90 feet below the general level of the eroded loess plain. A slightly lower and much smaller terrace is north of Rawhide Creek in the southeastern part of the county. The remaining terraces throughout the Platte plain are from 30 to 60 feet lower than the level of the high Shell Creek Terrace. All the benches range from nearly level to gently undulating. The surface relief of the higher benches is characterized by numerous shallow, basinlike depressions.

The flood plains or bottom lands throughout the Platte plain lie from 3 to 5 feet above the river channel and comprise the lowest land in the county. Here the surface relief is prevailingly flat, although it is modified locally by shallow depressions, slight elevations, overflow channels, and small areas having a strongly undulating surface where the wind has piled the looser flood-plain deposits in low mounds and ridges.

Colfax County has an average elevation of about 1,400 feet above sea level. Uneroded remnants of the old loess plain north of Leigh are about 1,640 feet, and the Platte River channel south of Rogers is about 1,300 feet above sea level, giving a total range in elevation of about 340 feet. The altitude[1] at Leigh is 1,592 feet, at

[1]GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U.S. Geol. Survey Bul. 274, Ed. 4, 1072 p. 1906.

Clarkson 1,490 feet, at Howell 1,458 feet, at Lambert 1,375 feet, at Schuyler 1,350 feet, and at Rogers 1,310 feet above sea level. The prevailing slope is to the south and east.

The drainage of the county is effected by streams flowing in a general southeasterly direction into Platte River which bounds the southern side of the county.

Well water of excellent quality is readily obtained in all parts of the county. On the upland and higher terraces wells range in depth from 60 to 150 feet, and in the lower-lying alluvial lands they are from 10 to 50 feet deep.

Colfax County is in the prairie region of the United States. Native trees, consisting principally of willow, ash, elm, boxelder, and cottonwood, grow only within or near the channels of the larger streams. The native grasses, in situations not disturbed by cultivation are of the tall-grass sod type—chiefly big bluestem and little bluestem.

The first permanent settlement in the area now included in Colfax County was made near the mouth of Shell Creek in 1856. The county was established from a part of Platte County in 1869 and was organized the same year. The first families to settle in the county were from Omaha, but most of the early settlers came from the Eastern and East Central States. People of German descent but of American birth formed a large percentage of the early settlers.

According to the census data, the population of the county steadily increased between 1880 and 1910, there being 6,588 inhabitants in 1880 and 11,610 in 1910. In the decade 1910–20, however, the population remained practically stationary, the 1920 census reporting 11,624 people in the county. The 1930 census reports a slight decrease in population to 11,434. Of this number 85.7 percent is native-born white; 14.2 percent foreign-born white; and only 0.1 percent is composed of Negroes, Japanese Chinese, and Indians. The foreign-born white people are largely from Czechoslovakia, Germany, Ireland, and England. The rural population averages 21.8 persons a square mile and is densest in the Platte Valley and in the vicinity of the towns.

Schuyler, in the south-central part, is the county seat and the only city in the county. It has a population of 2,588, which constitutes 23 percent of the total population of the county. Howell, Clarkson, Leigh, Richland, and Rogers are important villages, all of which are on railroads and provide good shipping points for farm products and distributing points for farm implements and supplies.

Transportation facilities are good. A main line of the Union Pacific Railroad, following the Platte Valley across the southern part, and a branch line of the Chicago & North Western Railway, crossing the northern part of the county, furnish connections with outside points. State and Federal highways, either paved or surfaced with gravel, cross the county in east-west and north-south directions. The county roads, which generally follow section lines, are of earth construction but are kept in good condition. Cement bridges and culverts are common on nearly all roads.

All sections are served with rural mail delivery, telephones are in common use, and the public-school system is highly developed.

CLIMATE

Climatic conditions influence crop yields and farming practices, regardless of the character of the soils, and must be considered in the selection of crops best adapted to any region. Differences in surface relief are not sufficient to cause appreciable differences in climate within the county.

The climate of Colfax County is continental and temperate. Variations in temperature between winter and summer are wide, but the climate is well suited to the production of grain, vegetable, and hay crops and to the raising of livestock. The spring season is cool with considerable rainy weather, which favors rapid growth of winter wheat and spring-planted small grains. The summers are long, with warm days and nights, which are especially favorable to the growth of corn. The autumn season is long and pleasant, with only occasional periods of rainy weather, giving the farmer ample time in which to prepare and seed the land for winter wheat. Low temperatures frequently prevail during the winter, but they are usually accompanied by snow which protects winter-grown crops from serious injury.

The average date of the last killing frost is April 29 and of the first is October 4. This gives an average frost-free period of 158 days, which is ample for the maturing and handling of all farm crops common to the region. Killing frosts have occurred as early as September 12 and as late as May 25. During the years from 1895 to 1914, there were 5 years in which killing frost occurred 10 or more days earlier in the fall and 4 years in which frost occurred 10 or more days later in the spring than the average dates.

The precipitation varies greatly from year to year. In the 20-year period, 1895 to 1914, inclusive, it was less than 85 percent of the mean annual in about one fourth of the years. About 78 percent of the mean annual precipitation falls from April to September, inclusive, or during the principal part of the growing season. In summer the precipitation usually occurs as heavy thundershowers, although torrential rains are rare. Droughts are almost unknown during May and June, but in the latter part of July and during August short dry periods sometimes occur. However, crops seldom suffer from lack of moisture when properly tended, as most of the soils have a high available moisture-holding capacity.

The annual snowfall ranges from a few inches to several feet, averaging 26.5 inches. Most of the snow falls from December to March, inclusive. From about October 1 to April 1 the prevailing wind is from the northwest, and during the remainder of the year it is from a southerly direction. Strong winds are common, yet tornadoes are infrequent.

Table 1, compiled from the records of the United States Weather Bureau station at Schuyler, located in the Platte Valley in the south-central part of the county, gives the more important climatic data and is considered representative for Colfax County.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Schuyler, Colfax County, Nebr.*

[Elevation, 1,357 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1916)	Total amount for the wettest year (1915)	Snow, average depth
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	23.9	67	−24	0.89	0.72	0.25	5.2
January	20.5	63	−28	.50	1.29	.36	4.8
February	23.3	70	−24	.90	.35	3.66	7.1
Winter	22.6	70	−28	2.29	2.36	4.27	17.1
March	38.0	91	−20	1.08	.65	2.00	4.9
April	51.0	98	19	2.66	1.18	2.64	2.5
May	61.5	103	25	4.10	3.43	4.53	.1
Spring	50.2	103	−20	7.84	5.26	9.17	7.5
June	71.7	105	39	4.58	3.19	5.36	0
July	78.2	110	44	3.38	1.93	9.47	0
August	74.8	108	39	3.74	2.98	5.04	0
Summer	74.9	110	39	11.70	8.10	19.87	0
September	65.5	106	25	2.79	.97	4.95	0
October	52.6	93	9	1.80	.89	.63	0
November	40.0	79	−4	.91	.51	.65	1.9
Fall	52.7	106	−4	5.50	2.37	6.23	1.9
Year	50.1	110	−28	27.33	18.09	39.54	26.5

AGRICULTURE

The early history of agricultural development in Colfax County is in a general way, similar to that of most counties throughout northeastern Nebraska. Prior to 1856, the area now included in the county was inhabited chiefly by Indians, hunters, trappers, and cattlemen. The land was covered with a luxuriant growth of prairie grasses, the range was free, and cattle raising was very profitable. The first permanent settlers located in the valleys where water and wood were easily obtained. Later, settlement gradually spread to the uplands, and most of the cattlemen were forced to move their herds farther west.

Sod corn was usually the first crop planted and this, together with game and beef, formed the chief food. Later, wheat, oats, barley, and garden vegetables were grown.

The early agricultural development was somewhat retarded by lack of familiarity, on the part of the farmers, with local climatic and soil conditions, by the use of seed poorly adapted to the region, by insect pests, and by droughts. However, the settlers profited by the experiences of farmers in counties to the east and southeast and rapidly adjusted their crops, seed, and farming practices to the requirements of the new region.

Corn has been the leading crop since farming began. Spring wheat ranked second in acreage until late in the eighties when the area devoted to oats was greatly increased and has since exceeded

that in wheat. The importance of wheat in the early agricultural development was owing largely to the fact that wheat was needed for food and for cash. The yields and profits from this crop were low, and where the farmers became better established, livestock became the most important source of revenue and more feed was needed. Oats, being an important feed crop and well adapted to the soil and climate, were grown more and more extensively at the expenses of the wheat acreage. Considerable wheat is still grown, and most of it is of the winter varieties.

Table 2, compiled from the Federal census reports, gives the acreage and production of the leading crops in Colfax County in 1879, 1889, 1899, 1909, 1919, and 1929.

TABLE 2.—*Acreage and production of leading crops in Colfax County, Nebr., in 1879, 1889, 1899, 1909, 1919, and 1929*

Crop	1879		1889		1899	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	24,224	816,977	67,545	2,894,613	82,680	2,928,510
Oats	5,713	76,153	20,738	558,892	34,596	1,128,410
Wheat	28,944	118,173	10,225	128,743	27,054	334,710
Rye	830	4,936	1,377	21,044	3,536	61,940
Barley	873	4,305	205	3,237	1,808	52,880
Flaxseed		3,511	2,125	19,397	8	100
Potatoes		23,918	1,107	97,186	1,114	135,306
		Tons		*Tons*		*Tons*
Hay (all kinds)	3,617	5,099	33,224	43,482	40,106	56,087
Wild					37,186	50,522
Timothy						
Clover					296	449
Timothy and clover						
Alfalfa					359	625
	Trees	*Bushels*	*Trees*	*Bushels*	*Trees*	*Bushels*
Apples			3,413	1,424	31,106	7,278
Plums						
Cherries						
	Vines	*Pounds*	*Vines*	*Pounds*	*Vines*	*Pounds*
Grapes					15,306	28,300

Crop	1909		1919		1929	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	73,942	2,691,550	76,181	2,496,623	[1] 82,718	3,220,977
Oats	43,233	1,012,122	42,187	1,419,974	41,753	1,338,763
Wheat	22,937	455,269	26,119	273,497	20,172	358,141
Rye	233	3,360	1,058	16,885	449	5,407
Barley	208	4,500	1,656	38,157	4,072	110,917
Potatoes	874	87,952	723	36,716	505	51,121
		Tons		*Tons*		*Tons*
Hay (all kinds)	30,479	53,775	32,299	52,925	27,232	43,815
Wild	22,635	37,234	20,199	28,797	15,859	21,100
Timothy	939	1,460	297	470		
Clover	230	341	703	1,259	2,052	2,980
Timothy and clover	2,448	3,791	618	864	1,030	1,231
Alfalfa	3,115	9,143	9,397	19,715	8,117	18,216
	Trees	*Bushels*	*Trees*	*Bushels*	*Trees*	*Bushels*
Apples	29,652	52,809	11,168	7,060	6,123	8,000
Plums	3,677	424	545	103	1,011	665
Cherries	5,336	1,064	2,458	660	2,572	1,294
	Vines	*Pounds*	*Vines*	*Pounds*	*Vines*	*Pounds*
Grapes	18,702	73,711	9,123	31,063	4,178	21,739

[1] In addition to corn harvested for grain, 114 acres were cut for silage, yielding 759 tons; 311 acres were cut for fodder; and 6,768 acres were hogged off.

Table 3 gives the number and value of domestic animals and poultry on farms and ranges in 1910, 1920, 1925, and 1930.

TABLE 3.—*Number and value of domestic animals and chickens on farms and ranges in Colfax County, Nebr., in 1910, 1920, 1925, and 1930*

Kind of livestock	1910		1920		1925		1930	
	Number	Value	Number	Value	Number	Value	Number	Value
Horses	8,753	$1,022,760	8,681	$903,070	7,971	$507,390	7,426	$485,321
Mules	471	65,185	566	81,482	653	53,078	601	49,783
Cattle	28,563	664,545	27,573	1,329,786	29,775	967,990	28,810	1,539,575
Sheep	4,792	17,191	931	10,598	2,695	28,525	2,405	16,756
Goats	73	241	9	67	18	126	25	137
Swine	66,025	476,358	65,752	1,298,986	74,002	1,209,488	103,147	1,209,588
Chickens	135,307	51,382	147,959	124,302	172,565	143,229	187,465	146,223

According to the 1930 Federal census, 96 percent of the land in the county is in farms, of which 76.4 percent is crop land, 20.4 percent pasture land, and 0.2 percent woodland not pastured. The remainder is not classified but is probably included in highways, incorporated places, and farm building sites. According to the same authority, the value of all crops was $3,674,643 in 1929, and the value of all livestock, including poultry on hand April 1, 1930, was $3,448,964. In 1929 dairy products, including butter, cream, and whole milk sold, were produced to the value of $230,825 and poultry and eggs sold were valued at $352,185.

Corn, oats, winter wheat, wild hay, and alfalfa are the major grain and hay crops. Less important crops are red clover, barley, potatoes, and sweetclover, ranking in acreage (during most years) in about the order named. Table 4, compiled from the 1928 Nebraska agricultural statistics, shows the average acre yields of the principal crops during the period 1916 to 1925, inclusive, and the average acre yields in 1928, together with the approximate percentage of the county devoted to each crop in 1928.

TABLE 4.—*Average acre yields of the principal crops in Colfax County, Nebr., 1916–1925, and 1928, with approximate percentage of the county devoted to each crop in 1928*

Crop	Average yield		Area in crops	Crop	Average yield		Area in crops
	1916–1925	1928			1916–1925	1928	
	Bushels	*Bushels*	*Percent*		*Tons*	*Tons*	*Per cent*
Corn	34.0	30	32	Wild hay	1.32	1.1	6
Oats	34.3	30	17	Alfalfa	3.06	3.0	3
Winter wheat	16.0	20	11	Sweetclover	----------	2.1	1
Barley	----------	31	0.4	Red clover	----------	2.0	0.7
Potatoes	----------	87	.2				

Most of the farms range in size from 100 to 500 acres. The average size in 1930 was 178.7 acres.

Of the 1,393 farms in the county in 1930, owners operated 922, tenants 458, and managers 13. On farms operated by tenants, either the cash or share-rental system, and sometimes a combination

of the two, is used. The cash system is most popular, 54.1 percent of the tenants being cash tenants. Under this system the tenant pays from $3 to $6 an acre as rent for the land, including the pasture areas and farm site. When the land is rented for a share of the crops, the owner receives from one third to one fifth of the grain, delivered to him, and from $3 to $4 an acre for the pasture land. All seed, labor, and machinery is furnished by the tenant. When alfalfa or prairie-hay land is rented on shares, the owner generally receives one half of the hay stacked in the field. Tenants on the better farming land, which includes that on the terraces and throughout the more nearly level parts of the uplands, usually rent on the share basis.

The farms, as a rule, are well improved, and practically all of them are equipped with modern labor-saving machinery. Most of the buildings are painted and are kept in good repair. The farms are fenced and cross fenced, mostly with barbed wire, but much woven-wire fencing is used around alfalfa fields and feed lots. Four-horse teams perform most of the farm work, although tractors are used on many of the more nearly level farms. According to the Nebraska agricultural statistics, there were 203 grain threshers, 726 gas engines, 530 tractors, 274 trucks, and 1,419 automobiles on the farms in 1928. The more expensive farm machinery is sheltered.

Farm laborers are ordinarily rather plentiful except during the corn and small-grain harvest seasons, when good help is often scarce. Permanent helpers receive from $30 to $40 a month with board and lodging. Day labor during the small-grain harvest season commands from $4 to $5. The customary charge for threshing is 6 or 7 cents a bushel for wheat and 3 or 4 cents for oats. Corn shuckers usually receive 4 or 5 cents a bushel for shucking corn.

The agricultural industries of Colfax County are closely related to the utilization of the crops. Most of the cultivable land is used for feed crops, including corn, oats, alfalfa, and sweetclover. The uncultivable areas are used largely for native pasture or hay. The greater part of the crops is fed to livestock either on the farms where produced or on farms situated within the county. The returns derived from the sale of livestock and livestock products, therefore, are the chief sources of income in Colfax County. Cattle fattening and hog raising are the most important branches of the livestock industry.

Some cattle are raised locally, but most of them are purchased when 2 or 3 years old, either from the Omaha markets or from ranches in the western counties of Nebraska. The animals are fed corn and alfalfa for a period ranging from 60 to 90 days, after which they are shipped to Omaha or Chicago. Many farmers fatten from 1 to 3 carloads of cattle each year, and a few feed cattle under contract. Under one form of contract the owner delivers the cattle to the farmer and allows him so much a pound for all gain in weight. At the end of the feeding period the owner ships the cattle to market. Another system is to allow the farmer a few dollars a head plus the market price for all grain and hay used in fattening. Some farmers fatten calves for shipment as baby beef to the Omaha market. The calves when weaned are fed on oats. The ration is later

changed to corn and alfalfa, and the animals are shipped when from 14 to 18 months old. Most of the beef cattle are of grade Hereford or Shorthorn breeding, and most of the local herds are headed by a purebred bull.

Nearly every farmer raises from 20 to 60 hogs a year, and a few have herds of several hundred. Most of the hogs are raised on corn and alfalfa, although young pigs usually receive some oats. Barley and rye are also sometimes added to the ration. Many hogs are raised in connection with the feeding of beef cattle. All the hogs are of good breeding, and many purebred herds are in the county. Duroc-Jersey, Poland China, and Hampshire are the leading breeds. Practically all the hogs are fattened on the farms where raised, and most of them are sold in Omaha. At times hog cholera disastrously affects hog raising, but the disease can be largely controlled through vaccination and sanitation.

Dairy products are an important source of income on most farms. Only a few farms are devoted exclusively to the dairy industry, but most farmers keep from 5 to 19 milk cows, chiefly of mixed beef and dairy breeding, and sell their surplus dairy products to local cream buyers. Cream routes are established in nearly all parts of the county, and most of the cream is collected by the purchaser. A few farmers keep purebred dairy herds, chiefly Holstein-Friesians, especially in the vicinity of the larger towns. The abundance of alfalfa, to balance the corn ration, and good market facilities favor the extension of the dairy industry.

Sheep raising receives little attention. A few farmers annually ship in a carload or two of sheep for fattening, but very few sheep are raised in the county. The animals to be fattened are fed corn, alfalfa, and sweetclover and are sold on the Omaha market when the price is favorable.

Horse raising is confined chiefly to the breeding of the work mares. Most of the horses are of Percheron breeding. Purebred stallions are kept on a few farms.

Chickens are a valuable asset on most farms. The local demand for poultry products is increasing, and poultry raising is receiving considerable attention. Most farmers keep from 50 to 60 chickens, and many maintain purebred flocks of several hundred. The principal breeds are Plymouth Rock, Leghorn, and Rhode Island Red. Poultry products are either sold or are exchanged for farm supplies in the local towns.

Cropping methods and practices in Colfax County are similar to those throughout other northeastern Nebraska counties.[2] The county lies along the northern border of the winter-wheat area of Nebraska. Much wheat is grown in the southern part of the county, chiefly on the finer-textured terrace soils, but the acreage devoted to this crop rapidly decreases in the northern part. The agriculture of the northern part is of the intensive meat-producing or livestock-production type, but the southern part is more typically a general-farming area, with more winter wheat grown and somewhat fewer livestock raised.

[2] The remainder of this section of the report was written by P. H. Stuart, Extension Agronomist, University of Nebraska.

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Corn is the most important crop, occupying about 84,000 acres, which is approximately twice the oat and three times the wheat acreage. Reid Yellow Dent is the leading corn variety, although other yellow varieties and some white dent varieties are grown. The tendency among farmers is to select a somewhat smoother, heavier, dimple-dented ear in place of the rougher deep-kerneled seed ears popular in the past. Tests have shown that this type of seed will yield from 3 to 5 bushels an acre more than the rough deep-kerneled seed. The smoother-eared types tend to produce somewhat earlier, less leafy corn plants which require less rainfall for their development, and which therefore, are better adapted where moisture may be a limiting factor in corn production as it is in most of the Corn Belt.

Most of the farmers select their own seed, either early in the fall when husking or, during favorable seed-maturing years, from the crib when shelling. Some seed corn is shipped into the county, although this is not advisable, as such seed usually yields less than a good type of well-adapted local seed.

One of the most important factors in determining the yield and profit from corn is soil fertility, particularly organic matter and nitrogen, which are the first plant nutrients to become depleted. The Nebraska 10-acre corn-yield contest results show a close correlation between legume crops in the rotation and high yields of corn. In 1929, the 10 highest-producing fields in the eastern Nebraska section of the contest averaged 1.8 years since they were seeded down to legumes. Their average yield was 98.4 bushels an acre.

Red clover, sweetclover, and alfalfa are used to maintain fertility. The use of sweetclover as a soil builder is increasing. This crop is very generally seeded with small grain, particularly oats and barley, to be plowed under as a green-manure crop during late April or early May of the following year. Corn is then planted on such fields.

Some corn in Colfax County is surface planted and some is listed. Listed corn stands drought better, requires somewhat less labor for cultivation, and the stalks are less likely to lodge, which facilitates husking. Soil washing is likely to be more serious in listed corn than in surface-planted fields, particularly on rolling land; and on level land listed corn may drown out more readily than surface-planted corn.

The practice of plowing alfalfa land to a slight depth and then listing it to corn is a common and recommended plan. Corn on newly broken alfalfa land is likely to grow rank, owing to an excess of available nitrogen, and dry weather may injure the crop badly. By listing corn on such land, the stalk growth is retarded somewhat and dry weather causes less injury.

The general tendency is toward the use of larger machinery for corn production, such as two or more rowed listers and cultivators. Corn is usually cultivated three times. The main purpose of cultivation, according to tests, is to eradicate the weeds, and cultivation in excess of this requirement is not likely to prove profitable, nor do the farmers of the county generally practice it.

Most of the corn is fed on the farm where produced, or at least within the county. The feeding of livestock assists in maintaining

soil fertility by use of legume crops and barnyard manure. Some corn is cut for fodder and some is put into silos, although silos are not numerous. Most of the cornstalks are pastured by livestock during the winter. A considerable acreage of corn is hogged down, and sheep and cattle are sometimes turned into the standing corn to pasture the crop.

Treatment of seed corn has not proved beneficial under Nebraska soil and climatic conditions and is not generally practiced. Corn smut is carried over from year to year in the fields and not on the seed, which makes seed treatment ineffective as a control measure for this disease.

Winter wheat annually occupies about 29,000 acres of land in Colfax County. Most of the wheat is produced in the southern two thirds. Turkey, or improved strains of this variety, such as Nebraska 60, predominates, and some Kanred is grown. A small acreage of spring wheat is grown, although this is not an important or profitable crop. Winter rye is a mixture in wheat that causes some trouble and loss to growers.

Wheat usually follows wheat, oats, or barley, although occasionally it is seeded in standing corn or in cornland from which the crop has been removed for silage or for fodder. A very important factor in the production of good yields of winter wheat is the early preparation of the seed bed. Experiments show that the yield of winter wheat on early-prepared land is approximately double that produced on fields plowed late. Small-grain stubble land plowed or listed in July and kept free from weeds until seeding time has produced 29 bushels of wheat an acre at the Nebraska Agricultural Experiment Station at Lincoln, compared to 14 bushels on similar land plowed in September. The increased yield on land prepared early is because of the accumulation of soil moisture and nitrates through the prevention of weed growth following harvest. Methods of tillage which prevent weed growth during the period between harvest in July and seeding in September give about equal results, measured in terms of yield of the following crop of wheat.

Stinking smut is a serious disease of wheat and is widespread in the county, requiring seed treatment with copper carbonate or formaldehyde. Although the hessian fly is ordinarily not a serious pest in this county it may cause some injury to very early seeded fields. Farmers seed fairly early, preferably in mid-September, as early-seeded wheat compared to late-seeded wheat is less likely to winter-kill and the land is less subject to blowing during late winter and early spring. When the hessian fly is prevalent, it is recommended that seeding be delayed until the fly-free date is announced by the State entomologist.

The winter-wheat crop ripens and is cut in early July. Most of the wheat is cut with a binder, then shocked, and later threshed from the shock. Much of the wheat is sold at harvest time, and some is stored for later sale.

Sweetclover or red clover is sometimes seeded on winter wheat in late winter or early spring. It may be harrowed or rolled in, but some farmers broadcast the seed, depending on rains and freezing and thawing of the ground to cover the seed. Winter wheat is a rather poor nurse crop, and the likelihood of obtaining a satis-

factory stand of clover is less than when clover is seeded with a spring-sown grain crop.

The farmers of Colfax County, particularly in the northern third, devote a large acreage to oats, about 44,000 acres being seeded to this crop each season. Ordinarily the oat crop returns a lower profit than corn, wheat, or barley, but, because it fits into the rotation well, makes a good nurse crop for clover or grass, and is a very desirable grain feed for horses and for growing livestock, it is extensively grown. There is a tendency to reduce the oat acreage in favor of barley. This is a logical trend, as barley produces an average of about one third more feed an acre than oats.

Most of the oats grown are of the early-maturing varieties. Kherson—or strains of the variety such as Nebraska 21 which is a white, high-yielding strain developed by the Nebraska Agricultural College—is most extensively grown. Oats ordinarily follow corn in the rotation. The land is usually disked and the oats broadcast or drilled in late in March or early in April. Early seeding is recommended, as tests show that seedings in late March or early April outyield later seedings. Smut may cause severe reductions in yields. Formaldehyde is recommended for treating seed oats and is very generally used by careful farmers. Most of the oats grown are fed on the farms of the county. Oat straw is valued as a feed and for bedding, and it is usually stacked at threshing time.

Colfax County does not have a large acreage devoted to barley, although the production of this crop is increasing as it rightly should. Barley ranks next to corn, measured in terms of feed produced an acre. The development of high-yielding smooth-bearded varieties of barley, such as Comfort and Glabron, has removed the disagreeable task of handling the rough-bearded varieties, which made the production of barley unpopular in the past. Beardless varieties have not yielded nearly so well as the bearded varieties and are not recommended. Early seeding of barley during late March or early April at the rate of 2 bushels an acre has given the best average results. Most of the barley grown is fed on the farms. Feeding tests show that coarsely ground barley is 90 percent as good as corn as a fattening ration. Barley is a good substitute for corn, and a reasonable acreage is profitable and will insure feed should unfavorable weather reduce the corn crop. Barley is equal, if not superior, to oats as a nurse crop for alfalfa or clover seedings.

Rye is not an important crop. It is used chiefly as temporary fall and spring pasture, especially for brood sows and pigs, and more rye might well be used in this way. It is seeded and harvested like winter wheat when grown for a grain crop. Rye is a particularly good crop for sandy soil, and Rosen is the best variety for this county.

Nearly 7,000 acres are devoted to alfalfa, and this acreage could be profitably increased. Alfalfa is largely seeded in the spring, during April or May. If seeded in the fall, it is sown during August or early September. Many farmers use oats or barley as nurse crops for spring-seeded alfalfa. Weeds, such as foxtail and crabgrass, cause considerable difficulty in obtaining satisfactory stands of alfalfa, when it is spring seeded, especially if no nurse crop is used. If the season is dry, alfalfa or clovers seeded with a full seeding of

small grain may fail to make satisfactory stands. It is a fairly common plan to reduce the rate of seeding of the nurse crop about one fourth or one third. A very important essential in obtaining stands of alfalfa and clovers is a well-packed seed bed.

Common alfalfa from Nebraska or from regions with at least as severe climatic conditions is ordinarily sown and, according to farmers' experience and experimental tests, is very satisfactory. A small amount of Grimm and Cossack alfalfa is seeded. It is highly important and strongly recommended that certified northern-grown alfalfa seed be used, otherwise untimely and costly losses caused by winterkilling may occur. The Nebraska Crop Growers' Association, with headquarters at the agricultural college, certifies and approves alfalfa seed which is recommended for use in Colfax County and other sections of Nebraska.

Tests fail to show the need of, or beneficial results from, liming or from inoculation for alfalfa or clover production. It is not good practice to leave alfalfa on upland fields too long, as the subsoil moisture is likely to be exhausted after several seasons, which results in low yields of hay. Some difficulty may be experienced in obtaining satisfactory yields of alfalfa when this crop is seeded a second time on upland fields which previously had been in alfalfa for a considerable period. This, according to investigations at the Nebraska Agricultural Experiment Station, is due to the exhaustion of the subsoil moisture to a great depth. The subsoil moisture is restored very slowly after alfalfa sod is broken, as most of the seasonal rainfall is used by the annual crop grown on the land. Alfalfa meadows are usually left as long as the stand and yield are satisfactory. The crop is not used in short rotations.

Owing to an excess of available nitrogen and to a lack of soil moisture, corn planted on alfalfa sod may "burn" badly during dry seasons. The large nitrogen supply tends to produce a luxuriant growth of corn which requires much water for its development. Damage from drought may be avoided, at least in part, by plowing alfalfa sod to a slight depth and then listing in the corn. An early variety of corn is also sometimes grown on new alfalfa land and, during normal seasons, corn on alfalfa land makes very excellent yields. Small grains may lodge when sown on land which has recently been in alfalfa or clovers, and corn is therefore ordinarily used on such fields.

The use of sweetclover has increased remarkably in the last 10 years. Its chief use is as a soil builder, although it is used largely as a pasture crop and to some extent for seed and for hay. Cattle and sheep on sweetclover pasture may sometimes suffer from bloating, but this trouble is usually not serious. Much of the sweetclover is seeded with small grain to be plowed under for corn in late April or early May of the following spring. This is a good and growing practice which often causes an increase, ranging from 10 to 15 bushels an acre, in the yield of corn over the yield in fields not seeded to sweetclover. Some farmers in plowing under the second year's growth of sweetclover for corn do this too late for best results, as the tall heavy growth dries out the soil moisture, causing the corn crop to suffer if the season is not favorable. Sweetclover should not be more than 8 or 10 inches high when turned under. Sweetclover

on poor thin soils is usually left throughout the second year, being used for pasture, hay, or seed. On a few farms, particularly on very poor land, it is plowed under in midsummer for green manure or is allowed to mature unpastured in the field. The second year's growth of sweetclover greatly improves the structure and tilth of heavy soil areas. Sweetclover is recognized as the outstanding soil-building crop, as it not only quickly restores soil fertility but also fits in well with short rotations.

Both the yellow- and white-blossomed biennial varieties of sweetclover are grown, and both are satisfactory. Most of the sweetclover is seeded with spring grain on disked cornstalk ground. Neither inoculation nor liming is necessary for growing this crop, but it starts easiest on those upland soils from which erosion has removed the surface soil, exposing a limy subsoil particularly favorable to sweetclover. Occasionally some trouble is experienced in starting sweetclover on alluvial bottom land.

Wild hay, in which big bluestem, little bluestem, and grama grasses predominate, is grown on about 16,000 acres. This crop is grown largely on land subject to overflow, where drainage is poor, or on slopes where soil washing is severe unless the soil is kept covered with sod. Much of this hay is fed to horses within the county, and some is baled and shipped.

The permanent pastures are composed largely of bluegrass and white clover, although some other perennial pasture crops are used. Permanent pastures usually occupy the flood areas along streams or the rough lands. Many pastures are overgrazed, thus allowing weeds to become established. Grazing too early in the spring is also detrimental to the grasses. Manure may be used to advantage on pasture land, but it is usually applied to cultivated land, and the quantity available is too small to cover such areas satisfactorily.

No commercial fertilizer is used. Tests to date have failed to show profitable returns from superphosphate or other fertilizers. Barnyard manure is commonly applied with good results to grain crops, particularly wheat and corn. It is necessary to use legumes to supplement barnyard manure, as the supply of manure is too small to maintain the organic-matter supply of the soil on the average farm.

SOILS AND CROPS

The soils of Colfax County are naturally productive, and, prior to their use for crops, most of them supported a luxuriant growth of prairie grasses. The annual decay of the grass roots produced an abundance of black well-decomposed organic matter, and most of the soils have accumulated enough of this material to make their topsoils dark regardless of the color of the parent material from which they have weathered. The intensity of darkness and the depth to which the dark color has penetrated depend on the surface relief, the drainage, and the length of time the soils have lain in their present positions undisturbed by erosion.

In the more nearly level well-drained parts of the county, except those parts covered by recently deposited light-colored sediments, decomposed vegetable material is most abundant and has penetrated most deeply into the soils. On the steeper slopes the organic matter

has been removed almost as fast as formed, and the soils are light colored even on the surface. Between these topographic extremes, the content and the depth of penetration of the organic matter varies with the degree of slope. The areas in which organic-matter accumulations have been greatly restricted are confined to a few steep valley sides around the heads of drainage ways and to local areas of recently deposited sand in the stream valleys.

In addition to their prevailingly dark color, most of the soils are characterized by a crumblike or granular structure in their topsoils, this feature persisting to greater or less extent in all except the more sandy soils.

A third fairly uniform characteristic in the soils is the occurrence of lime in sufficient quantities for crop needs. This characteristic, however, is less persistent and in many places is less pronounced than the dark color and crumblike structure. None of the soils contains an abundance of lime in the surface layer, and some of them do not have noticeable amounts in the subsoil. Nevertheless, none of the soils shows evidence of lime deficiency, except those in basinlike depressions, where water stands for considerable periods and downward seepage has carried the lime away in the underdrainage, and those underlain by loose porous sands from which the lime is easily leached.

The three rather persistent characteristics—high organic-matter content of the topsoil, granular or crumblike structure of the topsoil, and high lime content of the subsoil—are valuable soil assets in connection with crop production. Organic matter is a strong absorbent of both heat and moisture; it increases the water-holding capacity of the soil and assists in maintaining a uniform temperature; it is loose and mellow and promotes favorable tilth; and it is the chief source of nitrogen, an important plant food. The granular or crumblike structure facilitates easy penetration of crop roots and allows free passage of air and water, which change the raw vegetal and mineral constituents of the soil into food suitable for growing crops. Lime, when present in sufficient quantities, prevents the soil from becoming sour, or acid, and assists in preserving its organic-matter supply and crumblike structure.

The general soil characteristics mentioned favor the production of corn, small grains, and hay, on which the prosperity of the inhabitants of Colfax County largely depends. Nearly all the soils will produce these crops, and their intricate association on many farms necessitates using them to greater or less extent for each of the crops commonly grown. However, the characteristics common to most of the soils are not equally well developed in all, and one or more of them are absent in some soils. Some of the soils have characteristics which, although favorable to one crop, may be decidedly unfavorable to another, and all the soils cannot be used for all the crops with equal economy.

The distribution and yields of the different crops depend to a large extent on the character of the subsoils. The subsoils of the different soil types range from loose incoherent sand to dense comparatively impervious clay. These differences directly control the storage of available soil moisture in both surface soil and subsoil and affect the penetrability by plant roots.

In this report, as a matter of convenience, the upland and terrace soils will be considered in groups separate from the bottom soils. Such a grouping is not entirely justified by either soil characteristics or crop adaptations, but in the mind of the farmer the bottom soils are considered as distinct from the soils of the upland and the higher terraces.

On the basis of soil characteristics and other features that seem to be the most influential in determining the economic utilization of the land, the soils of Colfax County may be separated into three broad groups as follows: Upland and terrace soils with friable subsoils, upland and terrace soils with claypan subsoils, and bottomland soils.

The first and last of these groups include several soils which are used more or less extensively for all crops common to the county, but a greater proportion of the soils in any one group is used for some particular crop or crops than is similarly used in either of the other groups.

In the following pages of this report, the soils of Colfax County are described in detail and their agricultural relationships are discussed; the accompanying soil map shows their location and distribution in the county; and table 5 gives their acreage and proportionate extent.

TABLE 5.—*Acreage and proportionate extent of soils mapped in Colfax County, Nebr.*

Type of soil	Acres	Per-cent	Type of soil	Acres	Per-cent
Marshall silt loam	52,928	20.4	Lamoure silty clay loam	13,952	5.4
Marshall silt loam, heavy subsoil phase	19,136	7.4	Lamoure silty clay loam, claypan phase	3,520	1.4
Moody silt loam	62,464	24.1	Lamoure fine sandy loam	1,152	.4
Hall silt loam	15,040	5.8	Cass very fine sandy loam	8,576	3.3
Waukesha silt loam	14,528	5.6	Cass fine sandy loam	704	.3
Waukesha very fine sandy loam	1,408	.5	Cass loamy sand	3,648	1.4
O'Neill fine sandy loam	9,600	3.7	Sarpy sand	4,352	1.7
Shelby loam	3,584	1.4	River wash	832	.3
Hall silt loam, claypan phase	960	.4			
Scott silt loam	1,664	.6	Total	259,200	------
Wabash silt loam	41,152	15.9			

UPLAND AND TERRACE SOILS WITH FRIABLE SUBSOILS

The soils of this group occupy about 75 percent of the county, including all of the upland and terraces except small scattered areas in which a claypanlike layer is developed in the subsoil.

The soils of six soil series, namely, Moody, Marshall, Shelby, Hall, Waukesha, and O'Neill, belong to this group. The soils of the first three series named occupy upland positions, and the soils of the last three are on terraces or second bottoms. The Waukesha series includes two soil types and Marshall silt loam includes a phase, making a total of eight individual soils. The most extensive soils have developed over light-gray silty material, and the less extensive soils, over gray sand, red silt, or a mixture of grayish-brown silt, clay, sand, and gravel. All these parent materials are friable and, with the exception of the sand, are retentive of moisture and well supplied

with mineral plant food. None of them in its raw unweathered condition contains much nitrogen, but this constituent is abundant in the organic matter of the soils developed from them.

The surface relief of the area occupied by these soils ranges from nearly level to steeply sloping. Throughout the greater part of the upland the surface relief ranges from undulating to strongly rolling, and only a negligible proportion of the area occupied by the soils of this group is too rough for cultivation. The more nearly level areas are on the terraces and on the higher upland divides. Drainage is well developed, and on some of the valley sides surface run-off is rapid and erosion is rather severe.

Aside from the more sandy soils, which are seldom used for small grains on account of the danger of the sand drifting, thereby exposing the shallow roots to drought, the soils of the group are used more or less indiscriminately for all crops adapted to the county. The terrace soils of the group, as a whole, are a little more productive than the upland soils, owing largely to more favorable conditions for the accumulation of moisture. For the same reason the more nearly level parts of the upland are a little more productive of all crops than the more rolling parts. Corn is grown on about 50 percent of the area occupied by the soils of this group, oats on about 25 percent, wheat on about 10 percent, and the remainder is used largely for wild hay, alfalfa, or pasture. The large corn and oats acreage is needed to supply feed for cattle and hogs, which are the chief sources of income in the county.

Marshall silt loam.—Marshall silt loam, together with its heavy-subsoil phase, is the most extensive soil in Colfax County. It occupies high upland divides, the surfaces of which are only a few feet below the general level of the highest plain remnants on which the heavy-subsoil phase of Marshall silt loam occurs. The surface relief ranges from nearly level to undulating, the greater part of it being gently undulating, and it is characterized by shallow scarcely perceptible draws which afford excellent drainage.

The topsoil ranges from 18 to 24 inches in thickness, and it consists of very dark grayish-brown mellow silt loam, with a decidedly crumblike or granular structure. The upper part of the subsoil to a depth of about 40 inches is light-brown or grayish-brown silt or silty clay loam. It is a little denser than the topsoil but is not compact or claypanlike, and it is easily penetrated by roots, air, and moisture. With increased depth, the subsoil gradually becomes looser and lighter colored, merging at a depth ranging from about 5 to 6 feet beneath the surface with the light-gray floury silt of the parent loess formation. The soil and parent material, to a depth exceeding 10 feet, although not deficient in lime do not contain this material in sufficient quantities to effervesce when hydrochloric acid is applied.

Marshall silt loam is uniform in character throughout the area of its occurrence in the county. The upper subsoil layer is a little denser than typical in areas where the land is nearly level, and in such areas the soil greatly resembles the heavy-subsoil phase of Marshall silt loam. Locally the topsoil contains a little more clay than usual, approaching silty clay loam in texture, but these variations occupy such small areas that they could not be shown on a

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map of the scale used in this survey and are therefore included with the typical soil on the soil map.

Marshall silt loam is as productive and as well adapted to all crops commonly grown in the region as any of the upland soils. Practically all the land is under cultivation. Corn is grown on about half of the cultivated acreage, and most of the remainder is about equally divided between oats and winter wheat, although alfalfa, rye, barley, and sweetclover are grown in small fields on many farms.

Moisture conditions are not quite so favorable for most crops as on the lower-lying silty terrace soils of the county, and for this reason crop yields are usually a trifle lower than on those soils, but all crops yield better than on the sandy terrace soils or on the more rolling Moody silt loam. The average acre yield of corn over a period of years is about 38 bushels, of oats about 35 bushels, and of wheat about 22 bushels. Alfalfa yields about 3 tons an acre each season during the first 4- or 5-year cropping period, after which yields decline, probably because the crop has exhausted the deeper subsoil moisture and is unable to make optimum growth on moisture supplied by precipitation alone.

Marshall silt loam is easily tilled and, owing to its nearly level surface relief, high organic-matter content, and crop-producing power, is one of the most important general-farming soils.

Marshall silt loam, heavy-subsoil phase.—Marshall silt loam, heavy-subsoil phase, lies on the smoothest surface of all the upland soils. It occupies the highest topographic positions, except in two areas, both of which are on the north side of Maple Creek in the eastern part of the county. These areas are possibly on high terraces, but, owing to the gradual slope from their surfaces to those of the upland and owing also to the similarity of the soil to that of the heavy-subsoil phase of Marshall silt loam, they are included with that soil on the soil map. Aside from these areas, the heavy-subsoil phase is mapped only in the western part of the county, chiefly in Stanton and Wilson Precincts, where it occupies the highest and most nearly level remnants of the old loess plain. Drainage channels are not established, but precipitation is readily absorbed by the soil and removed by underdrainage.

The topsoil of the heavy-subsoil phase of Marshall silt loam is very dark grayish-brown friable silt loam, rich in organic matter and similar in all characteristics to the topsoil of typical Marshall silt loam. Locally it contains a little more clay than the typical soil, and in a small area south of Leigh along the Platte-Colfax County line approaches silty clay loam in texture. The subsoil continues to a depth of about 6 feet. The upper part, or a 14- or 16-inch layer, is grayish-brown silty clay loam which is noticeably more compact than the corresponding layer in any of the other well-drained upland soils, but it has no claypanlike characteristics and is easily penetrated by crop roots and soil moisture. The lower part is light grayish-brown friable silt loam which overlies very light grayish-brown or almost white loose floury silt similar to that beneath typical Marshall silt loam. In fact, the heavy-subsoil phase differs from typical Marshall silt loam only in the greater compaction of its upper subsoil layer. Neither the soil nor the underlying silt, to a

depth of at least 10 feet, contains sufficient lime to effervesce when acid is applied.

Practically all the land is under cultivation to corn, wheat, alfalfa, oats, and other grain, hay, and forage crops, all of which yield about the same and are grown in about the same acreage ratios as on typical Marshall silt loam.

Moody silt loam.—Moody silt loam ranks next in total area to Marshall silt loam. It occurs in all parts of the upland, where it usually occupies gradual slopes and gently to steeply rolling areas around the margins of the more nearly level areas on which the Marshall soils lie. It is most extensive in the northern part of the county, where the surface of the old loess plain has been most modified by erosion. The soil has excellent drainage.

The 12-inch topsoil consists of friable granular silt loam, is well supplied with organic matter, and is similar in its characteristics to the corresponding layer of Marshall silt loam but is a few inches thinner. The subsoil, which continues to an average depth of about 4 feet, is grayish-brown or light grayish-brown friable silt loam. It is very limy below a depth ranging from 30 to 40 inches, the lime occurring in finely divided form, thoroughly mixed with the silt, and as numerous round white concretions ranging from one eighth to one fourth inch in diameter.

Moody silt loam differs from Marshall silt loam in that it has a slightly thinner topsoil and a little more friable and much more limy subsoil. It is underlain by almost white floury loess which contains an abundance of finely divided lime.

The soil as mapped in this county includes a few variations, chiefly in the thickness and organic-matter content of its topsoil. On the steeper slopes, erosion has greatly thinned the topsoil in places and over local patches has removed it, exposing the light-colored limy subsoil. In the more nearly level places and at the base of the more gradual slopes are small areas in which the topsoil is considerably thicker and a trifle darker than typical. These areas are of local occurrence and of such small extent that they are not shown separately on the soil map. Most of them occur in the northern part of the county, and their combined area does not exceed 1,000 acres.

About 85 percent of Moody silt loam is cultivated, and the remainder, including the more steeply rolling areas, is used for pasture or wild hay. About 50 percent of the cultivated land is used for corn, about 25 percent for oats, about 10 percent for wheat, about 5 percent for alfalfa, and the remainder largely for rye, barley, sweetclover, and potatoes, all of which are grown in small fields on most farms.

Moody silt loam does not produce such high yields as the well-drained loessial soils lying on smoother relief, because the more rolling surface relief is not quite so favorable for the accumulation of organic matter and moisture, but it returns higher yields of all crops than the more sandy soils of the group and higher yields of small grains than any bottom-land soil in the county. The average acre yield of corn over a period of years is about 35 bushels, of oats 32 bushels, and of wheat 20 bushels. Alfalfa yields about 2¾ tons of hay an acre during the first 4- or 5-year cropping

period, but subsequent yields are much lower, owing to a decrease in the deep-seated moisture supply.

This soil is easily handled, provided care is taken to prevent erosion on the steeper hillsides. It can be cultivated under a rather wide range of moisture conditions and, owing to its large extent and high producing power, is one of the most important general-farming soils in the county.

Hall silt loam.—Hall silt loam, including its claypan phase, occupies about 40 percent of the terrace land and ranks fifth in total area among the soils of Colfax County. About 95 percent of it occurs on the Shell Creek Terrace in the southwestern part of the county, and the remainder is in small scattered bodies on the lower-lying terraces, mainly in Maple and Shell Creek Valleys. This soil has developed from light-colored silt, similar in character to the upland loess which underlies the Marshall and Moody soils, but which was carried to its present position and deposited as sediment by streams when they were flowing at higher levels.

Hall silt loam lies on nearly level or very gently undulating relief, and all of it is well drained. That part occurring on the high Shell Creek Terrace is thickly dotted with shallow basinlike depressions occupied by other soils which receive the surplus surface waters. On the lower terraces depressed areas are few, and the surface slope is sufficient to prevent excessive moisture accumulation.

The topsoil of Hall silt loam, which ranges from 16 to 20 inches in thickness, is very dark granular friable silt loam well supplied with organic matter. The upper part of the subsoil is brown or grayish-brown silt loam which is a little more compact than the topsoil but is friable throughout. The lower part of the subsoil, beginning at a depth of about 40 inches, is light-gray limy and floury silt which continues to a depth of more than 7 feet. The soil is very retentive of moisture. It is remarkably uniform throughout the area of its occurrence.

Hall silt loam is well adapted to all crops commonly grown in the region and is one of the most valuable general-farming soils. It occupies a much smaller area than the extensive upland soils but is more favorably situated to receive moisture from higher levels, which, together with that received through precipitation, gives it a somewhat higher producing power than the best upland soil.

Practically all the land is under cultivation. About 70 percent of the cultivated acreage is devoted to corn, about 10 percent to oats, and about 10 percent to alfalfa. The remainder is used for wheat, together with minor crops grown for sustenance or feed. The average acre yield of corn or oats is about 40 bushels, that of wheat about 25 bushels, and that of alfalfa about 3¼ tons of hay. These yields, with the exception of the one given for alfalfa, which is a little lower than is obtained on some of the bottom-land soils, are not exceeded on any other soils in the county.

Waukesha silt loam.—Waukesha silt loam occupies 22.7 square miles, ranking next in area to Hall silt loam among the finer-textured terrace soils. Like that soil it occurs on both high and low terraces. The higher terrace developments are in the eastern part of the county, mainly in the valleys of Rawhide Creek and East Fork Maple Creek, where they have a combined area of about 6 square miles. The

lower terrace developments occur as small scattered bodies and narrow strips in all the larger valleys. The surface features and drainage conditions on both terrace developments are similar to those prevailing in areas of Hall silt loam occupying comparable terrace levels.

The soil on both the high and low terraces is practically identical in its characteristics and is very similar to Hall silt loam, differing from that soil only in the lower lime content of its subsoil. Hall silt loam and Waukesha silt loam are used for the same crops in about the same acreage ratios and are about equally productive. In fact, the farmers recognize no differences in yields, tillage requirements, or crop adaptabilities between the two soils.

Waukesha very fine sandy loam.—Waukesha very fine sandy loam, in common with Hall silt loam and Waukesha silt loam, occurs on both high and low terraces, but it occupies only 2.2 square miles. Practically all of it is on or around the edges of the Shell Creek Terrace in the southwestern part. The high and low terrace developments are similar in surface features to corresponding developments of Hall silt loam and Waukesha silt loam, and the soil resembles Waukesha silt loam in all features except the texture of its topsoil which contains a little more sand than the topsoil of the silt loam soil and therefore can be cultivated under a slightly wider range of moisture conditions. Aside from this difference, Waukesha silt loam and Waukesha very fine sandy loam are identical.

This soil is used for the same crops in about the same acreage ratios as Hall silt loam. It also has about the same crop-producing power as that soil but, owing to its small extent, is of minor agricultural importance.

O'Neill fine sandy loam.—O'Neill fine sandy loam is the most sandy of the well-drained terrace soils. It occurs on a few of the terraces in the Platte River Valley. The largest body, comprising about 8 square miles, is between Schuyler and the Western boundary of the county on the south side of the Union Pacific Railroad. Another body, including about 5 square miles, is in the vicinity of Schuyler. The remaining bodies are few and small.

The material from which the soil developed was deposited in the same manner as that of the Hall and Waukesha soils but consists of incoherent gray sand instead of silt. O'Neill fine sandy loam has a very dark colored topsoil from 12 to 14 inches thick, as the surface relief and moisture conditions have been favorable for the accumulation of organic matter in the surface part of the sandy deposits. Considerable silty material, probably blown in from nearby silt soils, has also become incorporated with the sand in the topsoil. The subsoil is incoherent sand which is brown in its upper 4 or 5 inches and gray in its lower part. The silt and organic matter give the topsoil considerable stability and prevent the soil from drifting badly even under cultivation. The entire soil is very low in lime.

The surface relief is nearly level except in a few places where the wind has produced slight depressions and low rounded ridges, but even in these places differences in elevation in few places exceed 2 feet. Surface drainage is not established, as all excess water is rapidly absorbed by the porous sand. The topsoil is able to retain

considerable moisture, but the subsoil has low moisture-retaining powers, and the soil is considered rather droughty.

About 75 percent of this soil is cultivated, the remainder being used for pasture or hay land. Probably 90 percent of the cultivated land is in corn, and the remainder is used chiefly for alfalfa, although some oats, wheat, and sweetclover are grown.

Corn yields are a little lower than on the Moody, Marshall, Hall, or Waukesha soils, ranging from 25 to 30 bushels an acre in all except the driest years. In a few of the lower-lying areas, alfalfa seems to thrive even better than on the silty soils of the upland, probably because in such places its roots are able to reach the underlying water table. Sweetclover does well. Wheat and oats do well except in seasons of low rainfall, following an unusually dry winter and spring. Over a period of years, however, the average yields of all crops are lower than on the finer-textured upland and terrace soils. Included with O'Neill fine sandy loam are a few small patches of very fine sandy loam and loamy sand of the same general character. The very fine sandy loam areas occur in slightly depressed situations, and the loamy sand areas occupy low ridges or lie near stream channels. These patches are too small and agriculturally too unimportant to warrant showing them separately on the soil map.

Shelby loam.—Shelby loam occurs where erosion has removed the loess, and the underlying glacial drift, composed largely of silt and clay, together with considerable sand, some gravel, and a few boulders, is exposed to weathering. The soil occupies the lower valley slopes of a few streams north of Shell Creek in the western part of the county. Its total area is 5.6 square miles.

The topsoil is dark grayish-brown loam containing a high percentage of coarse sand and gravel. The upper 4 or 5 inches of the subsoil is brown and, although slightly more compact than the topsoil, is very friable. The remainder of the subsoil, which continues to a depth of about 3 feet, is gray or grayish-brown silt loam or silty clay loam containing some sand and gravel. The sand and gravel content of the topsoil and subsoil is not sufficient to make the soil droughty or to hinder cultivation. Lime is abundant in the underlying glacial drift but is scarce in the subsoil, but the soil shows no lime deficiency so far as crop needs are concerned.

About 90 percent of the Shelby loam is under cultivation and is used for the same crops in about the same acreage ratios as Moody silt loam. The soil has about the same producing power as Moody silt loam. The uncultivated areas are used chiefly for pasture land.

Shelby loam occurs on only a few farms and is, therefore, of minor agricultural importance. It is well adapted to all crops commonly grown in the region.

With this soil are included small scattered areas where erosion has removed the gray upland loess, from which the Marshall and Moody soils have weathered, and has exposed to weathering an older somewhat red loesslike formation. The bodies, although numerous, are small. They occur at the base of upland slopes in the more deeply entrenched valleys. One of the largest, comprising about 100 acres, is 1½ miles southwest of Henke Store in the western part of the county.

UPLAND AND TERRACE SOILS WITH CLAYPAN SUBSOILS

The soils included with the claypan group in this economic classification occupy 4.1 square miles, or about 1 percent of the total area of the county. They include Scott silt loam and a claypan phase of Hall silt loam. These soils occupy depressions ranging from slight to pronounced and have developed under poor drainage. Large quantities of clay have been carried into the subsoils by downward-percolating waters, producing an extremely compact condition, especially in the upper part of the subsoils. The depressed surface has also favored the accumulation of water-soluble salts washed in from the surrounding higher lands. Consequently these soils contain more or less alkali.

The claypanlike subsoils prevent good aeration and the free upward and downward movement of soil moisture, and they impede root development to a marked degree. Only those areas which have comparatively thick and dark-colored topsoils are used for cultivated crops.

Hall silt loam, claypan phase.—The claypan phase of Hall silt loam differs from the typical soil in having a dense heavy layer in its subsoil that greatly alters its character. Soil of this phase occurs chiefly in three bodies on low terraces west of Middle Fork Maple Creek in Colfax Precinct. The largest of these bodies occupies only about 300 acres, and the total area of the soil is 960 acres.

The topsoil, which is about 14 inches thick, differs from the corresponding layer in typical areas of Hall silt loam in that it is a trifle heavier, a little lighter in color, and contains more or less alkali. The upper subsoil layer, which continues to an average depth of 30 inches, consists of dark-brown extremely compact clay, which is plastic when wet and very hard and tough when dry. The lower subsoil layer is light-gray floury and limy silt similar to that underlying typical Hall silt loam.

About 80 percent of this land is used for cultivated crops, wheat occupying about 70 percent of the cultivated land and corn and oats the remainder. The claypanlike layer in the subsoil practically limits the storage of moisture available for crops to the topsoil, and early-maturing shallow-rooted crops naturally do better than those which require moisture in larger amounts and for longer periods. Wheat and oats yield about as well as on Hall silt loam or Waukesha silt loam. Corn yields average about 10 percent lower than on those soils and in unusually dry seasons are only about half as large. The uncultivated parts of this soil are used as pasture and hay land.

Scott silt loam.—Scott silt loam occupies numerous small basin-like depressions on the higher terraces and throughout the more nearly level parts of the upland. The basins are locally known as "lagoons," or "buffalo wallows." The largest comprises about 160 acres, but most of them occupy less than 2 acres.

Scott silt loam is the most poorly drained soil in the county. The basins have no natural surface-drainage outlets, and water accumulates in them after rains and disappears slowly through evaporation and seepage.

The topsoil is moderately heavy silt loam ranging from less than 4 to about 7 inches in thickness. In most places it is well supplied

with organic matter and is very dark, especially in its upper part, but it everywhere contains more or less light-gray silty material, and in many of the deeper and more poorly drained basins the lower part of the topsoil is gray. The subsoil consists of bluish-gray clay containing scattered iron stains and light and dark spots and splotches caused by the poor drainage. The clay is plastic when wet and extremely hard and tough when dry. It continues to a depth ranging from 5 to 6 feet, where it gives way rather abruptly to light-gray floury silt similar to that underlying the Marshall soil of the upland. The lime carbonate has been removed from both the soil and the underlying silt to a depth of more than 10 feet.

The areas of Scott silt loam are not suited to grain and tame-hay production, as most of them are too poorly drained for cultivation. The dense claypanlike subsoil is penetrated with difficulty by crop roots and practically limits the storage of available crop moisture to the topsoil which is too thin to store sufficient moisture for grain crops, especially during prolonged dry periods. This soil occupies only a small part of each farm on which it occurs and does not noticeably affect the general value of the farm land. Most of it is either included in pasture or is regarded as waste land.

BOTTOM-LAND SOILS

The soils classed with this group comprise 29.8 percent of the total county area. They include Wabash silt loam, Lamoure silty clay loam with a claypan phase, Lamoure fine sandy loam, Cass loamy sand, Cass very fine sandy loam, Cass fine sandy loam, and Sarpy sand. These soils occupy first-bottom, or flood-plain, positions along streams, having developed from sediments washed from the uplands and deposited in the stream bottoms during periods of high water. The Wabash and Lamoure soils have developed from the finer-textured more silty sediments, and the Cass and Sarpy soils have weathered from coarse-textured sands and gravels.

The relief on which these soils lie is nearly level, except where traversed by old and present stream channels or modified by slight elevations or shallow depressions. Surface drainage, although rather slow, is well established, as most of the bottom lands slope gently down the valleys and toward the stream channels. Local areas are subject to overflow from the main streams, but the water soon drains off and only a small percentage of the total area is too wet for cultivation. The water table lies at a depth ranging from about 4 to 15 feet beneath the surface of the ground, and the subsoils are kept well supplied with moisture except in the driest years.

The bottom-land soils, except in local poorly drained spots and in areas occupied by Sarpy sand, are especially adapted to corn and alfalfa and as a whole give higher yields of these crops than are obtained on the best upland and terrace soils. About 70 percent of the area occupied by them is in corn and about 20 percent in alfalfa. Most of the remainder, including the more poorly drained parts, is used for native hay and pasture. Some oats and wheat are grown but, owing to the abundant moisture supply, small-grain crops usually produce excessive stalk growth at the expense of the

grain, and yields are lower than on the more elevated and less moist soils.

Wabash silt loam.—Wabash silt loam is the most extensive bottom-land soil in the county. It occurs along most of the larger creeks and drainage ways throughout the upland and is also extensively developed northeast of Schuyler in the Platte River Valley. Surface run-off is well established, and practically none of the soil is too wet for cultivation.

The topsoil, to a depth ranging from 18 to 24 inches, is dark-brown or black smooth friable silt loam which is well supplied with organic matter. The subsoil, which continues to an average depth of 4 feet, is heavy silt loam or silty clay loam and is only slightly lighter in color than the topsoil. It is moderately compact but does not attain the density of the subsoil layers in the claypan soils, and it is easily penetrated by moisture and roots. Neither the topsoil nor the subsoil contains sufficient lime carbonate to react when dilute hydrochloric acid is applied, but the soil does not seem to be deficient in lime so far as crop needs are concerned.

Practically all this soil is under cultivation, with the exception of narrow forested strips adjacent to the stream channels. Its high organic-matter content, abundant moisture supply, and the nearly level surface on which it lies combine to make it one of the most productive corn and alfalfa soils in the county. Corn occupies about 80 percent of the land and alfalfa is grown on most of the remainder. The average yield of corn over a period of years is about 45 bushels and that of alfalfa about 3½ tons of hay an acre. Alfalfa can be grown on this soil as often as desired, because the subsoil moisture is sufficient to produce good yields regardless of the precipitation.

Lamoure silty clay loam.—Lamoure silty clay loam ranks next in area to Wabash silt loam among the bottom-land soils. It occurs chiefly in a large elongated body west of Schuyler and a few smaller bodies near Rogers. Its total area is 21.8 square miles. The soil as a whole lies a little lower than most of the Wabash silt loam areas and is not quite so well drained as that soil. In some spots it contains alkali in sufficient quantity to injure tame-hay and grain crops, but about 80 percent of the area occupied by it is sufficiently well drained and free from alkali for cultivated crops.

The topsoil, which averages about 20 inches thick, consists of almost black heavy silty clay loam containing an abundance of organic matter. Its high clay content does not favor cultivation under so wide a range of moisture conditions as is possible on the more silty soils of the bottom lands. If cultivated when wet, clods are formed, which require subsequent wetting and drying or freezing and thawing before favorable tilth is restored. It is almost impossible to cultivate this soil when it is extremely dry, but under normal moisture conditions the topsoil is easily kept in good tilth.

The subsoil is gray, light-gray, or mottled gray and brown silty clay loam which extends to an average depth of 40 inches. It is usually slightly more compact than the topsoil, but it has no claypanlike features and is easily penetrated by roots and moisture. The material is very limy, much of the lime occurring in rounded soft and hard nodules and in numerous irregular-shaped spots and splotches.

Beneath the subsoil is a rather friable light-colored limy mixture of sand, silt, and clay, which becomes coarser and less coherent with depth.

This soil differs from Wabash silt loam in the heavier texture of its topsoil and in the lighter color and higher lime content of its subsoil. About 80 percent of it is under cultivation, and the remainder, comprising the more poorly drained and more alkaline areas, is included in native pasture and hay land.

The same crops, in about the same acreage ratios, are grown on the cultivated areas as on Wabash silt loam, and the yields are about the same on the two soils. In fact, the farmers recognize no differences between Lamoure silty clay and Wabash silt loam in crop adaptabilities or producing powers, but they prefer the Wabash soil because it is more easily handled.

Lamoure silty clay loam, claypan phase.—The claypan phase of Lamoure silty clay loam occurs in the Platte River bottom lands, north and west of Rogers, in the southeastern part of the county. The largest development comprises about 3½ square miles, and the remaining areas are few and small.

The 8- to 14-inch topsoil is moderately heavy silty clay loam which is rich in organic matter and very dark, especially in the better-drained areas. In poorly drained spots, which are scattered throughout the soil, alkali is abundant and in many places lightens the color of the topsoil to a noticeable degree. Such spots also contain considerable gray silt, from which the organic matter has been leached. The subsoil is gray limy clay or silty clay, extending to an average depth of about 42 inches. In most places it is mottled with rust-brown, dark-gray, or almost white spots and splotches, produced largely by poor drainage. The subsoil material is plastic when wet but extremely hard and brittle when dry. It is underlain by light-gray friable and limy material composed largely of silt and very fine sand.

About 60 percent of this soil, including the better-drained and less alkaline areas, is under cultivation. Corn and wheat are the principal crops grown, and yields are variable. In normal or wet seasons, corn does as well as on the best soils of the county, because the low position of the fields favors an abundant moisture supply in the topsoil. In such seasons the yield of small grains is low, because the high moisture supply causes these crops to produce a rank stalk growth at the expense of the grain. In dry years the topsoil does not contain sufficient moisture for good corn yields, and wheat and oats give the larger returns. During the progress of the survey, only a few small fields of alfalfa were seen on this soil. This crop seems to do well provided a good stand is obtained, but most of the stands observed were very thin, probably because many of the seedling plants were killed by alkali before they could extend their roots into the subsoil. The land not under cultivation is used for native pastures and hay land.

Lamoure fine sandy loam.—Lamoure fine sandy loam is similar to Lamoure silty clay loam in all characteristics except the texture of its topsoil which contains an abundance of fine sand and medium sand intermixed with the silt and clay. The sand greatly facilitates tillage operations, and Lamoure fine sandy loam can be

cultivated without injury under a much wider range of moisture conditions than Lamoure silty clay loam. The sand is not sufficiently abundant to noticeably reduce the stability of the water-holding capacity of the soil.

Practically all of this soil is well drained and under cultivation. It is used for the same crops as the finer-textured Wabash and Lamoure soils and has about the same producing power. It occupies only a few small bodies scattered throughout the bottom lands and is of little agricultural importance. The largest body, comprising about 1 square mile, is west of Schuyler.

Cass very fine sandy loam.—Cass very fine sandy loam occupies 13.4 square miles, ranking next to Lamoure silty clay loam among the bottom-land soils. All areas of this soil are in the Platte River alluvial lands, the largest occurring along Lost Creek southwest of Schuyler.

This soil has developed from river deposits consisting largely of gray very fine sand, but which have been stationary long enough to have accumulated an abundance of black organic matter in the upper part. The land is nearly level, and drainage is adequate for cultivated crops, except in a few of the lower-lying situations where the water table is at or near the surface of the ground.

The topsoil is very dark grayish-brown or almost black friable very fine sandy loam, ranging from 8 to 12 inches in thickness. It is similar to the corresponding layer in the Wabash and Lamoure soils but is thinner and more sandy. The subsoil is composed of loose gray or grayish-brown fine sand or medium sand, which in most places becomes coarser in texture with depth, and in many places is gravelly below a depth of 3 feet. The subsoil may or may not be limy, but in most places it contains sufficient lime, especially in the upper part, to effervesce weakly when dilute hydrochloric acid is applied.

About 80 percent of the area occupied by this soil is cultivated, and the remainder, including the more poorly drained parts and those on which native trees interfere with cultivation, is used for pasture and hay land. About 70 percent of the cultivated land is used for corn, and most of the remainder is in alfalfa, although potatoes, garden vegetables, and truck crops—chiefly melons—are grown rather extensively on some farms in the vicinity of towns.

Cass very fine sandy loam ranks among the most productive corn and alfalfa soils in the county. Yields of these crops average a trifle lower than on the Lamoure and Wabash soils but are higher than those obtained on any of the upland or terrace soils. Small grains also grow well, but, as they usually produce a rank straw growth and low grain yields, they are seldom planted on this soil. A few fields of wheat and oats were observed during the progress of the survey. The soil can be cultivated under almost any moisture conditions without injury and with less power and lighter machinery than the more silty bottom-land soils. It warms up early in the spring and is well suited to truck crops. On account of its small extent, it is of little agricultural importance.

Cass fine sandy loam.—Cass fine sandy loam resembles Cass very fine sandy loam in all characteristics except the texture of the topsoil, this layer in the fine sandy loam containing a little more sand

of the coarser grades than occurs in the topsoil of Cass very fine sandy loam. The textural difference does not seem to cause any difference in crop yields or adaptability of the two soils, and both are regarded with equal favor by the farmers. Cass fine sandy loam occupies only 704 acres and is, therefore, of very little agricultural importance. It occurs in a few small bodies in the Platte River bottom lands, chiefly southwest of Schuyler.

Cass loamy sand.—Cass loamy sand occupies a few narrow and discontinuous strips bordering creek channels in the Platte River bottom lands. Its total area is 5.7 square miles. The topsoil, which in few places is more than 8 inches thick, is composed largely of fine sand and medium sand, together with sufficient organic matter to give the mass a dark color but not enough entirely to prevent soil drifting when the native sod is destroyed. The subsoil is incoherent gray sand which becomes coarser with depth and in many places contains an abundance of gravel 3 or 4 feet beneath the surface of the ground. The surface relief is a little less level than that of the finer-textured and more stable soils of the bottom lands.

This soil occupies slightly more elevated positions than the other Cass soils. Practically all the land is well drained and under cultivation. Corn is the chief crop. Alfalfa is grown on a few fields and seems to do well, provided a good stand is obtained, but the difficulty in procuring the firm compact seed bed so necessary in obtaining a good stand of alfalfa has evidently kept the acreage low, as only a few alfalfa fields were observed on this soil during the progress of the survey.

Corn yields in normal years compare favorably with, or are only slightly lower, than those on the finer-textured Cass soils. In dry seasons they are much lower, especially if dry weather occurs during early summer and is accompanied by considerable wind causing the sand to shift, thereby exposing the roots to drought.

Sarpy sand.—Sarpy sand occurs in numerous small bodies and narrow strips in the Platte River bottom lands, most of the bodies lying adjacent to the stream channel. One of the largest areas, comprising about 1,000 acres, is south of Schuyler; another occupies most of Hewitt Island in the southwestern part of the county; and the remaining bodies are small. The total area of this soil is 6.8 square miles.

The 8- to 10-inch topsoil consists of gray or grayish-brown loose incoherent fine sand or medium sand. It is underlain to a depth exceeding 5 feet by material of similar consistence though of slightly coarser texture and lighter color. The 1- or 2-inch surface layer of the topsoil usually contains considerable organic matter and in many places is much darker than the rest of the soil, but the humus content is insufficient to prevent soil drifting when the natural vegetation is destroyed, and the organic matter rapidly disappears if the land is overgrazed or brought under cultivation. The soil is not limy. With the exception of variations in the organic-matter content of the surface layer, the soil is uniform throughout the county.

Sarpy sand has developed from coarse-textured river sediments which have not accumulated much organic matter. In many places it resembles river wash, but it is more stable and not so greatly influenced by each slight rise in the streams.

Practically all this soil is included in pasture and hay land. Some corn is grown on a few areas, but the yield is low except in the most favorable years. The natural vegetation is sparse, and the soil does not have a high value even for grazing.

River wash.—River wash, although not a typical soil, may be included in the subirrigated group of soils because it is underlain at slight depths by a water table. It consists of sand bars, islands, and sand flats adjacent to, or within the channel of, Platte River. Only the larger areas are shown on the soil map. The material consists of gray sand or a mixture of sand and gravel. It differs from Sarpy sand chiefly in its lower position and less stable character. Most of it supports a tree growth and is either used for pasture or is regarded as waste land.

SOILS AND THEIR RELATIONSHIPS

Colfax County is in the prairie region of the United States where the climate has favored a luxuriant growth of grasses. Except in comparatively small eroded areas on the steeper slopes, the soils all show the influence of the grass vegetation in the dark color of their topsoils. This color is imparted by finely divided organic matter derived from the decay of grass roots and mixed with the mineral soil constituents.

The more extensive soils have friable or only moderately compact subsoils, most of which include a zone of lime accumulation. The precipitation of the county, about 27 inches per annum, has not been sufficient to leach the calcium carbonate from the entire soil but has removed it from the upper soil layers to the lower part of the subsoil, causing an unusually large accumulation of this material in that layer. The more extensive soils are of granular structure in their topsoils and are more coarsely granular, nutlike, or cloddy in their subsoils. The topsoils and subsoils have developed layers, or horizons, which differ from one another in one or more important characteristics, such as color, lime content, texture, structure, or compaction.

The characteristics mentioned are not everywhere equally expressed. They are the results of the climate and vegetation under which the soils have developed and are typically expressed only in those soils which have received the full impress of their climatic and vegetative environment. Such soils occupy well-drained uneroded areas where conditions have been most favorable for prolonged undisturbed weathering. In these situations the soil-forming processes—including leaching, oxidation, aeration, and the accumulation of organic matter—have acted to their full capacity, as governed by their environment. The soils, therefore, have reached a stage of development which is normal for the existing climate and vegetation, and those on the smooth undulating uplands are fully developed.

The soil characteristics derived from the climate and vegetation occur in varying degrees of development in nearly all the soils. The stage of development depends on the relief, drainage, character of the parent soil materials, and the length of time the materials have been subjected to undisturbed weathering. In the early stages of soil de-

velopment, the parent materials were the controlling factors in determining the character of the soils. As time went on, however, the processes of soil formation gradually altered the upper part of the parent materials to a degree dependent on the topographic and drainage conditions under which the processes were forced to act, the length of time they acted, and the relative resistance of the parent materials to their action.

The most important soil on the more nearly level parts of the upland, where conditions have been most favorable for prolonged undisturbed weathering and the accumulation of organic matter, is shown on the soil map as a heavy-subsoil phase of Marshall silt loam. This soil occurs chiefly in the western part of the county on the highest and least-eroded remnants of the old plain which once covered the greater part of eastern and southern Nebraska. It has weathered, under slow but adequate surface drainage, from light-gray friable and calcareous silt known by Nebraska geologists as Peorian loess.

A typical profile of this soil in its virgin condition as observed on a broad divide in the northwestern part of the county has a topsoil consisting of three well-defined layers. The upper one is loose, structureless, and about 1 inch thick; the second is 3 inches thick and has a laminated or platy structure; the third, or lower, layer is decidedly granular and occupies the remainder of the topsoil which extends to a depth of 23 inches. The granular aggregates are irregularly angular and range from one sixteenth to one eighth of an inch in diameter, the larger ones occupying the lower part of the layer. The three layers are friable and are composed largely of silt particles and organic matter, although the upper one contains some very fine sand and the lower one a noticeable amount of clay.

The content, distribution, and stage of decomposition of the organic matter varies slightly in the different layers. In the structureless layer the organic constituents, although abundant and uniformly distributed, are not all thoroughly decomposed and the color of the material in this layer is dark grayish brown or grayish brown. The laminated layer contains the largest quantity of thoroughly decomposed carbonaceous material and is almost black. Its color remains constant when the soil material is pulverized, indicating that the organic matter is thoroughly mixed with the mineral soil particles. In the granular layer, decomposition of the plant remains is complete but the organic matter is not sufficiently abundant thoroughly to permeate the soil material and is deposited as a film or coating on the surfaces of the granules. The film is thickest in the upper part of the layer, causing a natural exposure of that part to appear almost as dark as the overlying layer. However, the granular material, when crushed, becomes lighter in color than material similarly treated from the laminated layer, indicating a lower organic-matter content per unit of soil volume. The organic film decreases in thickness with depth, and the lower part of the granular layer is dark grayish brown or, when crushed, is grayish brown.

The fourth layer, or upper part of the subsoil, is the zone of maximum compaction. It is grayish-brown moderately compact silty clay loam with a faintly developed granular structure. This layer is 14 inches thick and extends to a depth of 37 inches. It has

been formed by the translocation of the finer-textured surface soil particles through the agency of downward percolating waters and is similar in most of its characteristics to the corresponding layer in the Hastings soils of central Nebraska. It is denser than any layer in the other well-drained upland soils of the county, but it has no claypanlike characteristics.

Beneath the zone of maximum compaction all structure disappears and the material gradually becomes looser and lighter in color with depth, merging about 8 feet beneath the surface of the ground with unweathered or only slightly modified Peorian loess.

The organic matter so noticeable in the upper soil layers decreases rapidly with depth, practically disappearing a few inches beneath the zone of maximum compaction. The soil throughout the entire profile has been leached of its carbonates. Worm casts and crooked rodlike soil forms are present in all layers beneath the laminated layer. The casts are most numerous in the granular layer and the rodlike forms, which are about one fourth inch in diameter and of different lengths, occur chiefly in the zone of maximum compaction.

Associated with the heavy-subsoil phase of Marshall silt loam throughout the upland, but occupying larger areas and occurring on slightly more undulating surfaces, is typical Marshall silt loam. This soil is also developed on Peorian loess, but its slightly less level surface has not allowed such a large proportion of the precipitation to enter the ground as has entered that occupied by the heavy-subsoil phase. Consequently, less clay has been carried into the subsoil, and this layer is much more friable than the corresponding layer in the phase. However, the soil has received sufficient moisture for the removal of the carbonates to a depth of more than 10 feet, and, with the exception of the more friable and slightly more granular character of its upper subsoil layer, typical Marshall silt loam does not differ noticeably in any soil characteristics from its heavy-subsoil phase.

The moderately to strongly rolling parts of the loessial upland are occupied by extensive areas of Moody silt loam. Surface runoff in these areas is comparatively rapid, and moisture entering the ground has been sufficient to remove the readily soluble carbonates to a depth of only 3 or 4 feet. The soil, therefore, is characterized by a pronounced zone of lime enrichment at about this depth. Downward percolating waters have not carried large quantities of fine material into the subsoil, and the layer of maximum compaction, although discernible, is less pronounced than in either Marshall silt loam or its heavy-subsoil phase. Also, the topsoil, having been subjected to greater erosion than the topsoils of the Marshall soils, averages a few inches thinner. Locally, in spots on the steeper slopes, the topsoil has been entirely removed, exposing the underlying gray or buff-colored calcareous loess. Aside from these differences, Moody silt loam has a profile similar to that of Marshall silt loam.

Locally, throughout the more nearly level parts of the soils of the Marshall and Moody series and in numerous places on the higher loessial terraces, are small shallow depressions, locally known as "buffalo wallows" or "lagoons", which are occupied by the Scott soils. Water accumulates in the depressions after rains and often

remains on the surface for several weeks. Downward percolation of water is excessive, and its results are pronounced. The topsoils are friable or only slightly compact and range from less than 2 to about 12 inches in thickness. They are variable in structure but are usually more or less laminated and in few places have a pronounced granular layer. The upper one half or three fourths of the topsoil layer has an almost black basic color but is everywhere sprinkled with light-gray or almost white floury silt from which the organic matter has been leached. The lower part of the topsoil may or may not be dark, its color depending on the amount of leaching to which it has been subjected; and it may range from almost black to white. In places where it is unusually light in color, it contains numerous black hard almost round ferruginous concretions ranging from one eighth to slightly more than one fourth inch in diameter.

The subsoil, which is a true claypan, extends to a depth ranging from 5 to 6 feet and consists of an extremely dense clay. Excessive moisture and poor aeration have given the material a lead-gray or dark bluish-gray color, in many places mottled with rust-brown stains, streaks, and splotches. The claypan contains scattered black concretionary forms similar to those occurring in the lower part of the topsoil.

Beneath the claypan is the parent Peorian loess. The entire soil profile, as well as the upper 3 or 4 feet of the underlying loessial deposit, has been leached of its carbonates.

In a few places throughout the upland, but chiefly north of Shell Creek in the western part of the county, the gray Peorian loess has been removed by erosion, exposing underlying formations to weathering. The uppermost of these is a reddish-colored limy loesslike material, known by Nebraska geologists as Loveland loess which is thought to be older and more oxidized than the overlying gray loess. On the more gradual slopes, the soil that has weathered from this material has developed a profile similar to that of Moody silt loam, except that the topsoil is coarser in texture and the subsoil has a decidedly red cast. On the steeper slopes, however, the development of soil on exposures of the Loveland loess has been greatly retarded by erosion, the profile in such situations showing a thin dark-colored topsoil directly overlying the reddish-colored and limy parent formation.

Beneath the Loveland loess is glacial drift consisting of a heterogeneous mixture of sand, silt, clay, and gravel. Where exposed, this material has developed a more or less immature soil which is extremely variable in its characteristics, owing largely to differences in the amount of erosion to which it has been subjected and to differences in the character of the glacial deposits in different localities. Throughout most of the area of its occurrence the topsoil, although dark, is only 8 or 10 inches thick. The subsoil is a brownish-colored fairly well oxidized loam or gravelly loam which rests at a depth of about 24 inches on the parent drift deposit. In the more nearly level situations both topsoil and subsoil are thicker than elsewhere, and the profile, except for its rather high gravel content, resembles that of the heavy-subsoil phase of Marshall silt loam. On some of the steeper hillsides both topsoil and subsoil have been removed by erosion, exposing the unweathered parent drift. The

soils developed from the glacial drift are typical of the Shelby series. The soils derived from the Loveland formation, though not typical Shelby soils, on account of their small extent, have been included with Shelby loam in Colfax County.

Soils of the Waukesha, Hall, and O'Neill series occupy well-drained terraces or benches along the larger streams of the county, having developed from sediments deposited by the streams when flowing at higher levels. The Waukesha and Hall soils have weathered from fine-textured loesslike sediments similar to the material which covers the greater part of the upland. Moreover, they have lain exposed to undisturbed weathering for sufficient time to have developed definite layers, or horizons, resembling, both in character and number, those in the more nearly level but well-drained parts of the upland. In fact, the Waukesha soils may be regarded as terrace equivalents of the Marshall soil, and the Hall as being similarly related to the Moody soil. However, the surface relief of the Hall soils is a little more level than that of the Moody soils, and the topsoils average a trifle thicker than those of the Moody soils.

The O'Neill soils have developed from coarse-textured sandy or gravelly sediments which are extremely resistant to weathering. These soils, therefore, have not acquired such definite zones, or layers, as occur in the Waukesha and Hall soils. The topsoils have accumulated considerable organic matter, are dark colored, and are 12 or 14 inches thick. They rest on porous brown or grayish-brown sandy loam or gravelly loam which extends to a depth of about 24 inches and constitutes the upper subsoil layer. The remainder of the soil is composed of incoherent gray sand or a mixture of sand and gravel. This soil has been leached of its carbonates to a depth of more than 8 feet.

The first bottoms, or flood plains, of Colfax County are occupied by the Lamoure, Wabash, Cass, and Sarpy soils, in addition to river wash, all of which have been developed from recent sediments deposited by the streams during flood stages.

The moist conditions prevailing in the first bottoms have especially favored the growth and decay of vegetation, and all the soils, except those on the most recent alluvial deposits, have dark-colored topsoils. The parent sediments, however, are so recently deposited that none of them has developed into soils having zones or layers of true soil character. Oxidation and aeration, in most places, have been greatly retarded by excessive moisture, and the topsoils rest on the unweathered or only slightly weathered alluvial sediments. The character of the sediments, therefore, is the controlling factor in determining the character of the flood-plain soils.

The Wabash and Lamoure soils have developed from fine-textured sediments, largely silts and clays. They have friable almost black topsoils ranging from 15 to 18 inches in thickness. The subsoils are moderately compact, owing to a rather high clay content. The subsoils of the Wabash soils are similar to, or only slightly lighter in color than, the topsoils. They are very low in lime. In the Lamoure soils the subsoils may be dark but in most places are more or less mottled with gray and white streaks and splotches, which produce a rather light-colored appearance. They contain an abundance

of lime in concretionary and disseminated forms. Both the Lamoure and Wabash soils have friable and moderately granular topsoils, but their subsoils are practically devoid of structure.

The coarse-textured flood-plain sediments, which consist of sand and gravel, have developed into the Cass and Sarpy soils. The Cass soils have accumulated considerable organic matter and have dark-colored topsoils ranging from 8 to 12 inches in thickness. The Sarpy soils have developed from the more recently deposited sands and gravels and are poorly supplied with organic matter, their topsoils being thin and light colored.

The subsoils of both the Cass and Sarpy soils are composed of loose gray sand and gravel, the gravel in most places becoming more abundant with depth. The subsoils may or may not contain lime but, where they do, the carbonates are in finely divided form and evenly distributed in the soil material. In a few places the topsoils contain lime.

River wash occupies local islands, bars, and flats within and adjacent to the Platte River channel. It is composed of a loose heterogeneous mixture of gray sand and gravel of such recent age that it has not been noticeably affected by the soil-forming processes.

The results of mechanical analyses of samples of five representative soils discussed in the foregoing pages are given in table 6.

TABLE 6.—*Mechanical analyses of several soils from Colfax County, Nebr.*

Soil type and sample no.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	Inches	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Moody silt loam:								
375001	0–1½	0.1	0.1	0.0	0.1	5.3	56.0	38.4
375002	1½–12	.1	.1	.1	.3	5.8	52.2	41.3
375003	12–19	.0	.1	.1	.1	3.8	54.0	41.9
375004	19–40	.1	.1	.0	.1	4.2	58.1	37.4
375005	40–58	.0	.1	.1	.1	4.9	60.6	34.1
375006	58–96+	.0	.1	.1	.2	4.2	63.7	31.7
Marshall silt loam:								
375007	0–2	.1	.1	.1	.2	6.1	55.1	38.2
375008	2–11	.1	.1	.1	.2	7.4	49.3	42.7
375009	11–17	.0	.1	.1	.1	4.0	49.5	46.3
375010	17–45	.0	.1	.1	.1	4.6	54.1	40.9
375011	45–60	.0	.1	.0	.0	5.2	58.4	36.3
375012	60–84+	.0	.0	.1	.1	5.8	61.5	32.5
Hall silt loam:								
375038	0–1	.1	.1	.2	.2	5.2	54.6	39.6
375039	1–5	.1	.1	.1	.3	6.4	67.6	25.4
375040	5–17	.1	.1	.1	.2	8.7	63.7	27.0
375041	17–38	.1	.1	.1	.3	3.8	54.3	41.3
375042	38–54	.2	.2	.1	.5	4.8	60.3	34.0
375043	54–96+	.1	.1	.1	.1	5.2	65.2	29.2
Waukesha silt loam:								
375043½	0–2	.2	1.0	1.5	2.6	5.1	56.5	33.0
375044	2–4	.1	.3	.6	1.1	4.9	57.3	35.6
375045	4–12	.0	.1	.1	.3	3.5	51.4	44.7
375046	12–23	.0	.0	.1	.1	3.1	49.5	47.2
375047	23–47	.0	.0	.0	.1	4.1	54.4	41.3
375048	47–78	.0	.0	.0	.1	6.3	56.8	36.8
375049	78–96+	.0	.0	.0	.1	4.8	58.6	36.4
Lamoure silty clay loam:[1]								
375058	0–¾	1.2	4.0	4.0	10.0	13.2	56.5	11.2
375059	¾–5	.1	.5	1.2	4.0	8.4	67.0	18.7
375060	5–15	.1	.3	.6	1.7	4.7	65.5	27.1
375061	15–29	.1	.6	1.5	3.5	6.0	63.0	25.3
375062	29–74	.1	.5	1.6	3.8	6.3	61.0	26.7
375063	74–92+	.9	5.7	23.8	39.5	5.7	12.5	11.8

[1] This set of samples was run after treatment with hydrochloric acid to remove carbonates.

In table 7 are shown the pH values of samples of several layers of four soils, as determined in the laboratories of the Bureau of Chemistry and Soils by the hydrogen-electrode method.

TABLE 7.—*pH determinations of Moody silt loam, Marshall silt loam, Hall silt loam, and Waukesha silt loam from Colfax County, Nebr.*

Sample no.	Soil type	Depth	pH	Sample no.	Soil type	Depth	pH
		Inches				*Inches*	
375001	Moody silt loam	0–1½	7.25	375039	Hall silt loam	1–5	6.17
375002	do	1½–12	6.94	375040	do	5–17	6.17
375003	do	12–19	7.13	375041	do	17–38	6.43
375004	do	19–40	8.13	375042	do	38–54	8.22
375005	do	40–58	8.10	375043	do	54–96+	8.52
375006	do	58–96+	7.99	375043½	Waukesha silt loam	0–2	5.80
375007	Marshall silt loam	0–2	6.40	375044	do	2–4	5.85
375008	do	2–11	6.15	375045	do	4–12	5.30
375009	do	11–17	6.15	375046	do	12–23	5.63
375010	do	17–45	6.25	375047	do	23–47	6.09
375011	do	45–60	6.90	375048	do	47–78	6.77
375012	do	60–84+	7.17	375049	do	78–96+	7.59
375038	Hall silt loam	0–1	6.33				

SUMMARY

Colfax County is in east-central Nebraska. It is roughly rectangular and comprises 405 square miles. It is part of a vast loess-mantled plain. In the upland, which comprises the northern three fifths of the county, minor relief has been produced by stream erosion, and the land surface ranges from almost level to strongly rolling. The southern two fifths is occupied by a lower-lying flat or gently undulating valley known in the Nebraska surveys as the Platte plain. The boundary between the upland and the Platte plain extends in a general northeast-southwest direction across the county and is fairly straight except where minor stream valleys extend into the upland.

Colfax County has an average elevation of about 1,400 feet above sea level, and a total range in elevation of about 340 feet. The general slope is toward the south and east.

The county is drained by Platte River, Shell Creek, and Maple Creek, together with their tributaries. The creeks flow in a general southeasterly direction, but Platte River flows slightly northeastward. Except locally, throughout the bottom lands and in small basinlike depressions in the upland and on the higher terraces, all the land is well drained.

The first permanent settlement in the area now included in Colfax County was made on Shell Creek in 1856, and the county was established and organized in 1869. Most of the early immigrants came from the Eastern and East Central States. According to the 1930 census, the population of the county is 11,434, 77.3 percent of which is classed as rural. Schuyler, with 2,588 inhabitants, is the county seat and only city.

Transportation facilities are good. Railroads cross the northern and southern parts of the county, and public roads follow most section lines. The important public roads are surfaced with gravel. All parts are served with rural mail delivery, telephones are in common use, and the public-school system is highly developed.

The climate is continental and temperate. It is well suited to the production of grain, vegetable, and hay crops and to the raising of livestock. The mean annual temperature is 50.1° F., and the mean annual precipitation is 27.33 inches. The average frost-free season covers a period of 158 days which is ample for the maturing of all crops common to the county.

According to the Federal census, 96 percent of the land in the county is in farms, of which 76.4 percent is crop land and 20.4 percent pasture land. The average size of the farms is 178.7 acres. In 1930, owners operated 922 farms, tenants 458, and managers 13.

The farm improvements are in general good, and most farms are equipped with modern labor-saving machinery. Some tractors are used in performing the heavier farm work.

Farm laborers are plentiful, except during the corn and small-grain harvest seasons. Wages range from $30 to $40 a month with board and lodging.

The agricultural industries are closely related to the utilization of the crops. Most of the cultivable land is used for the production of feed crops, including corn, oats, alfalfa, and sweetclover. Cattle fattening and hog raising are the most important industries. Only a few cattle are raised locally, the greater part being purchased at Omaha or from western ranchers. The animals are fed corn and alfalfa for a period ranging from 60 to 90 days, after which they are shipped to Omaha or Chicago.

Hogs are raised on most farms, and many farmers have purebred herds of several hundred. Most of the hogs are shipped to Omaha.

The soils are, as a whole, naturally productive. The more extensive soils are characterized by three rather persistent features, namely, high organic-matter content, granular or crumblike structure of the topsoils, and high lime content of the subsoils—all valuable soil assets in crop production. Some areas of the less extensive soils are limited in their adaptabilities to crops, but their limitations are usually the result of unfavorable surface relief or drainage and not of any deficiency in the soil itself. Moreover, such areas are of rather local occurrence, being confined chiefly to steep though narrow valley slopes, to poorly drained places in the bottom lands, or to local depressions on the upland and terraces. By far the greater part of the soils are well suited to the production of corn, small-grain, and hay crops. All of them, however, cannot be used with equal economy for each crop.

The Moody and Marshall soils of the upland and the Hall and Waukesha soils of the terraces are the most extensive and are regarded as the best general-farming soils. The upland soils have developed from Peorian loess and the terrace soils from old alluvial deposits. They are well drained, retentive of moisture, and have deep dark-colored topsoils and friable subsoils. Practically all the area occupied by them is under cultivation and is used for corn, oats, wheat, and alfalfa, ranking in acreage in about the order named.

Depressed areas scattered throughout the higher terraces and more nearly level parts of the upland are occupied by the Scott soils. Owing to poor drainage and the development of a pronounced

claypanlike layer in the subsoils, these soils are seldom used for cultivated crops, and most of their area is in pasture or hay land.

The Shelby soils have developed from red loess and glacial-drift formations, exposed locally throughout the upland by the removal through erosion, of the overlying Peorian loess. These soils, in most places, have been subjected to considerable erosion and as a rule have rather thin topsoils. Although not quite so productive as the more nearly level upland and terrace soils, the Shelby soils are well adapted to all crops commonly grown.

The O'Neill soils include the sandy terrace soils. They have developed deep dark-colored topsoils, but their subsoils are composed of incoherent gray sand and gravel and are not retentive of moisture. The soils are poorly adapted to small-grain crops, as their topsoils are rather unstable. Most of the area occupied by them is devoted to corn.

The bottom-land soils include the Lamoure, Wabash, Cass, and Sarpy soils, all of which, except the Sarpy soils, have accumulated considerable organic matter and have dark-colored topsoils. The abundant moisture supply in the bottom lands is especially favorable to the production of corn and alfalfa, and, provided adequate drainage is established, these crops yield higher on the Lamoure, Wabash, and Cass soils than on any of the upland or terrace soils. Small-grain crops are not grown extensively on the bottom lands, because the high moisture supply causes them to produce a rank straw growth at the expense of the grain.

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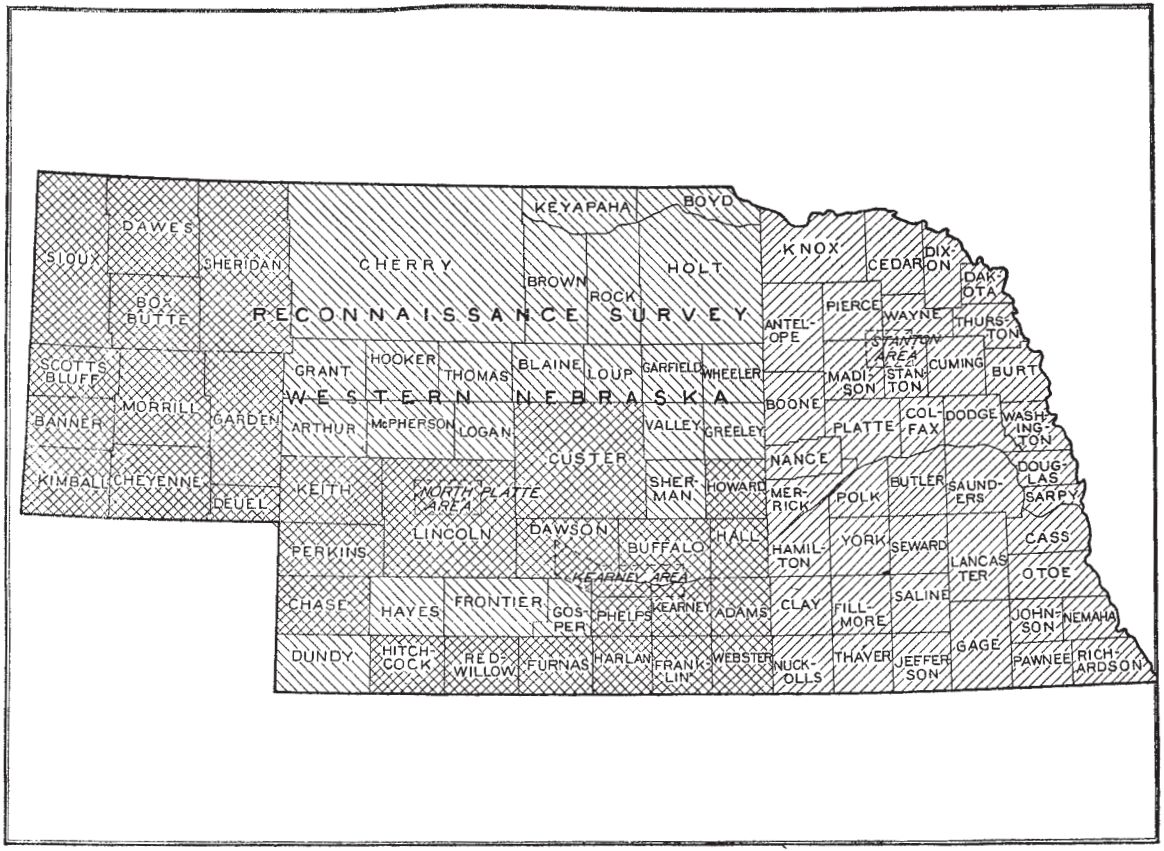

Areas surveyed in Nebraska, shown by shading. Detailed surveys shown by northeast-southwest hatchings; reconnaissance surveys shown by northwest-southeast hatchings; cross hatchings indicate areas covered in both ways.

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