

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE UNIVERSITY OF NEBRASKA; G. E. CONDRA,  
DIRECTOR, NEBRASKA SOIL SURVEY.

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# SOIL SURVEY OF FILLMORE COUNTY, NEBRASKA.

BY

A. H. MEYER, OF THE U. S. DEPARTMENT OF AGRICULTURE,  
IN CHARGE, AND C. E. COLLETT AND N. A. BENGTON,  
OF THE NEBRASKA SOIL SURVEY.

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THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

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[Advance Sheets—Field Operations of the Bureau of Soils, 1916.]



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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., May 8, 1917.*

SIR: Field operations of the Bureau of Soils for 1916 included a soil survey of Fillmore County, Nebr., undertaken in cooperation with the University of Nebraska. The selection of Fillmore County for survey was made after conference with State officials.

I have the honor to transmit herewith the manuscript and map covering this work and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1916, as authorized by law.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

Hon. D. F. HOUSTON,  
*Secretary of Agriculture.*

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Soil map, Fillmore County sheet, Nebraska.



# SOIL SURVEY OF FILLMORE COUNTY, NEBRASKA.

By A. H. MEYER, of the U. S. Department of Agriculture, In Charge, and C. E. COLLETT and N. A. BENGTON, of the Nebraska Soil Survey.—Area Inspected by THOMAS D. RICE.

## DESCRIPTION OF THE AREA.

Fillmore County, Nebr., lies in the southeastern part of the State. It is bounded on the north by York County, on the east by Saline County, on the south by Thayer County, and on the west by Clay County. It has an area of 576 square miles, or 368,640 acres.

The county lies entirely within the loess-covered part of the physiographic province known as the Great Plains. In general surface configuration it is an extensive plain sloping toward the southeast, with the original constructional surface slightly modified by stream erosion. The topography ranges from almost flat to slightly undulating, the only relief being that afforded by a few stream valleys. The valleys are not deep, but as a rule are somewhat sharply cut. The arrangement of streams is more irregular than in regions of extensive slope land where the development of streams and valleys has progressed more evenly.

The rolling land is the product of erosion. It is confined mainly to the valleys of the South Fork of the Big Blue River and Turkey Creek. Generally the slopes are moderately steep. The floors of the larger valleys are from 50 to 100 feet below the upland surface. There are numerous sharply cut gulches and draws in the county. The area of flood plains and terraces is relatively small. The largest area of bottom land is along Little Sandy Creek. There is a narrow strip along the South Fork of the Big Blue River and along Turkey Creek, and a few small areas in other parts of the county. The surface of the bottom land generally is flat. The terraces and the first bottoms usually are separated by low bluffs.

Fillmore County has a general elevation of 1,500 to 1,700 feet above sea level. The highest elevations are attained on the nearly level uplands. The highest point, 1,720 feet above sea level, is in the western part of the county, and the lowest points are in the eastern part, in the deeper stream valleys.

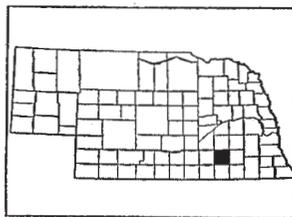


FIG. 1.—Sketch map showing location of Fillmore County, Nebraska.

The drainage of Fillmore County finds its way to the Missouri River through the Big and Little Blue Rivers and their tributaries. The northern part is drained by the South Fork of the Big Blue River, the central part by Turkey Creek, and the southern part by the tributaries of Big Sandy Creek. Local drainage is good, except on the broad divides, where the run-off is rather slow. There are numerous small, shallow ponds throughout the county, which, like most of the streams, are intermittently wet and dry. The largest ponds are in the southwestern part of the area.

The first settlement in Fillmore County was made in 1868, along the South Fork of the Big Blue River. The county was created by the Territorial legislature in 1869 and was organized in 1871, with Geneva as the county seat. Most of the early settlers came from Iowa, Illinois, and Missouri, and from New York and other eastern States. Later there was considerable immigration of settlers from Germany, Bohemia, Sweden, and Ireland. People of Bohemian descent live chiefly in the vicinity of Milligan, Swedish chiefly in the southwestern part of the county, and Irish in the vicinity of Grafton. People of German descent are distributed throughout the county. The total population is given by the 1910 census as 14,674. The average density is reported as 25.5 persons to the square mile. All the population is classed as rural.

Geneva, the county seat, with a population of 1,741 in 1910, is the largest town. It is situated near the center of the county, in a rich agricultural section. The State Industrial School for Girls is located here, but there are no important manufacturing enterprises. Fairmont, the second largest town in the county, is situated in the northern part. It has a population of 921. Exeter, only slightly smaller than Fairmont, is situated in the northeastern part of the county. Shickley, Ohioa, Grafton, Milligan, and Strang are small towns of local importance, and Burress, Martland, Sawyer, Carlisle, and Lyman are other railroad stations.

Fillmore County has good railroad accommodations, no place within it being more than 10 miles from a railroad station. The Chicago, Burlington & Quincy Railroad (Omaha, Lincoln, and Denver line) traverses the northern part of the county. The Holdredge & Nebraska City branch crosses the southern part of the county and several other branches of this system extend across the county. The Superior Line of the Chicago & North Western Railroad crosses the county from northeast to southwest.

Practically all the highways are dirt roads. The main public roads usually are kept in good condition, but little attention is given to less important roads. The Omaha, Lincoln, and Denver highway passes through the northern part of the county. Practically all the streams and drainage ways are bridged.

## CLIMATE.

The climate of Fillmore County is marked by rather wide seasonal variations. The winters are fairly long and cold and the summers quite warm. The spring usually is cool, with considerable precipitation. The fall season is long, with moderate temperatures and occasional periods of rainy weather. The mean annual temperature at Geneva is reported by the Weather Bureau station as 50.8° F. The lowest temperature recorded is -32° and the highest 108°.

The average date of the last killing frost in the spring, as recorded at Geneva, is May 5, and that of the first in the fall September 30. The latest killing frost recorded in the spring occurred on May 27 and the earliest in the fall on September 11. There is an average growing season of nearly 150 days.

The mean annual precipitation is 29.77 inches. The precipitation is the heaviest during the months of May, June, and July and lightest during the months of November, December, and January. The greater part of the rainfall in the summer occurs in thunderstorms. The rainfall in May and June usually is well distributed and periods of drought are almost unknown. In July the distribution is less favorable, and during August and September the total rainfall is lighter. Long periods of drought occasionally occur in these three months. Crop failures are rare, but the yield of corn is sometimes reduced by drought and hot winds.

The average annual snowfall is about 23 inches. Usually very little snow falls before the last of October. About 4 inches falls in December, 4 inches in January, 6 inches in February, and 6 inches in March. There generally is some snowfall in April. As a rule, snow remains on the ground only a few days, and the ground is covered with snow less than half the time even in the months of heaviest snowfall.

The prevailing wind direction for the year is from the northwest, but in June, July, and August the winds are mainly from the south or southeast. The average wind velocity at Lincoln, about 36 miles northeast of Fillmore County, is 11 miles an hour. A velocity of 70 to 80 miles has been recorded for short periods during severe storms. Tornadoes are very rare.

The average relative humidity for the year is quite regularly near 70 per cent. It frequently is low during the afternoons in the spring or summer, sometimes dropping below 20 per cent.

The weather is relatively clear; the average year consists of 175 to 185 clear days, 81 to 86 cloudy days, and the remainder partly cloudy.

The table on the following page gives the normal monthly, seasonal, and annual temperature and precipitation as recorded at the Weather Bureau station at Geneva, in the central part of the county.

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

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	28.9	69	-20	0.61	0.08	T.
January.....	25.0	66	-24	.43	.20	0.55
February.....	24.4	77	-32	1.10	1.55	1.40
Winter.....	26.1	77	-32	2.14	1.83	1.95
March.....	37.8	92	-11	1.00	.25	.17
April.....	52.3	98	15	3.17	2.59	1.17
May.....	62.1	102	24	4.93	1.47	8.00
Spring.....	50.7	102	-11	9.10	4.31	9.34
June.....	71.1	104	38	5.34	6.11	10.81
July.....	75.5	108	41	4.00	2.53	10.20
August.....	74.4	104	40	3.34	4.72	6.05
Summer.....	73.7	108	38	12.68	13.36	27.06
September.....	66.0	105	23	2.49	1.16	.80
October.....	54.0	94	13	2.54	T.	2.18
November.....	38.2	79	-6	.82	1.29	1.04
Fall.....	52.7	105	-6	5.85	2.45	4.02
Year.....	50.8	108	-32	29.77	21.95	42.37

#### AGRICULTURE.

The soils of Fillmore County originally supported a luxuriant growth of prairie grasses, with marginal strips of timber along the larger streams. The first settlers located along the streams where there was an abundance of fuel and game to supply their needs while the land was being put under cultivation. Crops were first grown about 1868, and consisted mainly of corn and flax, with some spring wheat. Vegetables and potatoes for home use, and small quantities of buckwheat, rye, oats, and barley were grown. Although this was a cattle country before its agricultural settlement, the early farmers had almost no cattle before 1880. From 1870 to 1891 flax and spring wheat were the chief money crops. Some corn was grown for market, but owing to the low price the acreage was small. About 1885 hay became an important crop. From 1885 to 1890 the ravages of the chinch bug caused considerable loss in the growing of spring wheat, and the crop was discontinued, the Turkey Red, a winter variety, being introduced. Winter wheat has received steadily increasing attention, and to-day is the leading crop of the county.

With the exception of the "grasshopper year," 1874, and three years of protracted drought, 1890, 1894, and 1901, agricultural progress has been steady. In 1913 the corn crop was practically a failure throughout the county, the average yield being not much over 5 bushels per acre, but winter wheat yielded fairly well.

The present agriculture consists mainly of grain production, though dairying and the raising of hogs and other live stock are becoming more important. Wheat, corn, oats, alfalfa, wild hay, and timothy and clover are the most important crops, ranking in the order named. The type of farming is remarkably uniform over the entire county.

Wheat is the main crop, about 35 per cent of the total area of improved farm land being devoted to its production. In 1909 there was produced 1,726,530 bushels from a total of 85,893 acres, giving an average yield of about 20 bushels per acre. The acreage devoted to wheat has been steadily increasing since 1910, while that of corn has decreased. At present Turkey Red wheat is grown almost exclusively. This variety yields better than the spring wheats, can be sown in the fall at a time when the farm work is light, and matures before the dry weather and hot winds occur. The present high prices of wheat and flour favor the extension of the acreage in wheat. The Hessian fly does some damage to the crop. Wheat is strictly a cash crop, and the bulk of it usually is sold direct from the thrashing machine.

At present corn ranks second in acreage to wheat. From observations made during the progress of the soil survey, there are apparently 2 acres of corn to every 3 acres of wheat. The acreage of corn has decreased considerably since 1900. The 1910 census reported a total of 119,007 acres in corn, with a production of 2,215,556 bushels. The occurrence of hot winds and droughts in July and August in some years causes considerable damage to corn, but when the rainfall is adequate throughout the growing season the crop does well, yielding from 30 to 45 bushels per acre. Reids Yellow Dent, Iowa Silver Mine, and Leaming Improved are the most popular varieties. On tenant farms most of the corn is sold, while on farms operated by the owners a large part is fed to hogs and other live stock. It is a common practice to husk corn from the standing stalks, pasturing cattle and horses in the fields during the fall and winter. A few farmers cut some of the corn for winter roughage. There were approximately 60 silos in Fillmore County in 1916, and the number is increasing. On farms with silos some corn, usually 10 to 15 acres, is cut for ensilage.

According to the census there was a total of 36,443 acres in oats with a production of 960,447 bushels, in 1909. The acreage in oats has noticeably decreased within the last decade. The crop is less

profitable than either corn or wheat. Most of the crop is fed to horses and other live stock.

Alfalfa has become an important crop in Fillmore County, and owing to its high feeding value it is largely displacing clover and timothy as a hay crop. The census reports a total of 9,260 acres in this legume in 1909, as compared with 1,184 acres in 1899. The production in 1909 was 23,707 tons. The acreage in alfalfa has materially increased since that year. Most of the crop is fed to horses and cattle. Some is shipped out of the county to the larger markets.

The acreage in wild hay is comparatively large, although it has decreased considerably since the last census was taken. The 1910 census reports 14,363 acres in wild grasses. The yield is small compared with that of other hay crops, and the prairie sod is being broken as rapidly as expedient. The wild hay is used chiefly for feed on the farm.

With the introduction of alfalfa as a hay crop the acreage of clover and timothy decreased, though these are still important hay crops. It is difficult to maintain the stand of young clover through the first summer, as the rainfall between the middle of July and the middle of September is generally not great enough to enable the delicate clover plants to withstand the hot winds and occasional long droughts which occur after the nurse crop has been removed. If the rainfall is ample at the time it is most needed, immediately after the cutting of the grain crop, clover does well.

The 1910 census reports 8,968 acres in timothy and clover mixed, with a production of 11,161 tons; 3,581 acres in timothy alone, producing 4,230 tons; and 245 acres in clover alone, with a production of 351 tons. In the last few years, with the exception of the season of 1916, the clover stand has been poor. Some timothy is grown for seed, which ordinarily yields 4 to 8 bushels per acre.

Sorghum and kafir are grown to some extent. Sorghum does well, yielding 3 to 4 tons of fodder and about 20 bushels of seed per acre. The seed is sold, and brings about \$1.25 a bushel. The stalks usually are fed to stock. Scarcely any sorghum is grown for the production of sirup. Kafir yields ordinarily from 3 to 4 tons of fodder and 20 to 35 bushels of seed per acre. It makes an excellent feed for horses and cattle. A few farmers thrash the crop and feed the seed to chickens and pigs.

Most farmers produce enough potatoes for home use and in favorable seasons have a small surplus for sale. The potato patches are poorly cared for, however, and in many cases the production is not sufficient to meet home needs. According to the census, 957 acres were devoted to potatoes in 1909, with a production of 82,470

bushels. A total of 496 acres is reported in other vegetables. Nearly every farmer has a small garden, but it is often too small to supply even the requirements of the family.

Scarcely any attention is given to orcharding. There are no commercial orchards in the county, and the farm orchards are small. Apples and cherries are the chief fruits, followed by plums and pears. The farm orchards are given very little attention, and a large number of trees have died within recent years. Some grapes, strawberries, blackberries, and raspberries are produced. Practically all the fruit is consumed at home, and considerable quantities are shipped into the county. The 1910 census reports 86,604 apple trees, 45,702 peach trees, and 12,917 grapevines in the county.

Nearly every farmer keeps 4 to 6 milch cows in addition to young stock. In the vicinity of the smaller towns there are a few dairies, each having 10 to 20 head of milch cows. Most farmers keep enough cows to furnish a small surplus of milk, cream, or butter for sale. As a rule the cream is separated on the farm. The surplus cream and milk in a few cases are hauled to the cream stations, from which they are shipped to centralized creameries at Crete, Lincoln, Seward, or Omaha. Most of the dairy cows are grade Shorthorns. On the average farm little attention is given to the breeding, housing, and proper feeding of cattle.

The raising of hogs is the most important live-stock industry. Ordinarily from 20 to 30 hogs per farm, and sometimes as many as 100, are fattened each year for market, in addition to those slaughtered for home use. Most of the hogs, as well as other live stock, are kept on the farms operated by owners. On a few farms all the corn grown is fed to hogs. Hog cholera has been a serious obstacle to the development of hog raising, but this disease is now under control. Duroc Jersey and Poland China are the chief breeds, with a few herds of Hampshire and Chester White.

Little attention is given to the raising of beef cattle. Many farmers fatten 4 to 6 head of cattle for sale when prices are most favorable. A few farmers feed cattle obtained from the stockyards at Omaha or Kansas City. Most of the beef cattle are Shorthorns.

Practically all the farmers raise their own work stock, and often a team is sold. The most popular breed of horses is the Percheron. Some Belgian, Shire, and French Coach horses also are raised.

The census reports 7,891 milch cows, 13,710 other cattle, 13,383 horses, 40,923 hogs, and 4,698 sheep in the county in 1909.

Poultry constitutes a valuable asset on most farms. Nearly every farmer keeps 50 to 100 chickens, and ducks, geese, turkeys, and guinea fowls are raised on some farms.

The following table shows the value of the various farm products produced or disposed of in Fillmore County in 1909 as reported by the census:

*Value of farm products, by classes.*

Product.	Value.	Product.	Value.
Cereals.....	\$2,970,781	Live stock and products:	
Other grains and seeds.....	3,543	Animals sold or slaughtered.....	\$1,156,233
Hay and forage.....	439,730	Dairy products, excluding home use.....	141,063
Vegetables.....	78,357	Poultry and eggs.....	273,979
Fruits and nuts.....	66,446	Wool, mohair, and goat hair.....	1,706
All other crops.....	81,491	Total value.....	5,222,389

The adaptation of the soils of the county to the various crops grown is given careful consideration in selecting fields. It is recognized that corn, wheat, oats, and alfalfa do well on all the soils except the unreclaimed areas of the Scott soils, which constitute better hay and pasture land.

Definite and systematic crop rotations are followed by a few progressive farmers. The usual plan is to grow corn 2 to 3 years, oats 1 year, and wheat 2 to 4 years, when the field generally is returned to corn. Frequently either corn or wheat is grown continuously on the same land for 5 years or more. Where these crops are grown year after year, the yields noticeably decrease. Occasionally wheat land is seeded to clover and timothy and allowed to remain in sod 2 or 3 years. Alfalfa, which is rapidly succeeding clover as a hay crop, is kept in the same field from 5 to 10 years, or as long as a stand can be maintained. Clover and timothy fit best in a short rotation, but their production is decreasing owing to the fact that alfalfa is a more certain crop. A rotation which is popular with some of the best farmers in the county is 2 years of corn, 1 year of oats, and 2 years of wheat, followed occasionally by a hay crop, usually clover and timothy.

Stubble and sod land usually is plowed in the fall if time permits. Where corn follows wheat or a hay crop, it is either listed or check-rowed on plowed and disked land; where the land is plowed in the spring, the crop is listed. Where corn follows corn the stalk land is disked two or three times before the seed is listed. Some farmers cut the stalks, if heavy, with a stalk cutter before disking. Corn generally is cultivated three or four times. Where the crop is check-rowed it is considered a good plan to harrow the field a number of times before the corn is large enough to cultivate, in order to keep down the weeds. In preparing corn land for oats most of the farmers disk the corn land a number of times, drag the fields, and then seed

with a press drill. In a few cases the oats are sowed broadcast. Land for wheat, if moisture conditions are favorable, is plowed immediately after the preceding crop has been removed. When too dry, the land is harrowed and plowed as soon as possible after the first rain and then left until time for seeding the wheat, when it usually is harrowed twice before drilling in the seed. If a volunteer crop of grain has come up in the plowed field it is disked before harrowing. As a rule the plowing is shallow, only 4 to 6 inches deep, and in many fields a plowsole has formed. Where deeper plowing is practiced larger yields are obtained.

Green crops are seldom turned under, and scarcely any commercial fertilizer is used. Very little barnyard manure is applied. Occasionally winter wheat is given a top-dressing of manure, which results in a material increase in yield.

Efficient farm labor is rather scarce, but usually enough help is obtainable to do the farm work. Farm laborers receive \$25 to \$30 a month, with board, where employed by the year. In many cases the term of employment is from April 1 to December 1, in which event the wage is increased to \$30 or \$35 a month, with board. For harvesting wheat, wages range from \$2 to \$4 a day. Extra help in the corn-husking season usually is paid 3 or 4 cents a bushel. A few farmers employ entire families in order to obtain more efficient and reliable help, paying from \$30 to \$40 a month, and permitting the laborer to keep a cow, horse, and chickens and to make a garden. An expenditure of \$209,293 for labor is reported for the county in 1909, about half of the farmers reporting the employment of help.

On the whole the farm improvements are good. The tenant houses are generally smaller and less substantial than the homes of the farm owners, but as a rule they are fairly comfortable. Most of the fences are of barbed wire, but the use of woven wire is increasing. There are a large number of hedge fences along farm boundaries, but the stunting of crops within a distance of 10 to 25 feet on each side of these hedges makes them undesirable, and they are gradually being removed. Labor-saving machinery is in general use.

Of the total area of Fillmore County, about 96 per cent, according to the census of 1910, is in farms. Of the farm land, about 94 per cent is reported improved. The average size of the farms is given as 175 acres. The size of the farms has been steadily increasing for many years, and is about 26 acres larger than in 1880. The total number of farms in 1910 is reported as 2,028, of which 53 per cent are reported operated by tenants, and practically all the remainder by owners.

Both the cash and the share systems are followed in renting farms. Share renting seems to be the more popular. Under this

system the owner receives two-fifths, and in some cases one-third, of the crops grown, all stock being furnished by the tenant. In a few cases a combination system is used, the wheatland being rented for one-third of the crop and the remainder of the farm for cash. In any system of renting the tenant is required to deliver the grain at the elevator.

The price of farm land in Fillmore County ranges from \$25 to \$125 an acre, depending on the character of the soil, the improvements, and the location.

#### SOILS.

The soils of Fillmore County are classed, on the basis of origin and mode of formation, in three principal groups: (1) Soils derived from loess, (2) soils derived from glacial drift, and (3) water-laid soils derived from alluvial and lacustrine deposits.

The upland originally was covered by a layer of plains loess to depths of 20 to 60 feet. Although thinned to some extent by erosion, this is still the soil-forming material of the uplands. The loess in its original unweathered condition consists of loosely consolidated material ranging in texture from silt loam to heavy silt loam. It varies in color from brownish yellow to yellow, light gray, or almost white. The material has a moderate lime content, and the presence of iron is indicated in places by rusty streaks and blotches. Since its deposition the surface material has undergone marked changes in color, structure, and composition, caused principally by weathering, the accumulation of organic matter in the soil, the concentration of clay in the subsoil, and the partial removal of lime from the soil and upper subsoil. These changes have resulted in the formation of a dark-brown or black silty surface soil, with a brown, heavy, compact upper subsoil and a more friable, calcareous lower subsoil. In Fillmore County the soil produced by these processes covers practically the entire upland, and is mapped as the Grundy silt loam.

Below the plains loess lies a layer of sand and gravel, classified by the State geologists as Western gravel. This layer consists of coarse sand and fine gravel, largely feldspar and quartz. It is exposed along the slopes of the South Fork of the Big Blue River. The soil derived from this formation occupies very small areas, and can not be satisfactorily separated on the map.

Soil derived from glacial material is of very small extent. It is probable that the Kansan drift originally covering approximately the eastern half of the county, but it is now exposed only in narrow strips along the deeply cut streams in the eastern and southeastern sections. In this county the silty phase of the Kansan drift is encountered. It consists of a heterogeneous mass of clay, silt, sand, gravel, and

boulders. The drift material has weathered into the Carrington silt loam.

Numerous sinklike depressions in the upland have been partially filled with sediments brought down by surface sheet water or by intermittent streams from the surrounding loessial areas. The soils here are lacustrine, and are classed with the Scott series.

Terrace soils occur along only a few of the larger streams, and cover a very small part of the total area of the county. The surface covering of the terraces consists of fluvial silts, and the material does not differ greatly from the silty soils of the uplands. The terrace soils are classed in the Waukesha series.

The soils of the first bottoms are less uniform in color and texture than the other soils of the county. They consist mainly of sediments washed down from the silty soils of the upland, modified locally by materials from the sandy and gravelly strata. They are classed with the Wabash and Sarpy series.

The soils of the Grundy series are dark brown to black. The subsoil consists of three layers. The upper layer, or the subsurface material, is brown or light brown to grayish, and a little heavier than the surface soil. The second layer, beginning at a depth of 16 to 24 inches, is a heavy, dark-brown to mottled dark-drab and brown clay, moderately crumbly when dry, but tough when wet. It usually extends to a depth of about 30 inches. The lower subsoil is somewhat lighter in color and less tough than the intermediate layer. The topography of these soils usually is flat. The series is derived from silty deposits of glacial age, usually defined as loess. Only one member of the Grundy series, the silt loam, is encountered in Fillmore County.

The surface soils of the Carrington series are dark brown and occasionally black. The subsoil is brown to faintly reddish brown. It is silty, moderately friable, and practically free from any concentration of clay in the upper part. The Carrington soils carry a low to moderate content of lime. They have a smooth to rolling topography. In Fillmore County the series is represented by a single type, the Carrington silt loam.

The surface soils of the Scott series are dark brown to drab. The upper subsoil is lighter in color than the surface soil, being usually gray. It ranges in thickness up to about 6 inches, and is underlain by a mottled dark-drab and brown, tough, plastic clay layer, ranging in thickness from 5 to 15 inches. At about 30 inches there is a gradual change to a friable, lighter colored, and somewhat lighter textured layer, which continues throughout the remainder of the 3-foot section. The Scott soils consist of lake-laid material eroded from higher lying loessial soils and transported by sheet surface waters or intermittent streams to the shallow temporary lakes or ponds occupying local,

undrained, sinklike depressions in the upland plains. They are poorly drained, and in places are occasionally inundated. The Scott silt loam and silty clay loam are mapped in Fillmore County.

The surface soils of the Waukesha series are dark brown to black. The subsoil is yellow. These soils are derived from water-assorted glacial débris and loessial material deposited in broad filled-in valleys or as outwash plains and terraces. The topography is mainly flat to undulating, but drainage is good. In this county only the silt loam type is mapped.

The Wabash soils are dark-brown to black, the latter color prevailing. They contain a high percentage of organic matter. The subsoil is gray to brown or drab, and has a heavy texture. These soils are developed in the first bottoms of streams in the central prairie States. The material is derived principally from the loessial and associated soils of the region. These soils have a flat topography, and usually are poorly drained. Only the silt loam type is mapped in this survey.

The soils of the Sarpy series range from grayish brown to brown. This series differs from the Wabash both in color and in usually having a subsoil distinctly lighter in texture than the surface soil. This series is developed in the bottom lands of the Mississippi and Missouri Rivers and their larger tributaries. Owing to their low position, the soils are subject to overflow, but the soil structure is such that between flood stages of the streams the drainage is good. In general, the surface is flat. The Sarpy very fine sandy loam is recognized in Fillmore County.

The various soils mapped in Fillmore County are described in detail in following pages of this report. The table below shows the actual and relative extent of each:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Grundy silt loam.....	322,240	87.4	Wabash silt loam.....	4,032	1.1
Scott silty clay loam.....	14,400	3.9	Sarpy very fine sandy loam...	1,038	.3
Waukesha silt loam.....	13,376	3.6			
Scott silt loam.....	8,704	2.4	Total.....	368,640	.....
Carrington silt loam.....	4,800	1.3			

GRUNDY SILT LOAM.

The surface soil of the Grundy silt loam is a dark-brown, heavy silt loam, ranging in depth from 8 to 15 inches, with an average of about 12 inches. It is deepest in the flat areas. The soil is friable and rich in organic matter. The upper part of the subsoil, or the subsurface layer, consists of a brown, very heavy silt loam, a little



FIG. 1.—TYPICAL WHEAT FIELD ON THE LOESS PLAINS OF FILLMORE COUNTY;  
GRUNDY SILT LOAM.

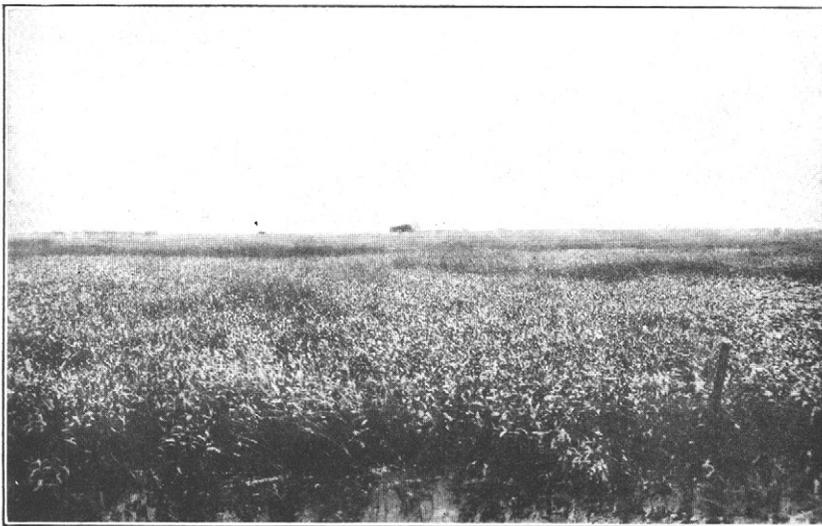


FIG. 2.—TYPICAL SEDGELIKE VEGETATION IN ONE OF THE DEEPER PONDS IN FILLMORE  
COUNTY; SCOTT SOILS.



heavier than the surface soil. This layer passes abruptly into a brown to nearly black heavy clay horizon, with a dark-drab and yellow-brown to brown mottled color. This stratum is compact, hard, tough, and moderately crumbly when dry, and plastic and relatively impervious when wet. There usually is a sharp change in texture from the subsurface layer to the underlying material, though in the more rolling areas this change is not so prominent. This part of the subsoil is spoken of by farmers as a "hardpan" layer, and where it is near the surface as "gumbo." At 24 to 30 inches there is encountered a yellowish-gray or pale-yellow friable silty clay, which is lighter in texture and more open than the upper subsoil. This lower subsoil generally is highly calcareous, the lime occurring in the form of concretions, and is more or less streaked and blotched with brownish iron stains. It is the slightly weathered upper part of the parent rock. Below the 3-foot section the color usually changes to light gray. The soil contains no sand or pebbles.

In the northern part of Belle Prairie precinct and in the area on the broad divide southwest of Exeter a heavy variation of this type is encountered. The surface soil ranges from a heavy silt loam to silty clay loam. The subsoil is similar to that of the typical Grundy silt loam. This land is known locally as "gumbo flats." It is poorly drained, and the chief problem in farming is the removal of the surface water rapidly enough after heavy rains to prevent injury to crops.

Another important variation of this type occurs in depressions reached by drainage ways. In such places the soil is a dark-brown, smooth-textured silt loam, 8 to 10 inches deep, underlain by a black, tough clay. It occupies depressions ranging from 10 to 30 feet below the level of the constructional upland surface. This variation is not so well drained as the typical Grundy silt loam, especially in the area east of Shickley. It is intermediate between the typical Grundy silt loam and the Scott silty clay loam in every respect except texture. It occurs in relatively large areas. One area of about 10 square miles lies west and northwest of Ohiova, one of more than 4 square miles east of Shickley, and a smaller area north of Shickley.

The Grundy silt loam includes small areas in which there is only a slight concentration of clay in the subsoil. In these areas the soil is a dark-brown, heavy silt loam, 6 to 18 inches deep, underlain by a yellowish-brown silty clay loam. At a depth of 24 to 30 inches a yellowish-gray silty clay loam is encountered. These areas occur mainly on slopes bordering the valleys of the South Fork of the Big Blue River and Turkey Creek. Along the shallow, U-shaped valleys in areas of Grundy silt loam the light subsoil frequently is exposed.

The Grundy silt loam covers seven-eighths of the total area of the

county. The type has a smooth or almost flat to slightly undulating, plainlike topography. It represents the original constructional surface of the country and occupies the highest topographic position of any of the soils. The surface drainage is generally adequate, though in wet seasons, especially on the broad divides, it is not sufficient for maximum crop production. On the other hand, crops do not withstand drought so well as on types with friable, open subsoils, as during periods of high temperatures and hot winds the hardpan layer does not permit a sufficiently free upward capillary movement of water to supply the need of crops. This is especially marked in the case of corn, occasionally causing a failure of the crop.

This type originally supported a thick growth of prairie grasses, but only a few small patches remain. About 93 per cent of its area is cultivated. High average yields are obtained. Wheat, the principal crop, does particularly well in normal years. (See Pl. I, fig. 1.) Ordinarily yields range from 18 to 25 bushels an acre, but occasionally 30 to 35 bushels are obtained. Corn ranks second in acreage. This crop does well except in dry, hot seasons. Ordinarily it yields from 30 to 40 bushels an acre, and in favorable years with proper cultivation as much as 60 bushels. Oats are grown extensively, and the crop does well if it matures before hot winds and dry weather occur. The average yield is 25 to 30 bushels per acre, and in favorable seasons yields of 50 to 60 bushels are reported. Alfalfa is the principal hay crop, though some timothy and clover are grown and wild hay is cut to some extent. Usually three and sometimes four cuttings of alfalfa are made, with a total yield of  $2\frac{1}{2}$  to 4 tons per acre. In seasons of favorably distributed rainfall clover and timothy do well, yielding from  $1\frac{1}{2}$  to 2 tons per acre. Wild hay yields 1 to  $1\frac{1}{2}$  tons per acre. The soil is especially suited to millet, which ordinarily yields 2 to 3 tons per acre. Millet is an important crop on this soil. It is grown usually in small patches. A few acres are devoted to kafir and sorghum, which do well. The farmers on this type are generally prosperous.

Owing to its smooth topography and friable, silty, stone-free character, the greater part of this soil is very easily handled, and it can be worked under a rather wide range of moisture conditions. In places where the hardpan layer is near the surface and where the soil approaches a silty clay loam, it is rather difficult to cultivate.

This type is naturally very productive. It responds readily to good farming methods; but little barnyard manure is applied, and no commercial fertilizer is used.

The price of land of this type ranges from \$90 to \$125 an acre, depending on location and improvements and the productive condition of the soil.

In fields which have been devoted to the same crop for a period of years the soil has deteriorated materially in productiveness. Deeper plowing results in increased yields and is needed on most farms. In general, more thorough cultivation would be beneficial. As the soil contains much organic matter, it is necessary to alternate the cereal crops with legumes only every four or five years or more.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Grundy silt loam:

*Mechanical analyses of Grundy silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
372301.....	Soil, 0 to 12 inches.	0.0	0.2	0.1	0.8	15.8	65.4	17.6
372302.....	Subsoil, 12 to 36 inches.	.0	.0	.0	.8	17.0	51.2	30.8

CARRINGTON SILT LOAM.

The Carrington silt loam consists of a brown to dark-brown heavy silt loam, 8 to 15 inches deep, underlain by a light-brown silty clay loam which has a reddish cast. The subsoil is crumbly and hard, but becomes plastic when wet. Below 24 inches the material is lighter in color, and a few grayish mottlings occur. The soil is high in organic matter, and works up into a mellow tilth. Lime concretions occur in places in the third foot of the soil section, and are invariably encountered at greater depths.

The Carrington silt loam is very inextensive. It occurs on slopes along Turkey Creek and some of its branches, and along the smaller streams in the southeastern part of the county. It is well drained. Erosion occurs on the steeper slopes. Crops on this type withstand drought better than on the Grundy silt loam.

The Carrington silt loam originally was in prairie, supporting the same native growth as the Grundy silt loam. About 80 per cent of it is under cultivation, the remainder being largely in permanent pasture. Wheat, corn, oats, and alfalfa are the principal crops. The yields are about the same as on the Grundy silt loam.

Owing to its silty texture, this soil is comparatively easy to handle, but when plowed too wet it bakes and clods considerably. Only small quantities of barnyard manure are applied, and no commercial fertilizers are used.

The price of farm land of the Carrington silt loam varies from \$70 to \$100 an acre.

On most farms in this type deeper and more thorough tillage should prove very beneficial. The growing of leguminous crops is advantageous in keeping up the organic-matter content of the soil.

## SCOTT SILT LOAM.

The surface soil of the Scott silt loam consists of a dark-brown to dark-gray, smooth silt loam, 6 to 15 inches deep, rather high in organic matter. The soil is very friable and has a decidedly velvety feel. It has a distinctly grayish cast when dry, in contrast with the associated Grundy silt loam. The upper part of the subsoil consists of an ashen-gray, pulverulent silt loam layer, ranging from 1 to 10 inches in thickness. The lower part of the subsoil is a dark-drab or nearly black, plastic silty clay, mottled with brown in the lower depths. This material is tough and compact. The change from the upper to the lower subsoil, both in texture and in color, is very distinct. Below 30 inches the subsoil usually is lighter in color and also in texture. The subsoil is highly calcareous. Small areas where the gray upper subsoil is absent or occurs only as a very thin layer are included.

This type occupies small depressions scattered throughout the Grundy silt loam. The drainage is poor, and in the spring after heavy rains water stands on the surface for periods of a few days to several weeks. The soil of the upper part of the section apparently consists of silt washed from the surrounding higher land in comparatively recent times and deposited over older material which now constitutes the lower subsoil. The lower substratum, which is high in organic matter, apparently is a very old soil, formed by the deposition of clay and silt in standing water.

The native vegetation consists of sedges and water-loving plants, with prairie grasses along the borders of the areas (Pl. I, fig. 2). About 20 per cent of the type is under cultivation. Where adequate drainage is provided corn, wheat, and timothy do well. In its natural condition the best use of this type is for grazing, and it is largely utilized as pasture land. Some wild hay is produced. The soil is not well suited to grain farming.

The Scott silt loam is valued at \$40 to \$60 an acre as farm land, the price depending largely on the drainage conditions.

Drainage is the greatest need of this soil, but where the depressions are deep it is not profitable to drain them.

The results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Scott silt loam are shown in the following table:

*Mechanical analyses of Scott silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
372313.....	Soil, 0 to 6 inches.	0.0	0.1	0.1	0.6	12.6	71.2	15.2
372314.....	Subsoil, 6 to 20 inches.	.2	.8	.3	.5	16.0	73.4	8.6
372315.....	Lower subsoil, 20 to 36 inches.	.1	.2	.1	.4	9.5	58.0	31.6

## SCOTT SILTY CLAY LOAM.

The surface soil of the Scott silty clay loam is a dark-drab to black silty clay loam, ranging from 6 to 10 inches in depth. There is usually a surface layer of black silt loam, ranging from 1 to 4 inches in thickness. The heavy stratum in the surface soil is tough, hard and compact when dry, and very plastic when wet. The change from the surface soil to the subsoil is imperceptible, the upper subsoil being similar in texture, structure, and color to the subsurface material. At a depth of 20 to 24 inches, however, the subsoil becomes lighter in color and at 30 to 36 inches a yellowish-gray or gray, moderately friable silt loam is encountered. The substratum is highly impregnated with lime, as well as with other salts which appear as whitish specks and streaks. The surface soil as well as the subsoil has a granular structure, often a characteristic of soils high in clay. The surface soil commonly cracks and checks. As its color indicates, it is high in organic matter. Locally this type is called "gumbo."

The Scott silty clay loam occurs in depressions on the loess plains, varying from several acres to two or three square miles in extent. The largest area occurs in the vicinity of Ohioa. The drainage is very poor, and some areas are inundated the greater part of the year. In wet seasons the water usually is not removed rapidly enough for the successful production of crops. On the other hand, in very dry years crops suffer on account of the retarded upward movement of water, caused by the impervious subsoil.

The native growth on this type consists of slough grasses and other water-loving plants. Most of the type is unreclaimed, and largely used as pasture and hay land. About 35 per cent of the type has been drained and is utilized for the production of corn, wheat, and timothy hay. Corn yields 30 to 40 bushels per acre, wheat about 30 bushels, and timothy 2 to 2½ tons. Wheat does particularly well on this type, owing to the heavy texture of the soil. Corn gives heavy yields in years of favorable distribution of rain. Wild hay yields from 1 to 1½ tons per acre.

The Scott silty clay loam is the most difficult soil in Fillmore County to handle. Under favorable moisture conditions it granulates and works up into a good seed bed, but when worked too wet it bakes and forms intractable clods, which are difficult to reduce. No barnyard manure or commercial fertilizer is used.

Land of this type is held at \$25 to \$80 an acre, the price depending largely on drainage conditions.

Where feasible the Scott silty clay loam should be reclaimed by the installation of drainage systems. The soil should prove as productive as the Grundy silt loam, and may be even more productive.

In the table on the following page are shown the results of mechanical analyses of samples of the soil and subsoil of the Scott silty clay loam:

*Mechanical analyses of Scott silty clay loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
372307.....	Soil, 0 to 6 inches.....	0.0	0.4	0.4	2.0	14.1	52.1	31.0
372308.....	Subsoil, 6 to 36 inches..	.0	.2	.2	1.0	14.3	43.8	40.6

## WAUKESHA SILT LOAM.

The surface soil of the Waukesha silt loam is a brown to dark-brown silt loam, with an average depth of 12 to 15 inches. It is high in organic matter and has a very smooth, velvety feel. The subsoil is a brown, compact silty clay loam to silty clay, becoming yellowish gray or grayish below 24 inches. The lower part of the soil section usually is lighter in texture and contains lime concretions. Along the South Fork of the Big Blue River the upper subsoil generally is a hard, tough, moderately crumbly silty clay, and in this respect resembles the soil section of the Grundy silt loam. When wet it is rather plastic and sticky. This layer is referred to as "hardpan," and where it lies near the surface as "gumbo."

Along Schoolhouse Creek, Turkey Creek, and smaller streams a variation of this type having a light-textured subsoil is encountered. The surface soil here is a dark-brown to nearly black, heavy silt loam. It has a velvety feel and is very friable. The subsoil is a gray, heavy silt loam, with a yellowish cast, and only slightly heavier than the surface soil. Below 30 inches the material is lighter in texture and more open in structure, consisting of a coarse silt loam.

The Waukesha silt loam has a very small total area, but is the third most extensive soil type in the county. The largest areas occur along the South Fork of the Big Blue River and along Turkey Creek. This type occupies distinctly benchlike areas modified to only a small extent by stream erosion. The terraces lie 10 to 25 feet above the present flood plain and are well drained.

Originally the Waukesha silt loam supported a thick growth of prairie grasses. It is considered one of the best soils in the county and 95 per cent of it is farmed. Corn is the principal crop, followed closely by wheat, which is being grown on a gradually increasing acreage. Corn does well except in dry years, the ordinary yields being 30 to 35 bushels an acre. Under very favorable conditions yields of as much as 60 bushels are often obtained. Wheat ordinarily yields 20 to 25 bushels an acre. Oats do well, but the crop is not extensively grown. Ordinarily a yield of about 30 bushels per acre is obtained. Considerable alfalfa is grown. In seasons of favorably distributed rainfall three cuttings, and sometimes four, are obtained, with a total yield of 3 to 5 tons per acre. The methods of cultivation, rotation, and fertilization of crops are similar to those practiced on the Grundy silt loam.

The value of farm land on the Waukesha silt loam ranges from \$90 to \$125 an acre.

The greatest needs for the improvement of this soil are more thorough cultivation and the growing of leguminous crops to maintain the high organic-matter content.

#### WABASH SILT LOAM.

The Wabash silt loam to a depth of 18 to 24 inches is a dark-brown to black, very friable silt loam, carrying a high percentage of organic matter. The subsoil has the same color as the surface material, but is somewhat heavier and more compact. Over a large part of the type there is no marked difference in color or texture within the 3-foot section. The subsoil is calcareous in the lower part.

This type is very inextensive. It occurs as first-bottom land along the smaller streams and is subject to overflow. The topography is flat, but the drainage between overflows is good. Along the stream channels part of this type is forested with a growth consisting mainly of elm, willow, and cottonwood. The remainder originally was in prairie grasses. Most of the wider areas are under cultivation, but the narrow strips of first bottom usually are in permanent pasture. The cultivated portion comprises about 60 per cent of the type. Corn and wheat are the important crops. Ordinarily yields of 45 to 50 bushels of corn and 20 to 30 bushels of wheat per acre are obtained.

No farms are composed entirely of land of this type. It ranges in value from \$125 to \$175 an acre, the price depending upon the location and improvements.

#### SARPY VERY FINE SANDY LOAM.

The Sarpy very fine sandy loam consists of a brown very fine sandy loam underlain by a gray or brownish-gray, open, loose very fine sandy loam. The type as mapped includes small areas of silt loam. The soil is low in organic matter.

This type is very inextensive. It occurs as a narrow strip along the South Fork of the Big Blue River and along Turkey Creek, lying about 3 to 4 feet above the normal flow of the streams. The surface is generally flat, but between stages of high water the drainage is good. The type is subject to frequent overflows.

Practically all this type is forested, principally with box elder, ash, poplar, elm, willow, and honey locust. The type is used largely for pasture, to which it seems best suited.

#### SUMMARY.

Fillmore County, Nebr., is situated in the southeastern part of the State. It has an area of 576 square miles, or 368,640 acres. The topography is predominantly flat to slightly undulating. The greater part of the county represents the original constructional surface of

the loess plains. There is a small total area of terrace and bottom land along streams. As a whole the county is well drained by the South Fork of the Big Blue River and by Turkey Creek.

The first permanent settlement in Fillmore County was made in 1868, and the county was organized in 1871. The early settlers came largely from the Eastern States. In later years many settlers have come from European countries. The population of the county is reported in the 1910 census as 14,674.

The county has good transportation facilities, no part being more than 10 miles from a railroad station, and all sections are supplied with rural mail delivery and telephone service.

The climate is favorable for the growing of a wide variety of grain, hay, and forage crops. The mean annual temperature is about 51° F., and the mean annual precipitation about 30 inches.

Grain farming is the chief type of agriculture, but increased attention is being given to the production of beef and pork and to dairying. Wheat, corn, oats, alfalfa, wild grasses, and timothy and clover mixed are the principal farm crops. Millet, sorghum, kafir, and potatoes are grown to a small extent. Systematic crop rotations are not commonly followed.

Seven soil types, representing six series, are mapped in Fillmore County. These are classed in three principal groups: (1) Soils derived from loess, classed in the Grundy series; (2) soils derived from glacial drift, classed in the Carrington series; and (3) water-laid soils, including alluvial and lacustrine deposits, classed in the Scott, Waukesha, Wabash, and Sarpy series.

The Grundy silt loam is a dark-colored loess soil. It represents the original constructional surface of the county, and covers seven-eighths of its area. It is used principally for the production of wheat, corn, oats, and alfalfa.

The Carrington silt loam is glacial in origin, and is derived from the silty phase of the Kansan drift. It is inextensive. Wheat, corn, oats, and alfalfa are the principal crops.

The Scott silt loam and silty clay loam occur in depressions within the Grundy silt loam type. They are poorly drained and are used chiefly as pasture and wild-hay land, but when reclaimed are productive of corn, wheat, and cultivated grasses.

The Waukesha silt loam is a dark-colored terrace soil. It is used mainly for the production of corn, wheat, and oats, of which good yields are obtained.

The Wabash silt loam has a small extent. It is considered a good corn and wheat soil, but is not nearly so well suited to oats.

The Sarpy very fine sandy loam is a light-colored, first-bottom soil with a loose very fine sandy loam subsoil. Scarcely any of the type is under cultivation.

[PUBLIC RESOLUTION—No. 9.]

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

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

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

Approved, March 14, 1904.

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



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