

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
In Cooperation with the Iowa Agricultural Experiment Station

SOIL SURVEY
OF
CHICKASAW COUNTY, IOWA

BY

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U. S. Department of Agriculture

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COUNTY SURVEYED

Chickasaw County is in the northeastern part of Iowa, in the second tier of counties south of the Minnesota-Iowa State line and in the third tier west of Mississippi River. New Hampton, the county seat, located in the center of the county, is about 40 miles due north of the city of Waterloo.

The county is rectangular in shape, extending 24 miles from east to west and 21 miles from north to south. The total area, 497 square miles or 318,080 acres, is divided into 12 townships, 8 of which are regular in size and shape and the remaining 4 of which, in the northern tier, include 1 full township and the southern half of an additional township each, or a total of 54 square miles each.

Chickasaw County consists of an undulating drift-covered plain incompletely dissected by a series of small streams crossing it from northwest to southeast. Along the larger streams the dissection is sharp and relatively deep. The hilly belts produced by the dissection lying along both sides of the streams range up to somewhat more than a mile in width. The smooth uplands consisted, in their natural virgin condition, of grassy plains. The hilly lands supported a cover of trees.

Although the streams of the county flow from the northwest to the southeast, the elevations at several points show that the slope is to the southwest. Fredericksburg, in the valley of East Fork Wapsipinicon River, has an elevation of 1,076 feet¹ above sea level, or 108 feet more than Nashua, in the valley of Cedar River. Lawler, on Crane Creek, has an elevation of 1,088 feet, and Bassett, located on Little Cedar River, is 1,029 feet above sea level. Elevations of Devon and New Hampton are 1,195 and 1,159, respectively.

Chickasaw County, originally attached to Fayette County for election, revenue, and judicial purposes, was established in January, 1851, and was finally organized in April, 1854. For several years the county seat was at Bradford, but after much dispute it was finally moved to New Hampton where it has remained since 1857.

The first white settlers arrived in the county in 1840 but did not remain long enough to establish themselves, and it was not until

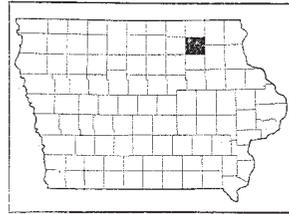


FIGURE 1.—Sketch map showing location of Chickasaw County, Iowa

¹ GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. (Fourth edition.) U. S. Geological Survey Bul. 274, 1,072 pp. 1906.

1848 that settlement really began. The first settlers built their homes along Little Cedar River in the vicinity of what is now Bradford. After the wooded areas were acquired it became necessary for the later settlers to take the black prairie lands which are now considered the most valuable in the county.

A large proportion of the early settlers came from native stock living in the Eastern and Southern States. The foreign settlers came from Germany, Bohemia, and Ireland. These foreigners settled in separate communities, the Germans near Fredericksburg, the Irish near Lawler, and the Bohemians near Saude.

With the exception of a woolen mill at Nashua and a few gristmills scattered over the county, the industries of Chickasaw County are primarily agricultural. The population is, therefore, classed principally as rural. Of the total population of 15,431 persons, only 2,539 or 16.5 per cent are classed as urban, the remaining 12,892 living on farms or in the smaller towns and villages. The population is well distributed over the county, but a slightly higher percentage of the population lives in the southern half of the county. The average density of the rural population is 25.9 persons to the square mile.

Chickasaw County has no large towns. New Hampton, the county seat and the largest town, had in 1920 a population of 2,539 persons. Other towns of importance are Nashua, Fredericksburg, Lawler, Alta Vista, and Ionia. Smaller towns are scattered over the county.

The Chicago, Milwaukee, St. Paul & Pacific Railroad traverses the center of the county from east to west, and the Chicago Great Western Railroad serves other parts of the county. A branch line of the Illinois Central Railroad runs through the southwestern corner. These railroads supply outlet to the eastern and northern markets. The agricultural products are marketed at Chicago, Minneapolis, St. Paul, Waterloo, and Dubuque. The local markets consume only a small percentage of the surplus farm products. United States Highway No. 18 enters the county east of Fredericksburg, runs west to Williamstown, north to New Hampton, and thence due west into Floyd County. State Highway No. 59 traverses the center of the county from north to south, passing through New Hampton. The county and township roads are kept in good repair, are brought to grade, and are graveled wherever necessary to promote travel throughout the year.

Country schools are located at 2-mile intervals over the county, and accredited high schools are in all the larger towns. Several small churches are located at convenient points. Telephone service reaches practically all farms in the county.

CLIMATE

Although there is a wide range in the temperature and precipitation of Chickasaw County during the year, climatic conditions do not prevent the successful growing and maturing of the staple crops common to Iowa. The climate is healthful, despite the wide ranges in temperature. Extremely hot and cold periods are usually of short duration, the hot waves being broken by electrical storms and the cold waves by east and south winds.

The average date of the last killing frost is May 7, and the latest recorded frost was on May 31. The average date of the first killing frost is October 1, and the earliest recorded was on September 13. This allows an average frost-free season of 147 days, which is sufficiently long to mature the early varieties of corn and other crops. Nearly three-fourths of the mean annual rainfall of 32.16 inches falls during the growing season from April to September. During April and May the precipitation falls in short showers, and in the hot summer months the storms are more severe and are often accompanied by lightning and hail. Windstorms are common throughout June, but they rarely cause any serious damage. Periods of drought of from two to five weeks duration occur during July and August but do not cause the crops to suffer from lack of moisture on any but the sandier soils. The grazing season extends over a period of about 200 days, or from April to November. Snow generally covers the ground throughout the winter, varying in depth from 3 to 14 inches at various times.

Table 1 gives the normal monthly, seasonal, and annual temperature and precipitation as recorded at the United States Weather Bureau station at New Hampton.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at New Hampton

[Elevation, 1,169 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1910)	Total amount for the wettest year (1902)
	° F.	° F.	° F.	Inches	Inches	Inches
December.....	20.8	53	-23	1.09	0.40	2.20
January.....	14.5	52	-34	.98	2.10	.90
February.....	18.7	56	-26	1.05	.75	.74
Winter.....	18.0	56	-34	3.12	3.25	3.84
March.....	31.3	81	-17	1.92	.15	1.94
April.....	47.0	90	5	2.60	1.64	1.04
May.....	58.3	91	26	4.83	2.91	12.04
Spring.....	45.5	91	-17	9.35	4.70	15.02
June.....	67.7	97	35	4.57	.87	7.38
July.....	72.2	104	45	3.77	.12	8.19
August.....	69.8	97	35	3.50	4.81	3.72
Summer.....	69.9	104	35	11.84	5.80	19.29
September.....	62.4	94	27	3.59	2.18	6.75
October.....	50.2	87	12	2.57	.54	1.40
November.....	34.1	75	-6	1.60	.22	2.37
Fall.....	48.9	94	-6	7.85	2.94	10.52
Year.....	45.6	104	-34	32.16	16.69	48.67

AGRICULTURE

When the first white settlers entered Chickasaw County from the Eastern and Southern States, they found extensive stretches of rich, black prairie lands, traversed at intervals by large creeks and rivers

along which timber had gained a foothold. Settlements were made first in the timbered sections, where the supply of fuel and water was plentiful and where there was some protection from the fires which annually swept the prairies. Small acreages were cleared and cultivated. Sufficient grain and vegetables were grown to supply home needs, but the principal occupations of the settlers consisted of hunting, trapping, fishing, and trading with the Indians. The few cattle and hogs kept were allowed to roam over the prairies and through the timber. Buyers purchased the animals and drove them to the Mississippi River, and they were transported by boat to the eastern markets.

It was not until later, however, when the railroads extended westward, making the eastern markets readily accessible, that agricultural development really began. With the advent of the railroads, new settlers entered the county and began to settle on the rich prairie lands that were formerly used only as pasture land. The well-drained areas were selected first, and the swampy sloughs served as a common pasture ground for all the livestock. The opening of markets led to more extensive farming. Wheat occupied large acreages of the newly broken prairie land. Heavy yields, often as high as 40 or 50 bushels to the acre, were obtained in favorable seasons. With the invasion of insect pests, the wheat acreage decreased and that of corn and of oats increased. Since early times corn and oats have been the most important crops grown. The livestock industry at first consisted mainly of raising cattle and hogs for home consumption, but as the eastern markets became accessible the number of animals kept on the farms increased until at present the livestock system of farming is general over the county. Dairying is one of the most important livestock industries. Practically every farmer has a few head of milk cows, and more than 50 per cent of the farmers maintain herds of from 10 to 30 cows. During the last five years, livestock farming has proved more profitable than any other type.

Table 2, compiled from Federal census reports, shows the acreage and yield of the leading crops in the county from 1879 to 1924, inclusive.

TABLE 2.—*Acreage and yield of principal crops in stated years*

Year	Corn		Oats		Wheat		Barley		Flaxseed		Hay	
	<i>Acres</i>	<i>Bushels</i>	<i>Acres</i>	<i>Tons</i>								
1879.....	31, 384	1, 208, 201	20, 332	708, 098	68, 984	505, 424	3, 027	63, 722	-----	38, 638	37, 150	52, 847
1889.....	46, 507	1, 532, 672	43, 125	1, 967, 413	2, 407	30, 313	2, 199	72, 214	4, 732	47, 102	56, 497	74, 188
1899.....	62, 191	2, 334, 660	72, 142	2, 962, 060	2, 599	41, 450	5, 255	175, 900	6, 542	78, 820	40, 550	50, 933
1909.....	61, 724	1, 962, 396	61, 811	1, 396, 249	1, 032	16, 032	6, 100	109, 170	912	8, 055	1 54, 587	86, 965
1919.....	47, 258	1, 453, 325	60, 992	1, 675, 032	5, 029	47, 826	2, 051	32, 638	399	1, 533	1 67, 569	122, 554
1924.....	46, 745	893, 990	62, 464	2, 359, 491	558	15, 849	832	25, 860	133	904	52, 937	55, 238

¹ Hay and forage.

Farming at present consists of the production of corn, oats, and hay and the raising of livestock in sufficient numbers to consume the feed raised on the farm. Barley, flax, and rye follow these crops in importance. Wheat has only a minor place in the cropping system. The minor crops are either grown on newly reclaimed land or

as catch crops when other crops fail or when the spring is too late for a late-maturing grain. Truck crops are raised to supply home needs, and the surplus is sold on the local markets.

The white varieties of corn are preferred in this section of the State. Silver King, Iowa Silvermine, and strains of these varieties occupy the greatest acreage. Reid Yellow Dent, Leaming, Bloody Butcher, and Calico varieties adapted to this part of the State are grown to some extent in the southern part of the county. Corn is fed to hogs and beef and dairy cattle. A common practice adopted in recent years is to hog down the corn crop. This eliminates the labor involved in harvesting, and when the fields are fenced in small plots and the hogs made to clean up the fields thoroughly as they go there is little or no waste. Soybeans are often sown with the corn when the crop is to be hogged down in the fall. The soybeans supply protein to the ration of corn.

The oat crop is important in this part of Iowa. The cool, moist climate and the short frost-free season tend to encourage the production of oats, and the yields obtained are comparatively high. The longer growing season required to mature the corn crop has a tendency to prohibit growing it in some seasons, and naturally the acreage of oats will be increased at the expense of corn. Oats generally follow corn in the cropping systems in use on most farms. Oats are fed whole to the work animals but are usually ground at one of the various gristmills in the county when they are fed to dairy cows and hogs. The average yield of oats in Chickasaw County in 1924 was approximately 40 bushels to the acre.

Sufficient hay is produced to feed the livestock during the winter months. The tame hay usually consists of a mixture of timothy and clover. Small acreages of alfalfa and sweetclover are grown experimentally. Red clover is seldom grown alone, as winterkilling may cause a shortage in the hay crop the following year. The seed is sown with the small-grain crop, which serves as a nurse crop to the clover while the small plants are becoming established. The fields are left in hay two or three years, usually being pastured after the second year. A large part of the Clyde silty clay loam and Floyd silt loam is in wild grass, which is cut for hay in the seasons when the supply of tame hay is insufficient. In 1924 wild hay was cut from 10,056 acres. Most of this hay is used on the farms. The surplus is baled and shipped to outside markets.

Of the minor crops barley, flax, rye, and buckwheat are the most important. Potatoes, the chief vegetable crop, are grown mainly for home consumption, but in some years a surplus is marketed. The county rarely produces enough potatoes to supply the demand, and carload lots are shipped in from the western and northern markets. The 1925 census reports show that on the 932 acres in potatoes in 1924, 101,738 bushels were produced. This was an exceptional yield for this part of the State, the usual yield being less than 100 bushels to the acre.

Table 3, based on State census reports, shows the number of livestock on the farms and the value of poultry in 1905, 1910, 1915, 1920, and 1923.

TABLE 3.—*Livestock on farms and value of poultry in stated years*

Year	Hogs	Dairy cattle	Beef cattle	Horses	Sheep	Value of poultry
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Dollars</i>
1905.....	42, 116	18, 006	25, 353	10, 614	1, 741	150, 187
1910.....	49, 564	14, 865	28, 012	11, 482	3, 267	159, 062
1915.....	78, 547	17, 367	27, 995	12, 819	1, 727	160, 024
1920.....	63, 486	16, 360	28, 739	11, 175	3, 686	618, 888
1923.....	87, 295	18, 683	24, 634	10, 199	2, 847	-----

Practically all the farmers keep cattle and hogs. Dairying is carried on on nearly all farms, but beef cattle are raised and fed by only a few farmers. Dairy farming has become thoroughly established in the county and has proved more profitable than any other type in recent years. Herds of Holstein, Jersey, Guernsey, and milking Shorthorn and of grades of these breeds are kept. The Holsteins outnumber all other breeds, largely because they produce the greatest quantity of milk. Good sires, usually purebreds, head practically all the dairy herds of the county. Milking machines are in use on farms where the herds consist of not more than 18 or 20 cows. The cream and whole milk are sold to the creameries located in the various towns of the county, and the skimmed milk is used as hog feed. Most of the beef cattle are purchased as feeders, are pastured through the summer, and are finished on corn and concentrates in the fall after the crop matures. A few beef cattle are raised on some of the farms, but the practice is not general.

Horses are kept on the farms to supply the farm power. Eight or ten head are needed on the average-sized farm. One or two colts are raised each year to replace the older horses or for sale.

Every farmer keeps poultry, consisting of chickens, ducks, geese, and turkeys. The value of chickens raised in 1924 was estimated at \$320,184 by the 1925 census. The eggs and poultry are marketed at the local produce houses, whence they are shipped in carload lots to the eastern markets.

Hog raising is the most important livestock industry in the county. From 25 to 100 head are raised on each farm annually. According to the 1925 census, the total number of hogs on farms in 1924 was 54,869 head. Hog raising and dairying are closely associated, since the skim milk is excellent feed for the growing pigs.

The type of soil and surface features affect the type of farming followed only in a general way. The better-drained areas are recognized as best suited to general farming. The artificially drained areas are best adapted to corn production. Small grains on these soils have a tendency to produce rank stem growth and to lodge badly. Newly reclaimed wet areas are usually first seeded to flax or buckwheat for one or two years. The sandy soils of the county are best adapted to the production of small grains and hay. Corn often fires badly during the dry seasons on the sandy soils. Areas of the light-colored soils, such as the Lindley soils, are left in pasture when there is danger of damage through erosion.

Most of the farm homes are well built. Those near power lines are equipped with all the modern electrical appliances, and a few farmers too far from power lines to use them have installed light plants of their own. Practically all the buildings are painted and

kept in a good state of repair. Well-constructed barns and sheds protect the livestock during the cold winter months. Shelter belts of evergreens and hardwoods are planted on the north and west sides of the farmstead to break the cold winds. On practically all dairy farms silos supply green feed in the winter. The farms are well fenced, and many are inclosed in hog-tight fence so that any part of the farm can be pastured.

All the farms are equipped with labor-saving machinery. On a few of the better equipped farms milking machines, hay stackers, gas engines, tractors, feed mills, and equipment in the barns for carrying out the litter are in use. Motor trucks and tractors are standard equipment on the large, well-managed farms. Windmills and gas engines are used to pump water.

Systematic crop rotations are not followed as a general rule. Continuous cropping, however, is regarded as detrimental to the soil, and cropping systems allow the land to remain in hay or pasture 2 or 3 years at a time. A few of the better farmers have adopted 4 and 5 year rotations, including corn 2 years, oats or wheat 1 year, and then some hay crop which may remain on the land 1 or 2 years. On some of the tenant-operated farms clover is rarely seeded, grain crops being grown annually.

The census figures for 1925 show that on only 88 of the 2,050 farms in the county was the use of commercial fertilizer, including lime, reported in 1924. The expenditure averaged \$76.46 to the farm. Since 1920 the value of phosphates and limestone has been recognized, and they have been profitably used on several farms in a small way. Manure is the chief fertilizing material applied to the land, but the supply never equals the demand of the soils for additional plant food and it is only a matter of time before commercial fertilizers will come into common use.

The farm labor is supplied by local towns and communities and in 1926 was plentiful throughout the year. Most farmers require extra help during the harvesting and haying seasons, and for this work laborers receive from \$2 to \$4 a day, with board. Farm hands hired by the month receive from \$35 to \$60, with room and board. Married laborers are furnished a house, garden, cow, and a few chickens for their own use and receive from \$35 to \$55 a month throughout the year. The general wage paid for husking corn is from 4 to 6 cents a bushel. At this price the husker is supposed to place the corn in cribs.

Table 4 shows the population, number of farms, average size of farms, acreage of improved land in farms, and percentage of tenancy as reported by the census between 1880 and 1925, inclusive.

TABLE 4.—Farm areas and tenancy in stated years

Year	Total population	Total farms	Owner-operated farms	Tenant-operated farms	Total area in farms	Average size of farms	Improved land in farms	Improved land per farm
	<i>Number</i>	<i>Number</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Acres</i>	<i>Per cent</i>	<i>Acres</i>
1880.....	14,534	2,008	80.2	19.8	85.0	134.2	80.5	108.5
1890.....	15,019	1,961	79.2	20.7	88.5	143.6	85.3	122.6
1900.....	17,037	2,197	76.1	23.6	97.8	141.7	82.2	116.5
1910.....	15,375	2,012	70.2	29.4	96.6	152.8	84.3	128.8
1920.....	15,431	2,005	63.3	35.9	94.3	149.7	77.4	115.8
1925.....		2,050	57.7	41.6	95.2	147.6		

Tenancy in Chickasaw County is still on the increase, and during the first year of the survey (1926) it was reported that more than 57 per cent of the total acreage of the county was operated by tenant farmers. Cash rentals range from \$4 to \$14 an acre, depending on the location and the natural fertility of the farm. Most farms are rented on the share basis, each party furnishing half the livestock and sharing the profits equally. The landlord furnishes the land and the tenant the labor and machinery to successfully operate the farm. The grain-share system allows the landlord one-half of the corn and two-fifths of the small grain. The hay and pasture land is rented for cash, from \$2 to \$4 an acre being the usual amount paid.

Table 5 gives the value of land and farm property per farm for the period 1880-1925.

TABLE 5.—Value of land and farm property per farm, 1880-1925

Year	All prop- erty	Land	Build- ings	Land and buildings	Animals	Imple- ments	Land value per acre
	<i>Dollars</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Dollars</i>
1880.....	3,324			78.4	15.8	5.8	
1890.....	4,128			78.4	17.3	4.3	
1900.....	7,651	69.2	13.9	83.1	13.4	3.5	37.26
1910.....	13,198	68.8	15.8	84.6	12.3	3.1	59.46
1920.....	28,011	71.9	15.2	87.1	8.3	4.6	134.49
1925.....	19,824	62.3	23.5	85.8	9.1	5.1	83.35

The abnormal rise in the price of land in 1920 shown in Table 5 was due to the effects of the World War. Land values at this time became greatly distorted. During 1921 and 1922 the land slumped in value to below pre-war prices. With the reestablishment of credits and loans in recent years, the land is slowly increasing in value. In 1926 it ranged in value from \$50 an acre for the hilly and wet areas to \$275 an acre for good farm land well located and well improved.

SOILS

The soils of Chickasaw County have been differentiated in this report into a number of series and types on the basis of their physical and chemical characteristics, so far as these can be ascertained in the field. On the basis of their most striking and widely developed characteristics, the soils may be classed as dark colored and light colored. These two groups are nearly everywhere coextensive with two kinds of surface features and a corresponding natural vegetation.

The dark-colored soils have developed on the smooth, rolling prairies. This group also includes alluvial soils which owe their dark color to organic matter washed down from the uplands and redeposited by the streams. The dark-colored soils of the prairies owe their color largely to the influence of the grass vegetation. The color is imparted by finely divided organic matter derived from decaying grass roots and intimately combined with the mineral constituents of the soil. A number of factors on which there is yet no general agreement favor the growth of grasses, and provide conditions under which the organic matter supplied by the grass vegetation can be preserved in the upper part of the soil.

As the smooth surface of the original plain was attacked by erosion, better surface and subsoil drainage were established on the eroded areas, and conditions were made more favorable for tree growth. When the region was first settled by the white man, the forest, following the eroded areas, was fast encroaching on the prairies. Under this new growth, which excluded the direct sunlight, the prairie grasses failed to thrive. As the source of the soil organic matter failed, the soils gradually became lower in humus and the color became gray or light brown.

In both the light and dark colored soils, the agencies of weathering and soil formation have resulted in the concentration of clay in the subsoil and the removal of lime and other carbonates to a depth of several feet.

The dark-colored soils of the county may be subdivided into two groups whose differentiation is based on the effect of drainage conditions in the surface soil or subsoil or both during soil development. The soils of one of these groups, of which the Carrington soils are representative, were developed under conditions of good drainage. The surface layer has a dark-brown or dark reddish-brown color, friable consistence, and finely granular structure. It is underlain by a brown granular subsoil, slightly heavier than the surface layer. At a depth ranging from 18 to 24 inches this material is underlain by a yellowish-brown horizon, commonly heavier in texture than the upper layers. Below a depth of 30 or more inches the material is typically lighter in color and more friable than that immediately above it. This is the slightly weathered parent material from which the upper horizons have been developed by weathering. In addition to the Carrington soils, the Dickinson soils, which have sandy subsoils, the Dodgeville soils, developed from and underlain by limestone, and the O'Neill soils of the higher terraces also belong to this group. The O'Neill soils are similar in their two upper layers but are underlain, at a depth of about 20 inches, by sand and gravel.

The members of the other group of dark-colored soils were developed under conditions of restricted drainage. Their surface soils are very dark grayish brown or black, and the subsoils are gray or mottled gray, yellow, and brown and are somewhat heavier, as a rule, than the surface soils. The details of the profiles vary considerably, depending on the depth to which good drainage and oxidation have reached. In this group may be placed the Floyd and Clyde soils of the flat or depressed upland areas, the Bremer soils of the terraces, and the Cass and Wabash soils of the stream flood plains.

On the surface of the soils developed under a native vegetation of trees is a thin layer of leaf mold or dark-gray soil rich in organic matter. Below this, to a depth ranging from 5 to 12 inches, is gray, grayish-brown, or light-brown soil underlain by brown or yellowish-brown heavy material continuous to a depth of 2 or 3 feet. Below this is the lighter-textured and less compact yellowish-brown parent material. In this county the light-colored soils have developed over glacial drift and have been classed in the Lindley series.

The principal characteristics of the groups of soils described have been determined to a greater extent by the soil-forming processes,

such as the accumulation of organic matter and the weathering, leaching, and oxidation of the material near the surface, than by original differences in the parent material. In the differentiation of soils into series, however, account has been taken of the composition and source and process of accumulation of the material from which the soils have developed and which underlies the weathered layers.

The upland soils of Chickasaw County are derived almost entirely from the fine-grained rock débris transported by the glacial ice. The mantle of drift varies in thickness from a few feet to 135 feet, as is indicated by readings of well borings taken in several parts of the county. Erosion has not materially affected the thickness of the drift, except in those areas adjacent to the main streams of the county. Erosion has exposed small areas of Kansan till in Chickasaw and Bradford Townships, and limestone bedrock outcrops along Cedar and Little Cedar Rivers. However, even here there is evidence of glaciation, since boulders of various sizes are scattered over the surface the entire length of the slopes.

Nearly all the upland soils of the county were formed from the Iowan drift. The Iowan glaciation was one of the older ice invasions and the glacial drift left behind has weathered more and the soils are therefore much older than in some other parts of the State. Leaching has progressed to such an extent that lime carbonate has been removed to a depth of 3 or more feet. Calcareous material was found at a depth of 5 feet in the Floyd soils, and a slight effervescence with acid was observed in the Carrington soils in one place at a depth of 12 feet. This indicates that the parent material contained some lime at the time of deposition but that the weathering action has removed it to such a depth it is no longer available or useful to the growing plants.

The alluvial soils of the county were formed during and after the recession of the ice sheet which invaded the county. The parent material was reworked glacial débris.

The soils of Chickasaw County have been grouped into series on the basis of similarity in color, structure, and other characteristics of surface soils and subsoils. The series have been further subdivided into soil types, on the basis of the texture of the surface horizon. Eighteen soil types and two phases, representing ten soil series, have been mapped within the county. In addition, the miscellaneous classification, muck and peat, is mapped.

The Carrington series includes those soils having dark grayish-brown surface soils and brown or yellowish-brown subsoils. Carrington silt loam, Carrington loam, and Carrington fine sandy loam have been mapped in Chickasaw County.

The surface layers of the Floyd soils are very dark grayish brown or black, and the subsoils are gray, gradually becoming mottled with yellow and brown with depth. The gray layer beneath the surface soil is distinctly heavier in texture than either the surface or lower horizons. The yellow color increases in intensity with depth. Gravel is present in many places below a depth of 3 feet. Floyd silt loam has been mapped.

The Clyde series includes those soils having very dark grayish-brown or black surface layers underlain by gray clay loam subsoils mottled slightly with yellow. These soils differ from the Floyd in

that they occupy poorly drained areas and lack the yellow subsoils. Clyde silty clay loam, with a mucky phase, and Clyde silt loam have been mapped.

The surface layers of the Dickinson soils are dark grayish brown, and the subsoils are light brown or yellowish brown. The entire soil is sandy and porous and is inclined to be droughty in extremely dry seasons. Dickinson fine sandy loam was mapped.

The Lindley series includes the timbered or light-colored soils of the county. The surface soils are gray or grayish brown, and the subsoils are yellowish brown and are heavier than the surface soil. The parent glacial drift is yellow and brown and with increasing depth a faint gray color appears. The percentage of sand and fine gravel increases with depth, and it is not uncommon to find pockets of sand and gravel in the lower layers. Lindley silt loam, Lindley loam, and Lindley fine sandy loam have been mapped.

The residual soils of the county are included in the Dodgeville series. The surface layers are dark grayish brown or almost black and are underlain by yellowish-brown or reddish-brown, compact, waxy residual clay having a nut structure. This in turn rests on the limestone bedrock. The rock outcrops in many places at the base of the slopes where erosion has removed the thin glacial covering. Dodgeville silt loam has been mapped.

The O'Neill soils have dark grayish-brown mellow or loose surface horizons, underlain by slightly heavier clayey sand and gravel subsoils which in turn rest on yellowish-brown stratified sand and gravel. O'Neill silt loam, O'Neill loam, with a light-colored phase, and O'Neill sandy loam have been mapped in the county.

The Bremer soils have black, finely granular surface soils underlain by brown or dark-brown heavy silt loam or clay loam, heavier in texture but lighter in color than the surface soil. Small iron concretions and stains are noticeable. Beneath this horizon is gray, sticky, compact clay loam, slightly stained by iron. Bremer silt loam was mapped.

The surface layers of the Wabash soils are very dark grayish brown or black and rest on lighter-brown, sticky, heavy silty clay loam mottled with gray or rust brown. Below a depth ranging from 24 to 30 inches is gray sticky compact silty clay loam mottled yellow, brown, and rust brown. The ground water table usually stands below a depth of 30 inches. Wabash loam and Wabash silt loam have been mapped in Chickasaw County.

The Cass soils differ from the Wabash in having dark grayish-brown surface soils and light-brown loose sandy subsoils. Cass fine sandy loam has been mapped.

Several small areas of cumulose soils, muck and peat, have been mapped in the county. These areas occupy marshy ill-defined drainage courses of some of the minor streams within the uplands and are closely associated with the Clyde soils. The depth of the peaty or mucky areas averages 8 inches and in very few places exceeds 2 feet. Muck and peat has been formed by the accumulation of plant material in places where the wet condition excluded the air and inhibited the decay of the plants.

Detailed profile descriptions of the various soil types, together with discussions of methods of handling the soils, adaptation to crops,

agricultural value, and recommendations for improvement are contained in the following pages of this report. The distribution of the soils is shown on the accompanying soil map, and their acreage and proportionate extent are given in Table 6.

TABLE 6.—*Acreage and proportionate extent of soils mapped in Chickasaw County, Iowa*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Carrington silt loam.....	85,248	26.8	O'Neill loam.....	17,152	} 5.9
Carrington loam.....	53,760	16.9	Light-colored phase.....	1,600	
Carrington fine sandy loam.....	2,432	.8	O'Neill sandy loam.....	11,392	3.6
Dickinson fine sandy loam.....	16,448	5.2	O'Neill silt loam.....	4,352	1.4
Floyd silt loam.....	35,008	11.0	Bremer silt loam.....	4,864	1.5
Clyde silty clay loam.....	40,192	} 12.8	Wabash silt loam.....	7,232	2.3
Mucky phase.....	576		Wabash loam.....	16,832	5.3
Clyde silt loam.....	2,816	.9	Cass fine sandy loam.....	4,608	1.4
Lindley loam.....	8,256	2.6	Muck and peat.....	1,024	.3
Lindley fine sandy loam.....	640	.2			
Lindley silt loam.....	1,024	.3			
Dodgeville silt loam.....	2,624	.8	Total.....	318,080	

CARRINGTON SILT LOAM

Carrington silt loam, in its virgin condition, consists of a 1 or 2 inch layer of dark grayish-brown mellow loam filled with grass roots and partly decomposed plant remains. Beneath this and extending to a depth of 8 or 10 inches is very dark-brown, finely granular, friable silt loam. The friable consistence of the surface soil is owing to the presence of a comparatively large amount of very fine sand. When the soil is dry the fine granular structure gives the impression that the texture is sandy loam, but when the soil is rubbed between the fingers the aggregates break down and the silty texture is evident. Earthworms have worked in these two upper layers.

The third layer is granular light-brown or brown heavy silt loam or silty clay loam. The upper 2 or 3 inches of this stratum show the effects of infiltration of organic matter from the overlying horizons. Wormholes in the upper part of this gradation zone allow the organic material to reach the lower depths. At the base of this horizon at a depth of about 20 inches there is an accumulation of boulders ranging in size from one-half inch to 1 foot or more in diameter. This concentration or layer of boulders is decidedly noticeable at about the same depth in all parts of the county where this soil is found. This heavy layer extends to a depth of 40 inches and is yellowish-brown clay loam in which are faint gray streaks. When the soil aggregates are broken down or powdered the gray coloring disappears, and the material is yellow. Small granitic boulders are embedded in this horizon. Below this is the parent material, little changed by weathering. This consists of gray and yellow gritty clay loam containing coarse sand and small pebbles. The parent material differs from the overlying layer in being lighter in texture and predominantly gray in color. The colors are imparted to this material by rocks of the parent material and not by imperfect drainage. The gray and yellow colors are so mixed, however, that when the soil aggregates are mashed the soil has a pale-yellow

appearance although as a mass it is gray. The upper 2 or 3 inches of the parent material show slight discoloration by iron oxides. The entire soil to a depth of 8 feet is noncalcareous.

More than 95 per cent of the Carrington silt loam is under cultivation, and the virgin areas are mainly along fence rows and shelter belts near the farmsteads. The cultivated soil does not differ materially from the virgin except in the surface layers. By plowing and cultivation the thin layer of material rich in organic matter has been mixed with the silty material directly beneath, making the surface horizon dark grayish brown. The subsoil and parent material are identical, with the exception of the local variations found within all soils.

Carrington silt loam is uniform in color and texture, but there are a few variations in all parts of the county. The main variation from typical occurs in Utica and Jacksonville Townships, where the surface soil contains a slightly higher percentage of sand and fine sand, the dark surface material is less deep and lighter brown in color, and the subsoil is weathered to a greater depth. Areas of Carrington loam too small to separate with accuracy on the scale used are included in mapping. These loam areas occur within the silt loam areas as small hillocks, higher than the surrounding silt loam soils and less than 5 acres in extent. Since Carrington silt loam is closely associated with the Floyd and Clyde soils, there are areas of gradation from one to the other. The subsoil in such areas is less well drained than that of the typical Carrington soils but is better drained and less gray than that of the Floyd soils.

Carrington silt loam is the most important soil in Chickasaw County. It occurs on the level or undulating upland plains in all parts of the county. The areas range in size from a few acres, where mapped within areas of Carrington loam, to several square miles. The large areas are broken only by fingerlike areas of Floyd and Clyde soils which follow the poorly defined drainage channels in the undulating plains. The largest areas are mapped in the southeastern part of Fredericksburg Township and in the vicinity of New Hampton and Ionia. Other important areas are mapped on the broad ridges between all the main streams of the county.

Areas of Carrington silt loam vary from almost level to undulating. Drainage on the level areas is in many places inadequate, but in the undulating areas the natural drainage of both the surface soil and subsoil is good. The subsoil, although sufficiently heavy to be retentive of moisture, is open enough to allow the surplus moisture to permeate to lower levels.

This soil is regarded as the most valuable in the county for general farming. Practically all of it is utilized for the production of corn, small grains, and hay. Trees grow only along the fence rows and in shelter belts surrounding the farmsteads and in a few groves of willows, oaks, elms, and maples in areas adjoining wooded soils and used as pasture land.

Corn and oats are the most important grain crops grown on this soil. The acreage devoted to each crop varies annually, corn occupying the greater acreage one season and oats another season. During the season of 1926 unofficial reports from several sources indicated that the acreage of oats during the preceding three years had been

greater than that of corn on all the soils of the county but especially on Carrington silt loam. Of the minor crops, hay, consisting of a mixture of timothy and red clover, is the most important. Alfalfa and sweetclover are grown in an experimental way on small plots where the soil has been limed. Barley, buckwheat, flax, rye, and potatoes are grown as cash or catch crops.

Crop yields obtained on Carrington silt loam are as high as the general average for this part of Iowa. Corn yields from 30 to 45 bushels, oats from 25 to 50 bushels, and hay from 1 to 1½ tons to the acre. Higher yields are obtained on some farms where regular rotations are followed and the soil fertility is maintained.

Owing to the presence of very fine sand in the surface layer of Carrington silt loam, it is much more easily handled than the silt loam members of the Clyde and Floyd series. The soil is friable or mellow, works well under varying moisture conditions without puddling or clodding, and requires less draft in plowing and cultivating than the heavy soils.

This soil receives applications of manure at regular intervals, especially on the owner-operated farms. On tenant-operated farms many fields located some distance from the feed lots receive no treatment of any kind. The use of commercial fertilizers is limited. Applications of limestone are made on small acreages to aid in establishing stands of sweetclover or alfalfa, but phosphates are used by only a few of the more progressive farmers.

Land values of Carrington silt loam vary from \$100 to \$225 an acre, depending on the location, improvements, and the conditions of the farm as to fertility and weeds. The estimated average price for land of this kind is about \$135 an acre.

Carrington silt loam is potentially a fertile soil, but the intensive cropping systems practiced in the past and at the present on some of the farms tend to deplete the fertility of the soil very rapidly. This robbing of the soil may be corrected by the adoption of proper rotations and the use of fertilizers. Barnyard manure is valuable as a fertilizer and should be conserved carefully. Even when manure is used, it alone can not maintain the soil fertility, and in time some commercial fertilizer must be applied in order to increase the crop yields. Legumes, clovers, and alfalfa should be grown in every rotation. The practice of mixing the clover and timothy for hay should be discouraged. Timothy, which is hardy, is used to insure a stand of hay grasses in case the clover winterkills, but if the clover stand can be insured against loss in normal seasons by the application of limestone and phosphates it will be unnecessary to grow the timothy. Plowing under the legume crop increases the yields of the following corn and small-grain crop by adding nitrogen to the soil. Experiments with limestone, manure, and phosphates in other counties on Carrington silt loam have shown that these fertilizing materials can be used with profit on most farms and that the crop-producing power of the soil can not only be maintained but improved by systematically following the recommendations of the Iowa Agricultural Experiment Station.

Table 7 gives the results of mechanical analyses of samples of the surface soil, subsurface soil, and subsoil of Carrington silt loam.

TABLE 7.—*Mechanical analyses of Carrington silt loam*¹

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>						
337043	Surface soil, 0 to 8 inches.....	0.9	7.1	9.6	10.7	5.3	36.7	29.7
337044	Subsurface soil, 8 to 20 inches.....	1.2	6.8	9.1	11.5	5.7	35.6	30.0
337045	Subsoil, 20 to 30 inches.....	4.5	8.3	10.8	16.3	8.8	21.5	30.0
337046	Subsoil, 30 to 84 inches.....	3.3	8.0	10.6	16.5	9.8	17.5	34.3

¹ After treatment with hydrogen peroxide.

CARRINGTON LOAM

Carrington loam is similar to Carrington silt loam in the color, structure, and thickness of the different layers. It differs from that soil mainly in the texture of the surface soil, which contains a larger proportion of sand and comparatively less silt.

Carrington loam is uniform in texture and color within the larger areas, but where it joins soils of other series it grades into them. Where associated with Carrington silt loam, as most of it is, the lines separating the two soils are arbitrarily drawn. Carrington loam in most places occupies the higher elevations. Where this soil is associated with the sandy Dickinson soils, a narrow fringe of sandy surface material rests on the typical Carrington yellowish-brown gritty clay loam subsoil. Wherever this band is too narrow to separate it has been included with Carrington loam.

Carrington loam has been mapped in all parts of the county, but the most extensive development is in the northeastern part of Utica Township north of Little Turkey River. Areas also occupy some of the slopes along the main streams of the county and the high knolls or ridges within Carrington silt loam areas.

Areas of Carrington loam are undulating or rolling, and drainage is good but not excessive. The heavy subsoil is retentive of moisture and hinders leaching but allows the surplus water to pass through.

Although Carrington loam is not so extensive as Carrington silt loam, it is an important soil in the county. Practically all of it is under cultivation to corn, small grains, and hay, which rank in acreage in the order named. Crop yields, although slightly less than on Carrington silt loam, average higher than on the other soils of the county. Corn yields from 30 to 45 bushels to the acre, oats from 25 to 40 bushels, and hay from 1 to 2 tons.

The presence of sand and fine sand in the surface layer of this soil promotes ease in handling. The soil warms up early in the spring, dries out soon after rains, and does not bake or clod when worked under adverse moisture conditions. The crops are handled in much the same manner as on Carrington silt loam, and the methods of farming are also similar on the two soils.

Carrington loam commands between \$100 and \$175 an acre, depending on the location and improvements.

The recommendations for conserving the fertility and supplying organic matter to Carrington silt loam apply with equal force to Carrington loam.

Table 8 shows the results of mechanical analyses of samples of the surface soil, subsurface soil, and subsoil of Carrington loam.

TABLE 8.—*Mechanical analyses of Carrington loam*¹

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>						
337037	Surface soil, 0 to 8 inches.....	2.5	12.3	16.3	16.6	5.4	25.8	21.1
337038	Subsurface soil, 8 to 18 inches .	1.8	10.5	15.8	16.0	5.6	20.4	29.9
337039	Subsoil, 18 inches to 7 feet.....	3.5	10.5	13.9	18.5	9.8	19.0	24.7

¹ After treatment with hydrogen peroxide.

CARRINGTON FINE SANDY LOAM

Carrington fine sandy loam, to a depth ranging from 6 to 10 inches, is dark grayish-brown loose or porous fine sandy loam. This rests on yellowish-brown heavy silt loam or silty clay loam which extends to a depth ranging from 16 to 20 inches and is underlain by yellowish-brown gritty clay loam, faintly mottled with gray and rust brown. Below a depth ranging from 40 to 55 inches, the material is variable, but it commonly consists of brown gritty clay loam containing small boulders, sand, and fine gravel. The entire soil is noncalcareous. Pockets of pure sand and gravel are present in many places below a depth of 3 feet.

This soil is closely associated with Dickinson fine sandy loam and Carrington loam, generally occupying a position between these two soils. The areas are small, few exceeding 500 acres in extent, and are scattered without uniformity over the county wherever the Dickinson soils are mapped. Many areas occur on the high hills within the Carrington loam areas. The greatest number of areas are shown in Utica, Stapleton, and Bradford Townships. Areas are rolling or hummocky, and drainage is good or excessive. Owing to the sandy texture of the surface soil, crops often suffer from lack of moisture during long droughts.

Practically all this soil is under cultivation to corn, small grain, and hay. These sandy areas are farmed in conjunction with the adjoining soils and are handled in the same manner. The sandy texture allows for earlier working in the spring, and therefore these fields are seeded first. Ease of cultivation allows easy control of weeds.

Owing to the sandy texture, crop yields are low except in seasons of abundant rainfall. Corn yields between 25 and 35 bushels, oats between 25 and 40 bushels, and hay between three-fourths and 1½ tons to the acre. Seasonal conditions determine the yields of the crops, and under good management and normal climatic conditions the soil has given double the yields quoted.

Carrington fine sandy loam requires care in handling. Sandy soils need organic matter to aid in reserving the moisture supply for the dry seasons. Crop rotations and fertilizer practices recommended for the other Carrington soils are applicable also to this soil. Special emphasis is laid on the addition of organic matter to these sandy soils.

Table 9 shows the results of mechanical analyses of samples of the surface soil, subsurface soil, and two layers of the subsoil of Carrington fine sandy loam.

TABLE 9.—*Mechanical analyses of Carrington fine sandy loam*¹

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>						
337057	Surface soil, 0 to 6 inches.....	2.0	15.3	20.2	15.0	3.9	27.6	15.9
337058	Subsurface soil, 6 to 26 inches..	3.4	9.0	11.1	14.3	7.8	27.1	27.2
337059	Subsoil, 26 to 44 inches.....	3.9	8.9	11.5	14.8	9.3	21.0	30.6
337060	Subsoil, 44 to 60 inches.....	3.0	8.9	12.8	18.6	9.5	19.4	27.8

¹ After treatment with hydrogen peroxide.

DICKINSON FINE SANDY LOAM

The surface soil of Dickinson fine sandy loam, to a depth of 2 or 3 inches, is dark grayish-brown fine sandy loam containing a high percentage of organic matter, some of which is in the form of grass roots and plants. The sand particles may be cemented together to give a fine granular structure. Between depths of about 3 and 12 or 14 inches is brown porous fine sandy loam, more compact than the surface soil and lighter in color. The dark surface material has filled the wormholes and gopher burrows, giving a streaked effect to the soil wherever these animals have worked. With increasing depth, the soil becomes lighter in color and loamy fine sand in texture. The light-brown or yellowish-brown sand occurs at a depth ranging from 24 to 28 inches and extends to a depth between 56 and 60 inches, where it grades into the yellow, gray, and brown unweathered sand. There is but little change in the soil from the surface to the unweathered material other than the variation in color.

The cultivated soil differs from the virgin soil described only in the surface layers. The shallow humus layer is absent in the cultivated soil, and the surface soil has a uniform dark grayish-brown or very dark grayish-brown color to a depth of 12 or 15 inches.

Dickinson fine sandy loam, as mapped in Chickasaw County, may vary in the lower subsoil layers from fine sand to gravel. The areas having gravelly subsoils are small but are common over the county and are included with this soil because of their similarity in position and their agricultural value. In the gravelly areas an 8 or 10 inch layer of porous brown fine sandy loam rests on lighter-brown more compact sand which in turn grades into the gravel and sand stratum at a depth ranging from 30 to 36 inches. These gravelly variations occur as small knolls or kame formations within Carrington loam and Carrington silt loam in the more rolling areas adjacent to the streams. The surface soil of Dickinson fine sandy loam may vary from fine sandy loam to loamy sand, and the thickness of the dark-colored surface soil varies with the relief. On the ridge tops where erosion and leaching have been active, the dark color rarely extends below a depth of 6 inches, but in many places on the slopes it reaches a depth of 12 or 15 inches.

The largest continuous areas of Dickinson fine sandy loam are shown in the northeastern part of Utica Township in sections 24 and 25; in Stapleton Township in sections 12, 13, and 24; and in Bradford Township in sections 28, 29, and 32. The areas range in size from

a few acres to 1 square mile. Within Carrington silt loam, the areas may occur on knolls which are several feet higher than the surrounding plain or may occur on the slope adjacent to some minor stream or drainage channel. Within areas of Carrington loam and Carrington fine sandy loam, they generally occupy the highest point on the ridges.

The areas are hummocky or strongly rolling, and drainage is excessive in most places, owing to the porosity of the soil. Moisture readily percolates through the soil, and in dry seasons the supply is often insufficient for successful plant growth.

Although its total acreage is rather large, this is not an important soil agriculturally. The areas are small and only a few farms consist entirely of land of this type. The soil requires special care to keep it productive, but since the areas are small little extra labor is required. Practically all the Dickinson fine sandy loam is cultivated or used as hay land. Where it is underlain by gravel, pits are often opened in the fields close to roads and the material is hauled and spread on the roads or driveways to the farmsteads. The State highway commission has opened gravel pits west of Nashua and south of New Hampton for obtaining material to surface the primary roads of the county.

Corn, oats, wheat, and hay are the principal crops grown, and potatoes, melons, and cucumbers furnish an income as special crops on farms near the larger towns. Dairying, in conjunction with hog raising, is the chief livestock industry.

Owing to the sandiness of this soil, crop yields are not high. Corn yields between 20 and 35 bushels, oats between 25 and 40 bushels, and hay between 1 and 2 tons to the acre, depending on the seasonal conditions. On dairy farms where the supply of manure is abundant and special attention is given this soil, it is often made to produce as well as the heavier soils of the county.

Moisture conservation on Dickinson fine sandy loam is of great importance, and the fields are cultivated often to prevent excessive evaporation of soil moisture. The soil warms up early in the spring and can be worked under any moisture condition without harmful physical effect. Applications of manure are made regularly, but the use of commercial fertilizers has not become common. Dickinson fine sandy loam is more porous and leachy than Carrington fine sandy loam, and even greater care is required to maintain its fertility. The methods of supplying organic matter and the fertilizer treatment recommended for the Carrington soils apply also to Dickinson fine sandy loam.

FLOYD SILT LOAM

The surface soil of Floyd silt loam is very dark grayish-brown or almost black friable silt loam to a depth ranging from 10 to 14 inches. The structure is finely granular, and when the soil is dry the particles are hard and difficult to break down. Beneath this and extending to a depth of 26 inches is pale yellowish-gray or drab, sticky, compact, heavy clay loam, the upper part of which, although of the same texture, shows a discoloration caused by organic matter. The third layer from the surface downward consists of yellow and gray gritty clay loam stained with brown and rust brown. Iron concretions are

abundant. The soil breaks up into clods with no definite shape. Gravel ranging from fine gravel to 1 inch or more in diameter is abundant throughout this material. The soil to a depth of 48 inches has been leached of its carbonates to such an extent that no effervescence is obtained with acid. Below a depth of 48 or 50 inches is the unweathered parent material consisting of gray and yellow gritty clay loam. The gray color is in all places predominant. This layer is very calcareous, and small particles of limerock in the process of decay are present. The gray part of the soil is more calcareous than the yellow. Small boulders are present, and an occasional large boulder or niggerhead was noticed. The water table level is below a depth of 5 feet in most sections of the county.

The thickness, color, and texture of the surface soil of Floyd silt loam are uniform, but the lower layers may vary in color and texture within short distances. Where Floyd silt loam joins Clyde silty clay loam there is a transition zone where the soil is not typical of either soil and the line separating the two soils is necessarily arbitrarily drawn. In such places the subsoil of Floyd silt loam may be more gray and thicker than typical. The percentage of sand and gravel in the subsoil may vary to a marked degree, and it is not uncommon to find pockets of sand and gravel in the lower layers. Areas of Clyde silt loam too small to indicate on the map are included with this soil. These small areas are less well drained than the Floyd soils, and the subsoils are gray.

Niggerheads varying in size from small stones to boulders several feet in diameter are scattered over the surface in many areas. Most of the smaller boulders are removed, but the larger ones remain as obstacles in the field.

Floyd silt loam occupies the flat table-land within the level or undulating Carrington silt loam areas and the gentle slopes between Clyde silty clay loam along the streams and the better-drained upland soils of the Carrington, Dickinson, and Lindley series on the ridges. It is found in all parts of the county on the uplands, and the various areas taken collectively make up a large acreage. The largest single areas mapped are in Deerfield Township 3 miles west of the village of Deerfield, in Washington Township in sections 28, 33, and 34, and on the broad plain between New Hampton and Ionia. These areas represent the soil as it occurs on the table-land of the prairie. They are level or slightly sloping, and drainage is poorly established. Most of the soil, however, occurs along the broad swales or at the head of these poorly drained areas.

Floyd silt loam is an important soil in Chickasaw County. It is naturally fertile, producing high yields when it is properly drained. Most of the areas under cultivation have been recently reclaimed through drainage by tile and ditches and therefore withstand heavy, continuous cropping with no apparent damage better than the well-drained soils which have been farmed for several decades. In its natural state, Floyd silt loam was covered by a heavy growth of prairie grasses. A large acreage of the undrained soil is still utilized as wild hay and pasture land. The timber growth consists of a few willows and elms found along the fence rows or in isolated sections of the fields.

Corn, oats, wheat, and hay are grown successfully on the artificially drained fields. Corn, the principal crop, occupies the land for longer

periods than the small grains. Oats and wheat were formerly grown on a small acreage, but with the introduction of stiff-strawed varieties adapted to rich, cold soils the small-grain acreage has increased materially. Of the minor crops, flax and buckwheat are the most important. Flax is seeded on newly drained land for one or two years. Buckwheat serves as a catch crop when the season is backward and corn can not be planted early enough to mature. On farms where there is sufficient well-drained upland soil to supply the required amount of grain for the farm, Floyd silt loam is left undrained and is fenced and used as pasture and wild hay land.

Floyd silt loam is usually farmed in conjunction with some other soil. It is handled in much the same manner as the Carrington and Dickinson soils.

Crop yields on Floyd silt loam in average seasons compare favorably with those obtained on the other soils of the county on the upland plains. Cold and wet weather hinders the maturing of the crops, especially corn, and there is danger of damage by the early fall frosts in these low areas. Estimates of corn yields give a range from 30 to 45 bushels to the acre, of oats from 20 to 60 bushels, and of hay from 1 to 2½ tons. Seasonal conditions and the thoroughness of the drainage determine largely the quantity as well as the quality of the crops.

Floyd silt loam, owing to its high natural fertility and the fact that it has not been cropped so long as the better-drained soils, is given little attention as to fertilization. The only source of organic matter is the crop residue. Limestone is used on small plots by a few farmers in order to obtain stands of sweetclover and alfalfa.

This soil is valued at between \$100 and \$200 an acre, depending on the location of the farm, the extent to which the soil is developed, drainage conditions, and the general farm improvements.

Floyd silt loam, when properly drained, is a fertile soil. Tiling is of primary importance, if the soil is to be successfully cropped. The soil is well adapted to corn, which can be grown profitably when early-maturing varieties are selected. Since this soil occurs on lower situations than the adjoining upland soils, there is more danger of injury from the early fall frosts than on higher ground.

Applications of limestone are recommended, not only for correcting the acidity but for improving the physical condition of the soil, thereby enabling the farmer to work the soil under slightly adverse moisture conditions without fear of it clodding or puddling. Ground limestone is applied to plowed fields and is disked or dragged into the upper 2 or 3 inches of soil. Liming also aids in obtaining stands of red clover, sweetclover, and alfalfa.

CLYDE SILTY CLAY LOAM

The surface 1 or 2 inch layer of Clyde silty clay loam consists of mucky material composed mainly of partly decomposed plant remains. Beneath this and extending to a depth of 12 or 14 inches is black, plastic or sticky, heavy silty clay loam. The content of organic matter is exceptionally high, as is indicated by the color. Below a depth ranging from 16 to 24 inches is dark-brown compact plastic clay loam or clay, heavier in texture than the overlying material but having a high content of organic matter. This passes

rather abruptly into gray, compact, rather impervious silty clay or clay mottled faintly with brown and yellow, which is sticky when wet and hard when dry. The soil mass breaks down into sub-angular particles giving a large nut structure. At a depth of 40 or 50 inches, the yellow mottling becomes more distinct and the percentage of sand higher. Small bowlders are embedded throughout the lower part of this layer. The entire soil, to a depth of 56 inches, showed no carbonates by the acid test. In most places the water table lies within 4 feet of the surface. A characteristic of Clyde silty clay loam is the presence of small bowlders lying on or near the surface. In the area mapped in the southeast quarter of section 17 of Chickasaw Township there is an unusual number of these bowlders on the surface.

Variations from typical are common wherever Clyde silty clay loam is mapped. The principal variations, however, are the presence of peat or muck on the surface or sand or gravel in the subsoil. Where the dark surface material is covered by less than a 3-inch mantle of partly decomposed organic matter resembling peat or muck, the soil has been included with Clyde silty clay loam in mapping, but where the areas are extensive and the mucky layer is more than 3 inches thick, the areas were separated as a phase or mapped as muck and peat. The gravelly strata in the subsoil occur more often in the form of pockets in the lower layers than as continuous developments. The texture of the surface soil varies, according to the associated soil. In areas joining Floyd silt loam and Carrington silt loam, the texture is more silty, and in those occurring within the sandy members of the Carrington and Dickinson series the surface soil contains more sand and is therefore more friable. The surface soil of the large areas, however, is comparatively uniform silty clay loam.

Clyde silty clay loam is found in all parts of the county along the poorly established stream courses or in the depressions within the uplands where drainage is poor. The areas range in width from a few rods to approximately one-half mile, but most of them are about 600 feet wide and are parallel to the stream, penetrating the uplands in fingerlike projections. The surface is slightly sloping or depressed. Drainage is poor, and the water table lies close to the surface. The more marshy areas where grass roots tend to bunch, forming small hillocks ranging in diameter from a few inches to a foot, have a hummocky surface.

This soil is extensive in Chickasaw County and is found in practically every part. However, it is not important agriculturally. Only a small percentage of the soil has been reclaimed by drainage, and the remainder is used for pasture and wild hay land. Wild hay grasses grow luxuriantly throughout the entire season and furnish abundant pasture. On some of the fields the livestock are kept off until one crop of hay is cut and are then allowed to graze on the fields well into the fall. A few willow and cottonwood trees are found along the fence rows and in isolated parts of the fields.

When this soil is artificially drained by tiling or open ditches, corn occupies the land continuously. The small grains grow rankly, producing heavy stem growth, and lodge easily. Flax and buckwheat are seeded on newly broken fields for one or two years before

corn is planted. Ninety per cent of the land is fenced and used as pasture. No improvements are made on the marshy areas other than straightening and deepening the channels of the streams.

When the fields are drained properly corn yields from 30 to 60 bushels to the acre. The yield of wild hay varies from 1 to 2 tons to the acre. Small grains lodge badly and are rarely grown.

Clyde silty clay loam is always sold in conjunction with some other soil, and its value depends on that of the soil with which it is associated. Unless it is drained, it can not be used for any purpose other than for hay or pasture land.

The first prerequisite in making Clyde silty clay loam tillable is good drainage. The tiles and open ditches have proved satisfactory in most places in normal seasons, but when there is an excess of rainfall the surplus water is slow in running off and the crops are often drowned out. After drainage so-called "alkali spots" sometimes appear in the field. Most of these are small, but their effect on the crops is very noticeable during the growing season. Good drainage and heavy applications of manure on these spots will reduce the injury to the crops. It is advisable to allow this soil to remain in pasture if there is sufficient land available on which to raise the required amount of corn and small grains for livestock kept on the farms.

Clyde silty clay loam, mucky phase.—Clyde silty clay loam, mucky phase, has a surface layer of muck, from 3 to 6 inches thick, consisting of partly decomposed vegetable matter resting on dark-brown or almost black, heavy, sticky silty clay loam. At a depth ranging from 18 to 24 inches, this grades into gray and drab, heavy, sticky, rather impervious silty clay or clay. Below this the material becomes lighter in texture, due to the presence of sand and fine gravel. Iron stains and small iron concretions are abundant in the lower layers.

This soil differs from typical Clyde silty clay loam only in having a surface covering of mucky and peaty material. It is not extensive in the county. It occupies the broad marshy areas within Clyde silty clay loam. Water stands on the fields almost constantly throughout the year, retarding decomposition of the large supply of vegetable matter accumulated from the water-loving plants which produce a rank growth each season. The largest areas are mapped in sections 21 and 22 of Deerfield Township. A few areas are shown on the slopes adjacent to streams, where seepage spots occur, and the other minor areas occur within areas of Clyde silty clay loam.

This soil is of low agricultural value. It is wet and marshy and supports a growth of wild grasses. Many of the areas are boggy, and it is necessary to fence off these sections to prevent the livestock from grazing on them during the wet season.

CLYDE SILT LOAM

Clyde silt loam differs from Clyde silty clay loam only in the texture of the surface soil, which is silt loam instead of silty clay loam. The relief, drainage conditions, vegetation, and farming practices on the two soils are almost identical. Several small areas of Clyde silt loam have been included with Clyde silty clay loam in the southern part of the county, but in the northern part the two soils were separated where the areas were of sufficient size.

This soil is of little agricultural importance and is utilized mainly as hay and pasture land. Where thoroughly drained by tiling or ditches, the land is cropped continuously to corn. High yields are obtained in favorable seasons. Small grains are not grown to any great extent, since they tend to produce rank stem growth and lodge badly.

Recommendations and methods of handling this soil are the same as those given in the preceding pages for Clyde silty clay loam.

LINDLEY LOAM

The surface soil of Lindley loam in virgin or wooded areas consists of a 1 or 2 inch layer of dark-brown leaf mold. This passes rather abruptly into grayish-brown or gray friable loam continuous to a depth of about 7 inches. When moist the soil has a dark-gray color. The structure is finely granular, the soil aggregates being smaller than fine bird shot. The material between depths of 7 and 20 inches is yellow gritty clay loam mottled with brown or stained with rust brown. Small pebbles are embedded throughout this layer and below a depth of 12 inches larger bowlders, from 1 to 12 inches in diameter, are found. The soil mass breaks down into subangular particles when gently shaken, and the aggregates range from one-sixteenth to one-eighth inch in diameter. Below a depth of 20 inches and extending to a depth ranging from 36 to 40 inches is gray and yellow, stained brown and rust brown, waxy, heavy, compact clay having a nut structure. This variegated appearance is due to the different kinds of rock in the parent drift. Below a depth of 40 inches, the gray color increases, and at a depth of 4 feet the mass is predominantly gray mottled slightly with yellow, brown, and rust brown. A few iron concretions are present in this layer. Neither the surface soil nor the lower layers effervesce when treated with dilute hydrochloric acid.

The cultivated areas differ from the virgin soil in having a uniformly grayish-brown or dark-gray surface layer about 7 inches thick. The dark-brown humus layer has been mixed with the lower soil through the process of plowing and cultivation.

A few minor variations occur within areas of Lindley loam. In the area mapped 2 miles west of Chickasaw, small patches of silt loam and fine sandy loam have been included. These areas are only a few acres in extent and could not be indicated on the soil map with the scale used. The fine sandy loam variations occur generally on the hilltops and the silt loam where the surface is less rolling or on the slopes below the typical loam areas. Where Lindley loam is associated with Lindley silt loam the surface soil contains more silt than where the soil is associated with more sandy soils of other series.

Lindley loam is most extensive along Little Cedar River in Chickasaw Township. The areas in this section are comparatively large and occupy the rolling land near the streams. Smaller areas are shown along Wapsipinicon, Little Wapsipinicon, and East Fork Wapsipinicon Rivers, Crane Creek, and Little Turkey River.

Lindley loam occupies areas adjacent to streams, where the rolling surface is conducive to good drainage. Approximately 70 per cent of this formerly timbered soil has been cleared and is now under

cultivation to the staple farm crops. The remainder of the soil is covered by a growth of timber consisting of hickory, white oak, bur oak, red oak, elm, and poplar trees and underbrush. These wooded areas serve as pasture land during the grazing season.

When Lindley loam is cultivated, corn, oats, and hay are grown to the best advantage. This soil is usually farmed in conjunction with some other soil. Crop yields do not come up to the standards of the dark, well-drained prairie soils of the county when the soil is not given careful attention to maintain the fertility. Corn yields from 25 to 40 bushels to the acre, oats from 30 to 50 bushels, and hay 1 or 2 tons. White varieties of corn, the Iowar and Albion (Iowa 103) oats, and a hay mixture consisting of timothy and clover are preferred for these soils.

Manure is the only fertilizer used on most farms. Profitable crop increases are realized from its use, and the fields on the well-managed farms are treated regularly to insure good crops at all times.

The value of Lindley loam depends on to what extent it is developed, the kind of soil adjoining it, the location, and the improvements on the farm. Values placed on this soil during the season of 1926 range from \$75 to \$150 an acre.

The light color of the surface soil of Lindley loam indicates that it is deficient in organic matter. Where the supply of barnyard manure is inadequate for the whole farm, green manures, preferably legumes, can be used to good advantage. Applications of ground limestone before the clover crop is seeded will aid in securing a heavy stand which is less likely to winterkill. Plowing under the entire clover crop will add organic matter and nitrogen to the soil for the use of the crops grown after the clover. The steep slopes should be seeded down to pasture where there is danger of serious damage through erosion. Bluegrass thrives on Lindley loam and furnishes excellent pasture through the summer.

LINDLEY FINE SANDY LOAM

Lindley fine sandy loam is similar to Lindley silt loam in the color, structure, and thickness of the soil layers. It differs from Lindley silt loam mainly in the texture of the surface soil which contains a larger proportion of fine sand and relatively less silt. The average texture is fine sandy loam.

Lindley fine sandy loam has been mapped almost exclusively on the west side of Little Cedar River in Chickasaw Township. It is closely associated with Lindley loam and Dickinson fine sandy loam, occurring adjacent to or as small areas within these soils. Small areas have been shown along Wapsipinicon and East Fork Wapsipinicon Rivers in the southern part of the county.

This soil occupies the rolling timberland near the large streams, where drainage is good. The total acreage is not large. Approximately 60 per cent of the soil is under cultivation. The remainder is used as pasture land and is allowed to remain in timber to supply fence posts and fuel for the household. No farm consists entirely of Lindley fine sandy loam, which is farmed with other soils. The slopes subject to erosion are kept in meadow as long as possible between cultivated crops. Manures and crop residues constitute the only fertilizing materials used on this soil.

Owing to greater openness of Lindley fine sandy loam, its value is less than that of the loam and silt loam members of the series. It commands between \$60 and \$100 an acre, depending on the location and improvements on the farm.

Recommendations given for the improvement of Lindley loam are applicable to Lindley fine sandy loam.

LINDLEY SILT LOAM

The surface soil of Lindley silt loam is dark grayish-brown friable, silty material to a depth of 2 or 2½ inches. The organic-matter content is high. Immediately beneath this layer is dark-gray, friable silt loam continuous to a depth of 8 inches. The presence of small amounts of very fine sand increases the friability of this soil. The layers which underlie the surface layers are similar to the corresponding layers of Lindley loam. The parent material is glacial drift similar to that which underlies the other Lindley soils.

Lindley silt loam has been mapped in a few small areas in this county. One of these is along East Fork Wapsipinicon River 1½ miles northwest of Fredericksburg, and other small areas are shown along the Floyd County line in Deerfield and Chickasaw Townships. The areas occupy the rolling or steeply rolling land along the main streams of the county, where drainage conditions have been favorable to timber growth. These areas were formerly covered by a growth of hickory, oak, elm, and ash trees, and an undergrowth of hazel brush. Most of the soil has been improved and is now used for the production of corn, oats, and hay. These fields are usually farmed in conjunction with other soils and are cropped in the same manner. The areas of the soil remaining in timber are used as pasture land.

Lindley silt loam is poor in organic matter, as is indicated by the light color of the surface soil. This deficiency may be corrected by growing and turning under some green-manure crop and by applying stable manure regularly. Liming will aid in securing satisfactory stands of the clovers which will furnish more organic matter to be plowed under. It is necessary to lime the soil for sweetclover or alfalfa.

DODGEVILLE SILT LOAM

The surface soil of Dodgeville silt loam is very dark grayish-brown mellow silt loam about 8 inches thick. This passes rather gradually through a lighter-brown transition zone into yellowish-brown or reddish-brown, compact, waxy, rather impervious residual clay. Small limestone and cherty fragments are embedded in the lower part of this layer. The residual clay has a distinct nut structure. Neither the surface soil nor the upper part of the residual clay shows effervescence when treated with acid. Below a depth of about 22 inches is a layer of pale-yellow, partly decomposed rock or rock flour which is underlain by the bedrock.

In the southwestern part of the county along Cedar River south of Nashua there is little or no development of the reddish-brown clay loam layer, and the silty material of the surface rests on the bedrock. In the areas mapped north of Deerfield in Deerfield Township, local variations of loamy material are included. These small

loam areas are numerous wherever Dodgeville silt loam has been mapped, but the extent to which they are developed did not warrant their separation. In section 25 of Utica Township, along Little Turkey River, a small development of Dodgeville silt loam was noted, but the band along the stream was so narrow that it was impossible to indicate it other than by means of rock-outcrop symbols.

Dodgeville silt loam is most extensive along Wapsipinicon and Cedar Rivers. The largest continuous areas occur near Deerfield and Chickasaw and south of Nashua. The surface varies from rolling to steeply sloping in areas adjacent to the streams. Erosion causes some damage on the slopes by removing the dark surface material and exposing the reddish-brown clay loam or the underlying bedrock.

Most of this soil is under cultivation, wherever the relief allows. The more rolling areas are used as pasture and hay land and many of them are covered by timber growth consisting of oak, hickory, ash, elm, and poplar trees, and hazel brush.

Corn, oats, and hay are the principal crops grown. Crop yields compare favorably with these obtained on the other soils of the county. Corn yields from 30 to 50 bushels to the acre, oats from 35 to 60 bushels, and hay 1½ or 2 tons. Most of the products raised are consumed on the farms where they are grown. The large tracts suitable only for pasture favor dairy farming. Bluegrass grows luxuriantly, furnishing succulent feed throughout the grazing season. The heavy timber growth hinders the growth of grasses, and it is advisable to thin out the timbered areas if good pasture is desired.

The tillable areas of Dodgeville silt loam may be improved by the application of manure and the growing of legumes in the rotation. The areas subject to erosion should remain in bluegrass pasture.

O'NEILL LOAM

The surface soil of O'Neill loam is a very dark grayish-brown friable loam to a depth of 8 or 10 inches. This passes rather gradually into lighter-brown loam containing a higher percentage of silt than the surface soil. This is a gradation horizon between the dark surface soil and the zone of clay concentration which is found between depths of 12 and 24 inches. This heavy layer consists of light-brown or yellowish-brown gritty clay loam. The soil mass in a few places has a coarse granular structure and in other places where the percentage of sand is higher there is no definite structure. Worms have worked throughout this clay layer and the dark humus material from the surface has filtered down the holes to a depth of 20 inches. Below a depth of 24 inches is the yellowish-brown stratified sand and gravel.

O'Neill loam is rather variable. The dark surface soil may vary from 6 to 14 inches in thickness and from dark-brown to almost black in color within short distances. In Utica and Jacksonville Townships along Little Turkey River and Crane Creek small areas of gray or light-gray soil resting on the stratified sand and gravel have been included with O'Neill loam. Such of these variations as were of sufficient size to warrant separation were mapped as a separate soil. Other included small patches are more sandy in texture

than typical. These occur mainly as hummocks at higher elevation than the surrounding loam, and few of them exceed 3 acres in extent. In sections 13 and 24 of Stapleton Township along Crane Creek there is a typical example of one variation commonly observed within O'Neill loam. It consists of an 8 to 12 inch layer of dark-brown loamy material resting on the yellowish-brown gritty clay loam which extends to a depth of 30 or 34 inches. Underlying this in turn is the yellowish-brown stratified sand and gravel. The main difference between this variation and the typical soil is in the depth of the gritty clay loam layer. These variations occur mainly within the loam areas in that part of the field where the relief is lower than that of the surrounding country. They are less droughty than the typical soil and are regarded as more fertile.

O'Neill loam occurs on terraces along all the main streams of the county and lies from 10 to 30 feet above the present flood plain of the rivers. The areas vary from almost level to slightly sloping toward the stream. A few of the fields have a hummocky appearance. Drainage is good or excessive, owing to the porosity of the subsoil.

The largest areas of O'Neill loam in the county are shown along the largest streams. Important areas are along Little Turkey River near Little Turkey, along Crane Creek near Lawler, along East Fork Wapsipinicon River east of Boyd, along Little Wapsipinicon River north of North Washington, and along the entire course of Little Cedar River through Chickasaw and Bradford Townships.

O'Neill loam is an important soil agriculturally. Practically all of it is under cultivation to general farm crops. Timber grows only along fence rows and in windbreaks or wood lots surrounding the farmsteads. Oak, elm, ash, maple, hickory, walnut, and cottonwood trees are planted in the wood lots for fuel and posts.

Corn, oats, wheat, and hay are the principal crops. The land is used for corn for longer periods and more often than for the small-grain crops and hay. Oats are preferred to wheat in most sections of the county, and the hay consists of a mixture of timothy and clover. Crop yields vary with the seasonal conditions. The soil is inclined to be droughty in some localities, and in seasons of low rainfall and when the hot waves are of extended duration the yields are low. In normal years, however, when the moisture is abundant, the yields obtained are as high as those obtained on the heavier upland soils of the county. Corn yields from 20 to 45 bushels to the acre, oats from 25 to 50 bushels, and hay from 1 to 2 tons. Average yields of corn are about 30 bushels, of oats 35 bushels, and of hay 1 ton to the acre.

O'Neill loam is generally farmed in conjunction with one or more of the upland soils and is treated in the same manner as these soils as to cropping and fertilization. It responds well to manure treatments, and the fields are given this treatment regularly in the rotation. Commercial fertilizers are not used on extensive acreages, but limestone and phosphates have been used on small plots to determine their value.

This soil is valued at between \$90 and \$150 an acre, depending on the location, improvements, and kind of soils with which it is associated.

O'Neill loam requires large quantities of organic matter to make it highly productive. Barnyard and green manures turned under at regular intervals aid in maintaining the soil fertility and in increasing crop yields. The droughtiness of the subsoil indicates that moisture must be conserved so that during the dry periods of the summer the crops will have an ample supply. Organic matter increases the moisture-holding capacity of the soil, and some means should be adopted to supply sufficient amounts to insure good moisture conditions for the plants in all seasons. Liming will aid in establishing good stands of the clovers and of alfalfa. In other counties of the State where this soil occurs, phosphatic fertilizers have proved profitable, and it is recommended that test plots be conducted on each farm to determine their value.

O'Neill loam, light-colored phase.—O'Neill loam, light-colored phase, has a gray or grayish-brown friable loam surface soil from 6 to 8 inches thick. This passes rather abruptly into a lighter-gray 1 or 2 inch layer, composed mainly of silt and having a fine granular structure. This thin gray layer, however, is not everywhere developed so distinctly, but it is present in practically all fields where this soil is mapped. Between depths of 10 and 24 inches is yellowish-brown heavy loam or silt loam having a granular structure. Beneath this is yellowish-brown stratified sand and gravel. The entire soil has been leached of its lime carbonates.

Some small areas of fine sandy loam were included with this soil in mapping. These occupy less than 1 square mile on the terraces along Little Cedar River west of Bassett and along East Fork Wapsipinicon River south of Fredericksburg. The surface soil is brown, loose fine sandy loam 10 inches thick. It is underlain by lighter-colored loose sandy loam and this in turn, below a depth of 34 inches, is underlain by light-brown sand. The crop yields on this soil are low except in seasons of unusually heavy rainfall.

The most important areas of this soil mapped in Chickasaw County occur in section 19 of Utica Township and sections 20 and 29 of Deerfield Township. Minor areas are shown in various parts of the county in association with O'Neill loam and O'Neill sandy loam. This phase of soil occupies a terrace position well above overflow. The surface is sloping or undulating, and drainage is good or excessive, owing to the porosity of the subsoil.

Practically all this soil is cultivated to corn, oats, and hay, which occupy the land all the time. The land was formerly covered by a timber growth of oak, elm, ash, hickory, maple, and wild cherry trees.

This soil is farmed in conjunction with other terrace and upland soils and is cropped in the same manner as O'Neill loam. No farm consists entirely of this soil, and therefore no special attention is given its management. The crop yields obtained are lower than on the dark-colored soils of the terraces and uplands.

Crop residues and barnyard manure are practically the only fertilizing materials used. Good increases in yields are obtained through the manure treatment.

The recommendations given for the management of O'Neill loam apply also to this soil, with additional stress laid on the incorporation of organic matter in the form of manures. The light color of the surface soil indicates lack of organic matter, and the deficiency

can best be corrected by plowing under some legume as a green-manure crop and by using stable manure.

O'NEILL SANDY LOAM

The surface 8 or 10 inch layer of O'Neill sandy loam consists of dark grayish-brown, structureless, loose sandy loam or fine sandy loam. This grades into more compact sandy loam containing some clay, which extends to a depth ranging from 16 to 20 inches. Small gravel pebbles are present in the lower part of this layer. This more compact layer rests on the yellowish-brown stratified sand and gravel.

Variations from typical were noted in all parts of the county. The principal differences are in the thickness and texture of the surface soil. The texture ranges from fine sandy loam to loamy sand within short distances, but owing to the small acreages in these variations it was regarded unnecessary to separate them. They occur wherever the soil has been mapped and are easily recognized as they are always found on the small knolls within O'Neill sandy loam.

The areas of O'Neill sandy loam are undulating or sloping toward the stream. Drainage, owing to the porosity of the subsoil, is good or excessive. During seasons of subnormal rainfall the crop yields are lowered, since there is insufficient moisture in the soil for the plants.

This soil has been mapped along all the main streams of the county, and the total acreage is rather large. The most extensive areas are in Utica and Jacksonville Townships along Little Turkey River and Crane Creek; along Wapsipinicon, Little Wapsipinicon, and East Fork Wapsipinicon Rivers through the central part of the county; and along Little Cedar River in Chickasaw Township. These areas range in width from a few hundred feet to about 1 mile. The terraces lie well above overflow, most of them being from 20 to 35 feet above the present flood plain of the stream.

Owing to the extent to which O'Neill sandy loam occurs in this county it is regarded as one of the main soil types and practically all of it is under cultivation to corn and oats. The sandy texture of the material makes this soil rather droughty, and special care is given to keep it productive. As much manure as is available is applied to the fields, and the crop residues are plowed under to supply humus. Like the other O'Neill soils, this soil is adapted to the livestock industry. Corn and small grains can be produced, and the adjoining upland soils and the first-bottom lands, which are everywhere associated with the terraces, can be utilized as pastures. Aside from the fact that these soils receive heavier and more frequent manure treatments, they are handled and cropped in the same manner as the other terrace soils of the county.

Corn in normal years yields from 25 to 40 bushels to the acre, oats from 20 to 35 bushels, and hay from 1 to 1½ tons. Abnormal seasons and the method of handling the soil may bring about considerable increase in these estimated yields.

The first prerequisite in improving O'Neill sandy loam is the incorporation of large quantities of organic matter. This is best

accomplished by making heavy applications of stable manure and turning under all the crop residues. Applications of limestone in sufficient quantities to correct the acidity before seeding the fields down to some legume hay crop will aid materially in establishing a good stand and will increase the total yield of hay to the acre. The use of phosphates on sandy soils has proved very profitable in other sections of the State. Fields as sandy as some of this soil are droughty, and therefore the crop yields are often lowered in dry seasons. Under proper management and normal rainfall, this soil can be made very productive.

O'NEILL SILT LOAM

The surface soil of O'Neill silt loam, to a depth of about 12 inches, is dark grayish-brown friable silt loam containing some fine sand and having a fine granular structure. The surface soil is underlain, to a depth of about 28 inches, by light-brown, heavy gritty clay loam. Small gravel pebbles are embedded throughout this gritty clay loam. The soil mass has no well-defined structure, but in some places it breaks down into irregular-shaped aggregates and gives the appearance of having a small nut structure. This is the heaviest-textured layer of the entire soil. The percentage of silt and clay is high for the O'Neill soils. Beneath this heavy layer is the yellowish-brown, stratified sand and gravel characteristic of the O'Neill soils. Neither the surface soil nor the lower layers contain lime. The main variation from typical occurs in the depth of the light-brown gritty clay loam layer, which may vary from about 14 inches to 34 inches within a few feet.

O'Neill silt loam is not extensive in Chickasaw County. It occurs on terraces, occupying a lower position than the lighter-textured soils of the O'Neill series. It is also found between the first bottoms and the uplands where the gradation from the terrace to the upland is rather gradual. The principal areas mapped are along Wapsipinicon River in Deerfield Township, along Little Wapsipinicon River south of North Washington, and along Crane Creek south of Lawler. These areas range in width from a few hundred feet to nearly one-half mile and are gently sloping toward the stream. Most of them lie lower than the adjoining lighter-textured terrace soils. Drainage, owing to the porosity of the subsoil, is good.

Approximately 90 per cent of this soil is under cultivation to corn, oats, and hay. The remainder is used as pasture land. Timber growth is confined to the fence rows and isolated sections of the field. Corn is favored in the cropping systems and occupies the greatest acreage. The yields range from 25 to 50 bushels to the acre, with an average of about 35 bushels. Oats yield from 30 to 55 bushels to the acre. A hay mixture of timothy and red clover is seeded with the oats. Hay remains on the land two or three years.

O'Neill silt loam, owing to the depth of the gritty clay loam layer, is not so droughty as the other members of the O'Neill series.

Crops rarely fire on this soil, even during exceptionally long dry periods. Methods of handling O'Neill silt loam are similar to those employed on O'Neill loam and Carrington silt loam. Barnyard manure, together with the crop residues, supplies the organic matter.

Land values for this soil range from \$75 to \$125 an acre, depending on the location and improvements.

BREMER SILT LOAM

The surface soil of Bremer silt loam, to a depth of about 10 inches, is very dark grayish-brown or almost black friable silt loam. The small percentage of fine sand present gives the surface soil its friable texture. The structure is finely granular. The extremely dark color is caused by the high organic-matter content. Beneath this surface layer and extending to a depth of about 18 inches is brown or dark-brown heavy silt loam or silty clay loam, slightly stained by iron in the lower part. This is a transition zone between the dark surface soil and the underlying dark olive-drab, sticky, compact clay loam. Iron stains are present but are not so marked as in the overlying layer. The lime has been leached from the entire soil.

A few variations were noted in the county. In sections 11, 12, and 13 of Chickasaw Township, there are numerous pockets where the drainage conditions were unfavorable and small "alkali spots" have formed. In section 1 of Chickasaw Township there are included small knolls, few of which are more than an acre in extent, which are underlain by gray and brown gravel. Many small depressions within the soil have heavier-textured surface layers, ranging from silty clay loam to clay. Where Bremer silt loam is associated with the sandy soils the surface material has been affected by the sand which has washed down on and over the terrace.

The most extensive areas of Bremer silt loam are along Wapsipinicon River throughout its course through the county. Large areas are north and south of Deerfield and south of United States Highway No. 18 along the entire course of the river. Smaller areas are mapped along Little Cedar River, East Fork Wapsipinicon River, and Crane Creek. The areas vary in width from one-eighth to one-half mile and many of them extend continuously along the stream for 1 or 2 miles.

The areas are level or slightly sloping toward the stream. Natural drainage is fairly well established. Bremer silt loam occupies a terrace position and lies from 2 to 8 feet above the flood plain of the rivers. In slightly depressed areas artificial drainage is necessary before crops can be grown successfully.

Approximately one-half this soil is used for the production of corn and oats. The remainder supports a luxuriant growth of wild grasses which furnish excellent pasture and hay. Corn is the chief crop and the soil is better adapted to it than to small grains. Corn yields on the better drained fields average about 50 bushels to the acre. Owing to the high natural fertility of this soil, oats and the other small grains have a tendency to produce rank stem growth and lodge badly. Before the introduction of the stiff-strawed varieties of oats, this crop was seldom grown. The Iowar variety of oats can be successfully grown, and yields as high as 75 bushels to the acre have been obtained. The average yield is about 40 bushels to the acre.

The soil is handled in much the same manner as Carrington silt loam and Floyd silt loam. Drainage is of primary importance. Tiling or ditching is necessary in most places before the fields can

be successfully cropped. The injury caused by the "alkali spots" may be corrected by heavy applications of stable manure and turning under green-manure crops. The soil is naturally fertile and will withstand continuous cropping over long periods, but this system should be discouraged and good crop rotations adopted.

WABASH SILT LOAM

The surface soil of Wabash silt loam is very dark drayish-brown or almost black heavy silt loam to a depth ranging from 10 to 14 inches. This passes gradually into dark-brown heavy silty clay loam, mottled or stained brown and rust brown. This is very sticky when wet and hard when dry. The structure is poorly defined. Below a depth of 24 inches is the gray sticky silty clay loam mottled yellow, brown, and rust brown, which is characteristic of the Wabash soils.

Although Wabash silt loam is very uniform in Chickasaw County, a few variations are noticeable. As this is a first-bottom soil subject to overflow, there are variations in the thickness and texture of the surface soil. Included with this soil are depressed areas where the texture is decidedly heavier than typical. Small hummocks are lighter in texture, ranging from loam to fine sandy loam. After each period of overflow, new material is deposited on the surface. This may alter the texture and depth of the surface soil several times during a decade. Wash from the sandy slopes adjoining the first bottoms has affected the texture near the edge of the bottoms.

Wabash silt loam is subject to frequent overflow during high stages of the streams. It is found in practically all parts of the county along the larger streams. The most extensive areas are along Wapsipinicon River in Deerfield, Dayton, and Richland Townships. Other important areas are in Dresden Township along East Fork Wapsipinicon River and in Washington Township along Little Wapsipinicon River. Areas vary from almost level to slightly undulating or hummocky. Drainage is poorly established, the water table in many places lying within 3 feet of the surface.

Only a small percentage of the Wabash silt loam has been reclaimed for cultivation by tiling or ditching. Corn is raised on the drained areas. The remainder of the soil supports a growth of wild hay and bluegrass and is used as pasture and hay land. It furnishes excellent pasture and is well adapted to the livestock system of farming.

When Wabash silt loam is well drained and provisions are made to prevent the flood waters from covering the fields, high yields of corn are obtained. The uncertainty of maturing a crop of corn successfully has hindered the reclaiming and improving of the soil, and only large tracts a considerable distance from the streams are cultivated. No fertilizers are used, and no special attention is given the soil. It is continuously cropped to corn, as it is not well adapted to small grains.

Since Wabash silt loam occurs on the first bottoms subject to frequent overflow, recommendations for improvement must be confined to methods of draining and preventing the flood waters from covering the fields. Some means must be provided to carry off the

surplus water rapidly after the fields have been covered to minimize the damage to the crops. Dikes or levees along the streams and the straightening of the channels will aid materially in keeping the water within the banks of the stream. Lateral ditches through the fields aid in removing the water after the streams have receded from flood stage. The high natural fertility of this soil insures heavy yields if the drainage can be established.

WABASH LOAM

The surface 6 or 8 inch layer of Wabash loam is dark grayish-brown or almost black, granular friable loam. The dark color is due to the high content of organic matter. Underlying this layer to a depth of about 18 or 20 inches is brown silt loam beneath which is gray heavy silt loam or silty clay loam mottled brown and rust brown.

This soil varies widely in the county. As it is subject to overflow and lies close to the streams, each successive inundation may change the surface soil. There may be a deposit of sandy material resting on a previous deposit of silt. In many places the dark-colored humus layer extends below a depth of 3 feet, and there may be no appreciable difference in the texture of the soil to a depth of 3 or 4 feet. Near the banks of the streams, the surface soil is more sandy, due possibly to the fact that the heavy material carried by the flood water is deposited here when the current is checked as the water begins to spread over the bottoms.

Wabash loam has been mapped in all parts of the county along the streams of sufficient size to develop first bottoms. Few of the areas are more than one-fourth mile in width. They follow the streams in ribbonlike bands on either or both sides.

This soil is level or hummocky, and natural drainage is fairly well or poorly established. The soil is subject to frequent overflow and therefore is of little value as crop land. Most of it supports a growth of bluegrass and is sparsely timbered with elms, maples, red haw, birch, swamp oak, willows, and cottonwoods. It is excellent pasture land and is regarded as an asset on farms having large cultivable acreages which can be used for the production of grain.

CASS FINE SANDY LOAM

Cass fine sandy loam has a dark grayish-brown, porous fine sandy loam surface soil 6 or 8 inches thick. This grades into lighter-brown fine sandy loam, more compact than the surface soil and containing a small percentage of clay. Below a depth of 18 inches is light-brown porous fine sand mottled slightly with gray and rust brown.

This soil is variable and includes small areas of Cass silt loam and of Wabash loam. In some places there is a brown or dark-brown silty clay loam layer beneath the sandy surface. This grades abruptly into the lighter-brown sandy subsoil.

Cass fine sandy loam occurs only in the first bottoms along the larger streams of the county. Extensive tracts are mapped along Cedar, Little Cedar, Wapsipinicon, Little Wapsipinicon, and East Fork Wapsipinicon Rivers, and, to a less extent, along Crane Creek. Few of the areas are more than one-fourth mile in width. They occur

immediately adjacent to the stream and are frequently covered by the flood waters.

Practically none of this soil is cultivated, as damage by overflow prohibits cropping. It has little value other than as pasture land. In the natural state it supports a growth of timber consisting of poplar, maple, willow, cottonwood, elm, birch, red haw, and swamp oak trees, and an undercover of bluegrass where the timber is sparse.

MUCK AND PEAT

The areas mapped as muck and peat include the peat swamps which are composed of a brown or dark-brown fibrous mass of partly decomposed plant remains and a small percentage of mineral matter washed in and deposited. Underlying this spongy mass at a depth ranging from 10 to 20 inches is gray, drab, or slate-gray compact, heavy, sticky clay loam, or clay. The muck is composed of the very dark-brown or black, finely divided, sticky decomposed plant remains which have lost their fibrous nature, together with a small amount of fine sand and other finer mineral particles. The muck and peat are closely associated.

The most important areas of muck and peat mapped in the county are in sections 4 and 21 of Deerfield Township, sections 28, 29, and 32 of Chickasaw Township, and sections 2, 11, and 15 of Stapleton Township.

Muck and peat areas are poorly drained, and water stands on the surface throughout the year. During the dry seasons cattle are allowed to graze on the land, but in the wet season the fields are usually too soft to be pastured. Muck and peat are of little value unless they are reclaimed by drainage.

SUMMARY

Chickasaw County is in the northeastern part of Iowa. The total area is 497 square miles, or 318,080 acres.

The relief varies from almost level to strongly rolling. The level prairies show no effect of erosion, but along the streams the relief is more pronounced and the land is rolling. High terraces have developed along all the main streams, and first bottoms occur along all the streams of the county.

Chickasaw County was organized in 1851. The population, as given by the 1920 census, is 15,431 persons. New Hampton, the county seat, is the largest town.

Three railroad systems furnish transportation facilities to the county. The public highways are kept in good repair, and the main roads are graveled. United States Highway No. 18 traverses the county east and west, and State Highway No. 59 crosses it north and south.

Chicago, Minneapolis, St. Paul, Waterloo, Mason City, and eastern markets absorb the surplus livestock and products of the county.

The climate of Chickasaw County is healthful and is suited to the production of the staple crops of the Corn Belt.

The industries of Chickasaw County are primarily agricultural. Corn, oats, and hay are the principal crops, and hog raising and dairying are the chief livestock industries.

In 1925, 41.6 per cent of the farms were operated by tenants. The grain-share and stock-share plans of renting are preferred. Cash rentals range from \$4 to \$14 an acre.

Land values in Chickasaw County range from \$50 to \$275 an acre, depending on the location, relief, and kind of soil.

The Iowan drift is the material from which practically all the soils of the county have been derived. The soils have been formed under different conditions, and as a result they have distinctly different profiles. Those formed under good drainage conditions under a cover of prairie grasses are included in the Carrington and Dickinson series of the uplands and the O'Neill series of the terraces. These soils have dark-colored surface layers and brown subsoils. The timbered or light-colored soils fall within the Lindley series. The soils formed under poor drainage conditions are included in the Floyd and Clyde series of the uplands and the Bremer series of the terraces. The first-bottom soils are grouped in the Wabash and Cass series. Dodgeville silt loam represents the soils of the county formed wholly or in part from material in place. The 10 soil series of this county have been further divided into 18 soil types and 2 phases on the basis of the texture of the surface horizons. In addition the miscellaneous classification, muck and peat, is mapped.

[PUBLIC RESOLUTION—No. 9]

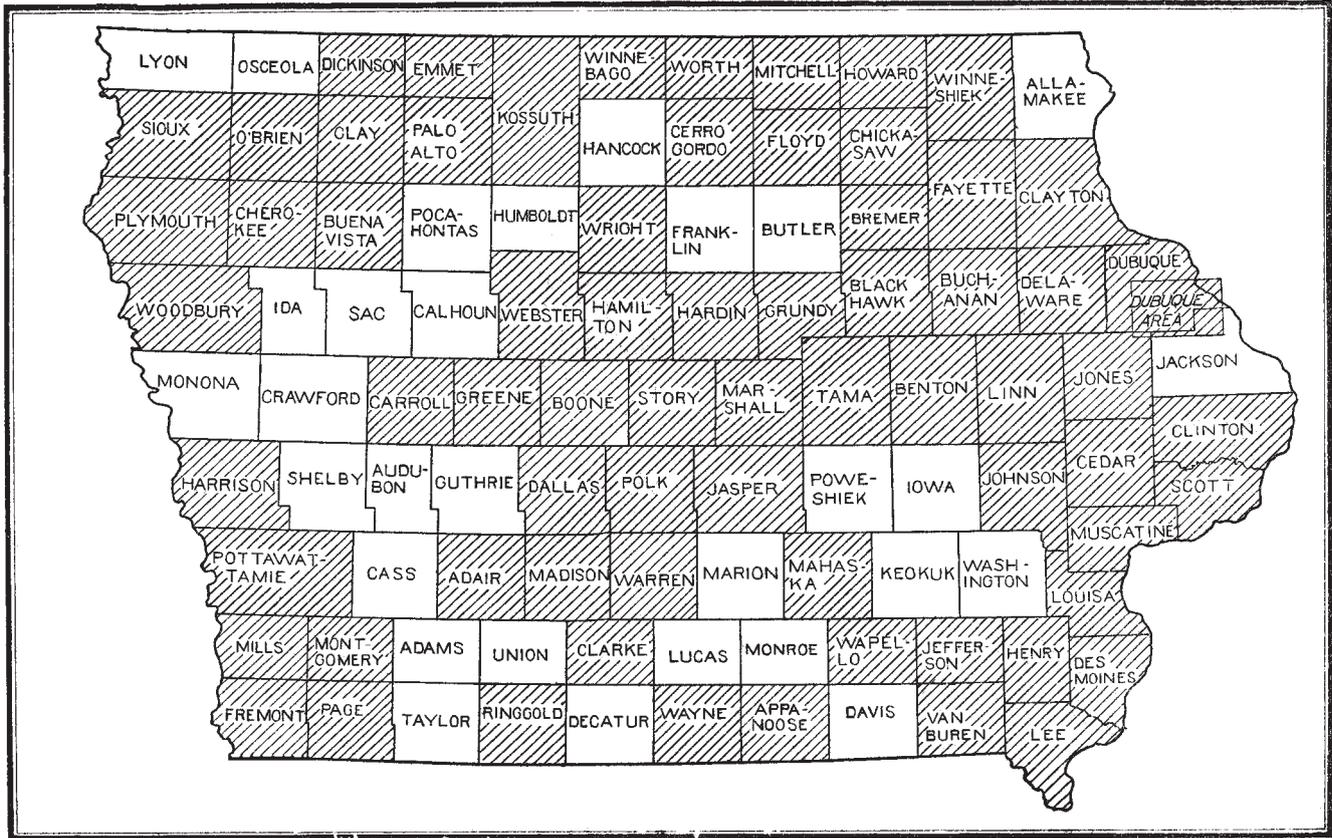
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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 4, 1904.

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



Areas surveyed in Iowa, shown by shading

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