

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS.
IN COOPERATION WITH THE IOWA AGRICULTURAL EXPERIMENT STATION.

SOIL SURVEY OF GRUNDY COUNTY, IOWA.

BY

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EXPERIMENT STATION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1921.]



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[PUBLIC RESOLUTION—No. 9.]

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

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

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

Approved, March 14, 1904.

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

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MAP.

Soil map, Grundy County sheet, Iowa.

SOIL SURVEY OF GRUNDY COUNTY, IOWA.

By E. MALCOLM JONES, of the United States Department of Agriculture, in charge, and W. E. CARSON, of the Iowa Agricultural Experiment Station.

DESCRIPTION OF THE AREA.

Grundy County is located a little northeast of the central part of Iowa. Its length north and south in the western half is 24 miles, and in the eastern half it is 18 miles, making the county somewhat irregular in shape. It includes 14 townships, and has an area of 501 square miles, or 320,640 acres.

The county as a whole is a gently rolling prairie intersected by shallow valleys of streams and by interstream divides consisting of flat areas or prominent ridges. In the northwestern part of the county there are numerous well-rounded ridges and hills, called "pahas," which have a general trend northwest and southeast. These pahas are most prominent northwest of Bucks Grove, in Pleasant Valley and German Townships. The surface is more rolling in the northern part of the county, and the origin of the soils from glacial drift is indicated by the presence of gravel and boulders. There are two very prominent boulders, one about 3 miles northeast of Wellsburg, and the other near the Black Hawk County line, 2 miles south of the Butler County line. The latter is said to be one of the largest if not the largest boulder in the State.¹ In the vicinity of Conrad and between Grundy Center and Conrad there are flat to slightly depressed areas which represent former lake beds and now constitute broad areas of level land.

The main valley of Blackhawk Creek is composed of level first-bottom land with an average width of three-fourths mile, and, flanking the first bottom, a series of benchlike lands or terraces. The terraces range in width from a few rods in places to a half mile or more. The town of Morrison is located on one of these terraces, and a large part of Reinbeck occupies a terrace. Nearly all the slopes are gentle and well rounded. The bottom lands are usually level, with only occasional depressions.

The elevation of the railroad at Grundy Center is given as 976 feet above sea level; at Reinbeck, 926 feet; at Morrison, 947 feet; at Holland, 995 feet; at Wellsburg, 1,058 feet; at Beaman, 984 feet; at

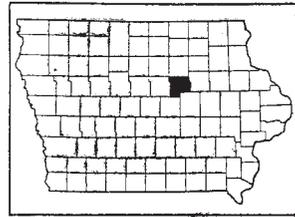


FIG. 35.—Sketch map showing location of the Grundy County area, Iowa.

¹ This boulder is probably 27 feet wide by 40 feet long, with 8 feet exposed above the surface. The part beneath the surface would probably reach 12 to 20 feet, according to local estimates.

Conrad 1,010 feet.² About 2 miles northeast of Wellsburg the water drains away in different directions, and in this vicinity the elevation may be greater.

With the exception of Beaver Creek, which enters the county from Hardin County northwest of Wellsburg, all the streams of the area have their origin within the county and derive their flow from the local precipitation.

Beaver Creek flows in a northeasterly direction into Butler County. It drains the northwestern part of the county, including Shiloh, German, and Pleasant Valley Townships. Blackhawk Creek, the largest stream, flows in a general easterly direction and passes out of the county near Hicks. Through its tributaries, including Mosquito Creek, it drains Black Hawk, Washington, Colfax, and the northern part of Palermo and Melrose Townships. The North Fork Blackhawk Creek flows east and southeast and drains the greater part of Lincoln, Beaver, Grant, and the southwestern part of Fairfield Townships. Hammers Creek flows north and drains part of Fairfield Township. Bear and Dowd Creeks flow into Hardin County and drain the western parts of Melrose and Felix Townships. Wolf Creek begins in Melrose Township, flows south and east through Felix and Clay Townships, and passes out of the county into Tama County.

The drainage of the county as a whole is good, with branches and streamlets ramifying nearly all parts, so that nearly all the farms can be connected by tile with an outlet. With the exception of a few small areas, the surface is well drained. Much of the land has been underlaid with tiling, and the surface water drains off quickly, allowing cultivation of the fields soon after heavy rains. A few small flat areas and slight depressions have poor drainage, but most of these can be improved by tiling.

A few streams in the area have a rather swift current, but most of the streams are sluggish and follow winding courses. There are a few small ponds along the larger streams; the largest of the permanent ponds are shown on the map. Overflows of the first bottoms occur at rare intervals and are of short duration.

Out of the total area of land in Grundy County, not a single acre can be classed as waste land, all of it being utilized either for growing crops or as pasture.

The first settlement of Grundy County was made in 1853, and the county was organized in May, 1856. The population has gradually increased, and in 1920 the census reported a total of 14,420. The population is all classed as rural, there being no town in the county with 2,500 inhabitants. The population is fairly evenly distributed throughout the county, but is probably densest in the vicinity of Grundy Center and Reinbeck.

The first settlers came from Pennsylvania and other Eastern States, but within the last 45 years there has been an influx of Germans and Danes. Most of the Germans first settled in the northwestern part of the county in the vicinity of Wellsburg, and the Danes in the northeastern part near Dike and Fredsville. The greater part of the present population is either German or of German extraction. Both

² Gannett, Dictionary of Altitudes.

the Germans and Danes are very thrifty, and through their efforts the county has been brought into its present high state of development.

Grundy Center, the county seat, has a population of 1,749. It is located near the center of the county on an elevation between the Blackhawk and Minnehaha Creeks. When the first settlers built their homes here there were no trees except along the streams, and the rest was a broad expanse of unbroken, rolling prairie land. The first house built in the town was constructed of logs, probably obtained from Cedar River, and the roof was made of hay. The first schoolhouse was erected in 1860 and was frequently used by the pioneers for holding religious services. At present Grundy Center has a magnificent school building and six churches.

Reinbeck, which is located on two railroads, is an important transportation center, with a population of 1,415. Conrad has a population of 560. Wellsburg, a thriving little town noted for its beautiful homes, has a population of 482. Other towns of importance are Beaman, Stout, Dike, and Morrison.

Grundy County has excellent transportation facilities, supplied by four railroads, and no point within the county is more than 8 miles from a railroad. The Chicago, Rock Island & Pacific Railway crosses the county diagonally, passing through Wellsburg, Holland, Grundy Center, Morrison, and Reinbeck. At Reinbeck it makes connections with the Chicago Great Western Railroad, which passes through the southeastern corner of the county. The Chicago & North Western Railway traverses the northeastern part of the county through Stout and Dike. Another line of the same railroad crosses the southwestern part through Conrad and Beaman.

Nearly all of the public roads follow the section lines. Most of the main highways are graded and some have a gravel surface (Pl. XXXVI, fig. 1). The roads over the entire county have been improved by grading and by installing a thorough drainage system preparatory to surfacing with gravel. Telephone service extends over the entire county and reaches most of the homes.

Nearly all the towns have grain elevators. The inland towns usually have creameries which afford a market for dairy products. Chicago is the principal outside market and receives most of the cattle and hogs that are shipped out of the county.

CLIMATE.

The climate of Grundy County has been a most important factor in the development and maintenance of productive soils, and it is highly favorable to the growth of a large number of profitable crops.

There is considerable variation between the extremes of winter and summer. The lowest temperature recorded by the Weather Bureau station at Waterloo is -32° F., and the highest is 109° F. The mean temperature for the winter months, as recorded at Grundy Center, is 22.1° F., and the summer mean is 72.4° F.

The average date of the last killing frost in the spring is May 2, and of the first in the fall, October 2, though the records show that killing frost has occurred as early as September 12 and as late as May 31. The average growing season is about 152 days. Owing to good circulation of air throughout the soil profile, most of the soils warm

up quickly after the summer season sets in, and vegetation makes a rapid growth. During the season of 1921 spring opened unusually early and most crops were advanced from three to four weeks. This was detrimental to the oat crop, which advanced too rapidly to mature the grain.

The average rainfall is about 32 inches for the year. Usually more than half of the total precipitation occurs during the months of May to August, inclusive. The average for the three winter months is about 3 inches.

In normal seasons the climatic conditions of the area are well suited to the growing of corn, oats, barley, rye, clover, and soybeans. Corn reaching the height of "knee-high" by July 4 is usually considered far enough advanced to be able to mature the grain before a killing frost, and most farmers endeavor to have their corn crop reach the above height by the first week in July.

The average snowfall, as recorded at Waterloo, is 30.1 inches for the year. Usually the month of January has the maximum amount of snowfall, while December, February, and early part of March have an average of 5 inches or more of snow per month. Snow often comes in early October and as late as April.

The following tables, compiled from the records of the Weather Bureau stations at Grundy Center and Waterloo, give the more important climatic data pertaining to this region:

Normal monthly, seasonal, and annual temperature and precipitation at Grundy Center.

[Elevation, 976 feet.]

Month.	Temperature.	Precipitation.		
	Mean.	Mean.	Total amount for the driest year (1894).	Total amount for the wettest year (1902).
	° F.	Inches.	Inches.	Inches.
December	25. 2	1. 18	1. 02	2. 05
January	19. 6	. 92	1. 00	1. 16
February	21. 6	. 89	. 49	. 79
Winter	22. 1	2. 99	2. 51	4. 00
March	34. 4	1. 81	2. 40	2. 08
April	49. 6	3. 07	3. 31	1. 70
May	61. 4	4. 91	1. 51	7. 11
Spring	48. 5	9. 79	7. 22	10. 89
June	69. 8	5. 02	2. 66	16. 04
July	74. 8	3. 94	. 09	8. 74
August	72. 5	3. 63	1. 71	9. 81
Summer	72. 4	12. 59	4. 46	34. 59
September	63. 7	3. 43	2. 16	4. 67
October	51. 3	2. 60	3. 37	1. 65
November	35. 4	1. 40	. 47	2. 28
Fall	50. 1	7. 43	6. 00	8. 60
Year	48. 3	32. 80	20. 19	58. 08

Normal monthly, seasonal, and annual temperature and precipitation at Waterloo, Black Hawk County.

[Elevation, 862 feet.]

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1902).	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December.....	23.3	59	-28	1.27	0.47	1.94	6.4
January.....	16.2	61	-32	1.14	1.49	1.93	7.8
February.....	19.5	64	-30	1.17	.50	1.47	7.4
Winter.....	19.7	64	-32	3.58	2.46	4.34	21.6
March.....	32.5	86	-13	1.63	.09	2.29	5.0
April.....	47.9	92	13	2.43	2.17	1.28	1.3
May.....	59.9	95	22	4.06	2.05	8.54	.0
Spring.....	46.8	95	-13	8.12	4.31	12.11	6.3
June.....	68.5	98	37	3.79	1.84	6.81	.0
July.....	73.9	109	44	4.23	.84	10.61	.0
August.....	71.5	104	34	3.59	4.11	7.70	.0
Summer.....	71.3	109	34	11.61	6.79	25.12	.0
September.....	63.0	100	19	3.76	2.98	4.86	.0
October.....	51.0	91	12	2.35	.37	1.50	T. 2.2
November.....	35.0	79	-7	1.45	.44	1.83	
Fall.....	49.7	100	-7	7.56	3.79	8.19	2.2
Year.....	46.8	109	-32	30.87	17.35	49.76	30.1

AGRICULTURE.

The land now included in Grundy County was originally a broad unbroken, rolling prairie, with no trees except along the stream courses. The luxuriant growth of grasses for grazing, the ease with which the soil could be brought into cultivation, and the richness of the virgin soil in organic matter were the principal factors which attracted settlers to this section.

The first settlement was made about 1853 in that part of the area now known as Fairfield Township, on the uplands where the natural drainage was good. In later years the fertile soils of the level or flat areas and bottom lands were brought into cultivation, after proper drainage had been established.

Corn, oats, wheat, and hay have always been the leading field crops, except that the acreage of wheat has been greatly reduced in recent years. Horses, cattle, and hogs constitute the chief domestic animals.

In the early days the settlers produced crops almost exclusively for home use, and the most important crops were wheat and corn. Flax was also raised to some extent, the census report showing a production of 24,819 bushels of seed in the county in 1879. Sheep were raised for wool, which was used almost exclusively for the homespun clothing of that day. The raising of sheep presented many difficulties, as wolves were numerous and destroyed many annually. The

grazing of cattle was engaged in. The settlers depended largely upon game for meat. Sorgo was grown for sirup. Potatoes and tobacco were also raised for home consumption.

Prior to the development of public roads communication was very difficult, and each community was practically isolated. Dubuque, located on the Mississippi River, afforded a market for the early settlers, but as the distance was great and travel rather difficult, only a few trips were made annually.

In the fall of 1877 the Burlington, Cedar Rapids & Northern Railroad reached Grundy Center. The coming of the railroad encouraged building and improvements and caused a rapid settlement. The lands were first used for pasture, but as fast as they could be fenced the soil was brought into cultivation.

Fruits, especially pears and apples, were grown rather extensively for home consumption in the earlier days, but little attention has been given to the production of fruit in recent years.

The following table, compiled from the reports of the Federal census, shows the acreage and production of the leading crops and indicates the trend of agriculture in Grundy County in the last 40 years:

Acreage and production of the leading crops in 1879, 1889, 1899, 1909, and 1919.

Crop.	1879.		1889.		1899.		1909.		1919.	
	Area.	Production.								
	<i>Acres.</i>	<i>Bushels.</i>								
Corn	87,808	3,742,904	86,862	3,605,550	102,248	4,159,460	95,558	3,909,249	95,490	3,925,786
Oats	23,492	846,878	68,396	3,298,608	68,573	2,919,000	69,088	2,205,170	78,426	2,915,801
Wheat	57,622	683,387	1,488	19,523	10,055	194,550	535	9,885	2,343	37,877
Rye	436	7,350	362	5,807	328	5,660	43	1,185	49	706
Barley	5,230	109,674	5,164	176,919	14,428	507,210	7,906	170,944	1,326	34,697
Buckwheat	258	2,210	173	2,040	83	960	157	2,170	-----	-----
Flaxseed	-----	24,819	585	5,346	254	3,050	15	105	-----	-----
		<i>Tons.</i>								
Hay	30,279	41,872	45,142	65,987	37,444	48,336	38,858	71,374	30,914	48,614
Coarse forage	-----	-----	-----	-----	2,451	6,279	1,323	5,291	5,185	12,536
Silage crops	-----	-----	-----	-----	-----	-----	-----	-----	-----	31,687
		<i>Bushels.</i>								
Potatoes	-----	128,907	2,289	245,281	2,160	218,401	8,849	864,132	1,791	82,771
		<i>Trees.</i>								
Apples	-----	-----	15,300	28,017	30,378	25,000	22,586	15,422	15,139	10,526
		<i>Vines.</i>		<i>Vines.</i>		<i>Pounds.</i>		<i>Vines.</i>		<i>Pounds.</i>
Grapes	-----	-----	-----	-----	1,770	3,000	4,515	29,938	5,313	66,119

The 1880 census report shows that 90.9 per cent of land in the area was included in farms and that 97.1 per cent of the farm land was improved. There were 1,872 farms in the county, with an average value of \$4,434 per farm. The land, fences, and buildings constituted 79.7 per cent of the average value, implements and machinery 4.5 per cent, and domestic animals 15.8 per cent. The 1920 census gives the number of farms as 1,725, with an average valuation of \$55,971. This shows that the number of farms has decreased in the last 40 years, while the valuation has increased very materially.

Corn is the most important crop of the county. The average yield is about 40 bushels per acre, but yields as high as 85 bushels on individual fields are not uncommon. The corn is used for feeding work stock and fattening cattle and hogs for the market, or is sold to the local grain elevators and shipped to the market.

Oats constitute the next most important grain crop, and the acreage has steadily increased in the last 40 years. The average yield usually fluctuates between 30 and 45 bushels, the average for the period from 1910 to 1920 being a little over 37 bushels. In 1921 the early season forced the crop into maturity, resulting in a low yield, as the grain did not have time to fill out properly before ripening.

Wheat was formerly an important crop, but during several successive seasons the grain failed to fill well owing to dry, hot weather, and damage by the chinch bug also discouraged the growing of wheat. The average yield of spring wheat for the last 40 years has been a little over 14 bushels per acre, while the average for winter wheat is 3 to 4 bushels more.

Barley is grown to some extent for feed, but is much less important than it was 20 years ago. The average yield of barley for the last 10 years has been about 26 bushels per acre.

Potatoes are grown on a relatively large acreage and have constituted one of the important crops of the county. Excellent yields are obtained, and there is always a ready market. Reinbeck is an important shipping point for potatoes. The average yields have ranged from 40 to 125 bushels per acre, with a general average yield of about 78 bushels per acre during the last 30 years.

Hay is an important crop on nearly every farm. The area devoted to hay generally produces an adequate supply for home use. Timothy, red clover, and a mixture of timothy and red clover are the predominating hay crops grown. Alfalfa and sweet clover are grown to a very small extent. Alsike clover is grown on the less well drained land, as it is adapted to poorly drained areas. The growing of clover serves a dual purpose, being used as a hay crop and as a green-manure crop. The yields of hay vary with the kind. Alfalfa averages nearly 3 tons per acre, red clover yields less than 2 tons per acre, and wild hay averages about 1½ tons. Very little of the hay crop is sold outside of the county. In the northeastern section some hay is baled and sold at Waterloo. The greater part of the hay crop, however, is put away in bulk for home use.

Other field crops of minor importance include rye, buckwheat, soybeans, and rape.

The only apple orchard of any size is located in the northeastern corner of the county, near enough to Cedar Falls and Waterloo to insure a ready market for the apples. The Wealthy variety predominates; the varieties include the Oldenburg, Greening, and Whitney.

Most of the farms have enough grapevines to insure an ample supply of grapes for home use. Different varieties are grown, but the most popular is the Concord. Small fruits, including strawberries and brambles, were grown on 37 acres in 1919 and yielded about 39,000 quarts of fruit.

On one farm just west of Grundy Center pop corn is the main cash crop and has a ready sale. The yield of pop corn will average about the same as other corn in the area. The raising of sunflowers is also a profitable industry, the seed being sold to a chick-feed company.

The dairy industry has made rapid progress since 1900. The value of dairy products, excluding those for home use, was \$355,846 in 1909 and \$730,880 in 1919. Dairying is followed in practically every part of the county. The milk is usually sold to creameries located in the vicinity of the farms. The milk is separated at the creamery and

the skim milk usually returned to the farms and fed to hogs and chickens. Holstein, Guernsey, and a few Jerseys are the principal dairy cows in the area. Shorthorn cows are also used to some extent for dairying.

The Iowa Yearbook of 1916 gives the number of silos as 39 in Grundy County, but since then the number has increased until few farms are without one. Most of the farms of any size have handsome silos, constructed either of concrete, tile, or pressed brick.

There are many fine herds of beef cattle in the county. Aberdeen Angus, Hereford, Red Poll, and Shorthorn are favorite breeds. One of the finest Aberdeen Angus herds in the State is located southwest of Grundy Center, and here annual sales of these cattle are held to supply farmers with breeding stock.

The feeding of cattle is an important industry. The cattle are shipped into the county to be fattened and later shipped to the Chicago market. This was very profitable when the price of beef was high, but the decline of prices for beef cattle recently has discouraged this industry to a certain extent.

Hogs are raised and fattened on nearly every farm where corn is grown. According to the census, there were 71,731 hogs on farms in the county in January, 1920.

Small herds of sheep are found within the county. The 1920 census reports that the value of wool produced in 1919 amounted to \$12,529.

Poultry raising is rapidly becoming an important industry on the farm, and many fine flocks are kept within the county. The most popular breeds are the White Leghorn, Rhode Island Red, Black Minorca, and Brown Leghorn. Other fine breeds are the Barred Plymouth Rock, White Plymouth Rock, and Silver Laced Wyandotte. The culling of poultry within the last two years has become very popular with poultry raisers, and their flocks have been materially improved both in egg production and in general vigor. The Chinese pheasant has been placed in the county within recent years to replenish the game and take the place of the prairie chicken, which is fast becoming extinct.

The more sandy soils are recognized by the farmers as being adapted to the raising of early truck and watermelons for local markets, and these crops are grown to a limited extent. While all the soils appear to be well adapted to the growing of corn, the Muscatine silt loam is considered the most productive corn soil in the area.

Corn is planted by the check-row system in hills $3\frac{1}{2}$ feet apart each way, and the soil is cultivated level. Corn is usually planted as early in the spring as practicable and is thoroughly cultivated with labor-saving implements. The crop usually receives three or four cultivations before the time for cutting hay and oats. As a rule the time between the first and second cultivations is devoted to hauling out and spreading on the clover and oat fields the winter accumulation of barnyard manure. Some of the corn is cut for silage, some is shocked in the field, and the greater part is picked and stored to be shelled later for the grain elevators.

The oat crop is threshed in the field and the straw is stacked in a convenient place where the stock may have access to it during the winter.

Nearly all the farms are well equipped with machinery, work stock, and milk cows. Few mules are used for farming, most of work ani-

mals being large draft horses. In addition, the tractor plays an important part in hastening the preparation of land for planting during the rush season and also for fall plowing. Nearly all of the farm buildings are well built and attractive.

Practically every farm has a good supply of water obtained from bored wells. This is usually lifted by a pump attached to a windmill or by a small gasoline engine. Many homes are supplied with modern bath conveniences and running water from installed water tanks and a few have electric lights.

A systematic rotation of crops is generally followed on the majority of the farms. The land is planted to clover and oats one year, the oats being harvested in the summer and the clover pastured for the remainder of the season. The following year the clover is allowed to make hay, and afterwards the stubble or second growth is plowed under, to be followed the next year by corn.

Commercial fertilizer has not been employed in the growing of crops in Grundy County, but recent experiments on soils similar to these in other areas have shown that the supply of phosphorus is being drawn upon heavily and that the use of phosphate fertilizer on some of the older fields would probably prove profitable.

At the present time (1921) the labor is efficient and plentiful, except during the harvest season of small grain. Usually farm labor can be had for \$40 to \$50 a month with board. During the harvest season day laborers receive from \$2.50 to \$3 a day.

The farms range in size from 40 to 320 acres or more; the average size of farms in the county is about 163 acres. The 1920 census shows that 41.3 per cent of the farms are operated by owners, and 58 per cent are rented either for cash or part of the crop.

The rise and fall of the land values in Iowa within the last few years has made it almost impossible to obtain a conservative estimate of the rental of farms, either for cash or on share basis. Probably an average cash rental at the present time would be about \$8 an acre. The selling price of farm land is also difficult to determine. Prior to 1921, some land in Grundy County reached a price of \$600 an acre, and farms were frequently changing hands at \$375 to \$500 an acre. The average farm at present (1921) would probably have a value of \$275 to \$350 an acre.

SOILS.³

Grundy County, Iowa, lies in the prairie region of the United States, where the topography and a rather high moisture supply favor a heavy grass vegetation over the greater part of the area. It is not necessary to discuss here the agencies which brought about this prairie condition; it is sufficient to state that at the time of the first settlement by white men hardly an acre of forest had established itself upon the upland of the county. The soils therefore, without exception, have characteristics which indicate their development under prairie conditions.

³ Grundy County adjoins Black Hawk County on the east and Marshall County on the south. In places the soil maps of these areas do not agree along the boundaries. A part of the Tama silt loam as mapped in Black Hawk County is classed with the Carrington silt loam in Grundy County, as the loess over the drift is now considered too shallow to allow the soil to be placed with the Tama. The Carrington loam as mapped in Marshall County, occupies such a small area in Grundy County that it has been included with the Carrington silt loam.

The most striking characteristic of the surface soils of this region, and one common to soils developed under a grass vegetation with proper conditions of moisture, is the dark color. This color is imparted by finely divided carbonaceous material derived from the decay of grass roots and intimately mixed with the mineral constituents of the soil. The percentage of this organic matter and the depth to which it has affected the color and other physical properties of the soils is determined very largely by average drainage conditions. On the rolling uplands the organic matter extends to depths of 10 or 12 inches, but on the better drained or eroded slopes it may not extend to more than 8 inches in depth. On flats and sloughs, where imperfect drainage has favored its accumulation, the black organic matter extends to depths varying from 14 to 24 inches.

The soils of the area fall into two classes or groups, whose differentiation is based on the drainage conditions of soil or subsoil, or both, during their development.

The soils of one of these groups, of which the Carrington series is representative, were developed under conditions of good soil and subsoil drainage. The typical profile has a surface layer of dark-brown to black color and granular structure, ranging from 8 to 14 inches in thickness. This is underlain by a brown horizon, lighter in color than the surface, with a somewhat granular structure, ranging in thickness from a thin layer up to 12 inches. Below this horizon the subsoil is brown to yellowish brown and heavier in texture than the two upper layers. It is friable and coarsely granular in structure. This does not differ greatly from the fresh parent material into which it passes at depths of 3 to 5 feet. The carbonates have as a rule been removed to a depth of several feet. This group includes the various members of the Tama, Carrington, and Shelby series on the upland, and the Waukesha and O'Neill series on the higher terraces.

The soils of the group developed under conditions of poor drainage have a surface layer of black color and usually well-defined granular structure. This is generally underlain by a gray or a mottled gray, yellow, and brown subsoil heavier in texture than the surface. The details of the profiles of these soils vary considerably, depending upon the depth to which good drainage and oxidation have extended. In some cases both surface soil and subsoil have developed under a cover of water or at least a predominantly wet condition. Weathering under such conditions has produced the Clyde, Wabash, Fargo, and Lamoure series. The Clyde and Wabash soils have been leached of the greater part of their carbonates. The Fargo and Lamoure soils contain sufficient carbonates to effervesce when treated with acids. The Muscatine series has been developed on a flat or very gently rolling upland. The soil has been fairly well drained, but the deeper subsoil has been frequently wet, resulting in a slight mottling in the lower subsoil. This series may be regarded as being in an intermediate stage of development between the well-drained soils represented by the Carrington series and the poorly drained group represented by the Clyde series.

The principal characteristics mentioned above have been imparted to the soil by the great soil-forming processes, such as leaching, oxidation, and accumulation of organic matter, and no account has been taken of the characteristics due to the composition and the processes

of accumulation of the mineral matter from which the soils have been developed. In the following pages the differentiation into series has included a consideration of the source of the parent material.

About two-thirds of the area of the upland soils in Grundy County has been developed over loess. The loess consists of a very uniform mixture of silt and clay particles, the silt predominating, with a very small percentage of coarse material. Originally the loess contained more or less calcareous material, but this has in this area been largely removed by weathering and leaching. A characteristic of the loess is its columnar structure, which causes the banks of drainage channels to remain nearly perpendicular. The Tama silt loam of the well-drained group on the rolling upland and the Muscatine silt loam on the flatter areas have been developed over loess.

The glacial drift which underlies the loess consists of a heterogeneous mixture of clay, silt, sand, and gravel, with occasional boulders. The material of which the drift is composed has been transported by ice from long distances. Two drift sheets occur beneath the surface in this county; the lower and older is the Kansan drift, which is exposed to a very small extent; above it is the Iowan, upon which the greater part of the drift soils have been developed. The Iowan drift covers that part of the county north of the loess-covered area, and underlies the loess to some extent. The Carrington series is largely derived from this drift, and the Shelby gravelly sandy loam is derived from a gravelly variation of this material.

The alluvial soils, with respect to the characteristics brought about by age and topographic position, fall into two divisions: (1) Soils of the higher benches or terraces, and (2) soils of the first bottoms or flood plains. The terraces usually lie above the present limits of overflow; the first bottoms are subject to flooding in many places. Since practically all the streams of the county rise within its boundaries, they are small and carry no large quantities of sediments, so that no large bottoms have been formed. The alluvium consists of the same parent material as the surrounding upland soils, and since deposition in the flood plains it has undergone weathering under various conditions of drainage. The original material having been loess and finely divided drift, these soils range in texture from silt loams to silty clays. The Waukesha and O'Neill series on the higher terraces have developed profiles similar in their principal features to those of the well-drained soils of the upland. The Fargo and Lamoure series have developed on sedimentary materials under such conditions of restricted drainage that the lime has not been leached from the subsoil, and in places the surface soil is also highly calcareous.

The soil materials in the county have been modified by weathering either in place or after erosion and sedimentation, and have given rise to a number of types of soil. These soils are classed in soil series on the basis of color, origin, and structural characteristics, and the series are divided into soil types on the basis of texture. Ten series are represented by 11 soil types in the county, and some miscellaneous materials are mapped as Meadow.

The surface soils of the Tama series are dark brown to almost black; the subsoil is usually loose and friable in structure and yellowish brown to light brown in color. The topography is gently rolling to rolling. Neither soils nor subsoil of this series contain sufficient lime

carbonate to effervesce with hydrochloric acid. The Tama silt loam is the only type mapped in this county.

The types of the Carrington series are characterized by dark-brown surface soils and a yellow to light-brown subsoil. They are derived from glacial drift, but may be modified in some places by an admixture of loess. Two types, the Carrington silt loam and the Carrington fine sandy loam, are mapped.

The Muscatine series is characterized by dark-brown to almost black surface soils, and a yellowish-brown to grayish-brown upper subsoil. The lower part of the 3-foot section is mottled with gray, brown, and yellow, and iron concretions are abundant in many places. Neither soil nor subsoil contains enough lime carbonate to effervesce with acid. The topography is level to gently undulating. One type, the Muscatine silt loam, is mapped.

The Shelby series includes types with dark-brown soils underlain by a light-brown to yellowish-brown sandy or gravelly clay subsoil. Coarse sand, gravel, and small stones are found throughout the soil section. In this area the series occurs on slopes where sandy drift is exposed. One type, the Shelby gravelly sandy loam, occupies a small area.

The surface soils of the types correlated in the Clyde series are dark gray to black, and the subsoil is gray, usually mottled with yellow. These soils are derived from glacial till weathered under conditions of poor drainage. The topography is level to gently sloping, the areas occupying depressions or broad poorly drained old channels. The silty clay loam is the only type of this series mapped in the county.

The Fargo series has black surface soils, underlain by a yellow and gray mottled subsoil, which is heavier in texture as a rule than the surface soil, and is highly calcareous. These types are of alluvial origin and have been developed under conditions of restricted drainage. They differ from those of the Clyde series principally in their high lime content. The Fargo silty clay loam occurs in this area.

The types of the Waukesha series have dark-brown surface soils and a yellowish-brown friable subsoil which becomes heavier with depth. The series occupies level to gently undulating terraces and is well drained. It is represented here by the Waukesha silt loam.

The O'Neill series has dark-brown surface soils underlain by a brown upper subsoil which rests on stratified sand and gravel. These soils are well leached of their carbonates and will not effervesce with acid. They occupy high terraces along the upper streams. One type, the sandy loam, is mapped.

The surface soils of the Lamoure series are dark brown or black, and the subsoil is gray to grayish brown or mottled gray and brown. The series has been derived from material washed from upland soils high in lime, so that the types are highly calcareous in the subsoil. The Lamoure silty clay loam has been mapped in this area.

The types of the Wabash series have very dark brown or black surface soils over a heavy grayish-brown or gray and brown mottled subsoil. They differ from those of the Lamoure series in that they do not contain sufficient lime carbonate to effervesce with hydrochloric acid. The Wabash silt loam is the only type mapped in this area.



FIG. 1.—GRAVEL ROAD NEAR GRUNDY CENTER.
Typical farm house and buildings in the background.

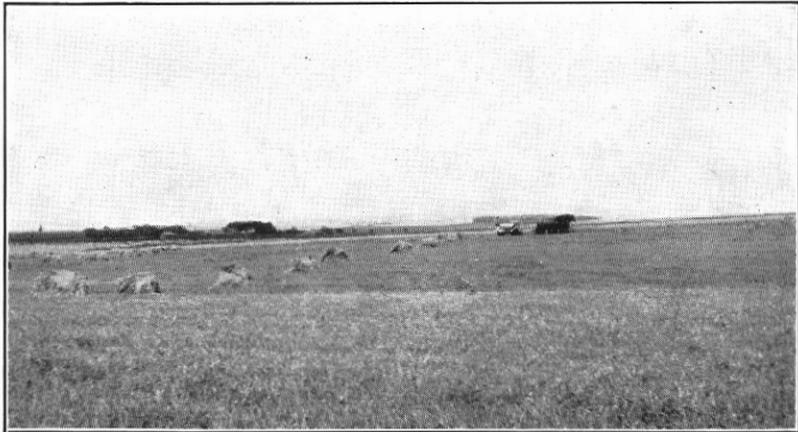


FIG. 2.—GENERAL VIEW OF THE TAMA SILT LOAM.
A field of oats in the foreground.



FIG. 1.—LEVEL TOPOGRAPHY OF THE MUSCATINE SILT LOAM.
Tama silt loam in the background.



FIG. 2.—A FIELD ON THE WAUKESHA SILT LOAM.
Note the gentle rise to the uplands in the background.

The soil types are described in detail and their relation to agriculture is brought out in the following pages of this report. Their distribution in the county is shown on the accompanying soil map. The actual and relative extent of the several types are given in the table below:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Tama silt loam.....	150, 016	46. 8	Fargo silty clay loam.....	3, 008	0. 9
Carrington silt loam.....	76, 160	23. 8	O'Neill sandy loam.....	1, 088	. 3
Wabash silt loam.....	38, 720	12. 1	Meadow.....	960	. 3
Waukesha silt loam.....	14, 528	4. 5	Carrington fine sandy loam.....	832	. 3
Lamoure silty clay loam.....	14, 272	4. 4	Shelby gravelly sandy loam.....	256	. 1
Muscatine silt loam.....	11, 264	3. 5			
Clyde silty clay loam.....	9, 536	3. 0	Total.....	320, 640	-----

TAMA SILT LOAM.

The surface soil of the Tama silt loam in its typical development consists of a dark-brown to almost black friable silt loam, 10 or 12 inches deep. This is underlain by a dark-brown to brown, heavy silt loam or clay loam, which passes at about 20 inches into a brown to yellowish-brown friable silty clay loam. The surface appears black when wet but on drying out assumes a dark-brown to dark grayish brown color. It is slightly plastic when moist but does not bake. In some places the soil below the plow line has a slightly reddish tinge, which continues downward to the yellowish lower subsoil. In many places a loose, mellow, dark-brown silt loam extends from the surface to a depth of 36 or 38 inches.

The silty deposit upon which the Tama silt loam in this area was developed ranges in thickness from 3 to 30 feet, but over much of the area it is about 5 feet thick. The type as mapped in this county is confined to those areas where there was no evidence of gravel or rock within the 3-foot soil profile. In fact the soil as a rule was not mapped as Tama unless devoid of all gritty or sandy material. There is one exception to this near the Black Hawk County line, where the sandy or gritty material is encountered in the lower part of the 3-foot section.

This type has the largest total area of any in the county and occupies extensive uniform bodies in all parts, with the exception of the northern parts, where the Carrington soils predominate. The surface is prevalingly level to gently rolling, but in a few places it is sharply rolling (Pl. XXXVI, fig. 2).

The drainage of both surface and subsoil is usually adequate, as the favorable topography, in most cases with moderate relief, and the desirable structure of soil and subsoil insure excellent moisture conditions and good aeration. The fineness of the grains of soil and the high organic content of this type afford a large feeding surface to the roots of plants and enable the soil to hold considerable moisture. The physical properties of the soil favor the downward percolation of water in most places, and the level parts may be easily drained artificially.

This is the most important soil type of the county, owing to its extent, its productiveness, and the ease with which it can be tilled. Practically the entire type is under cultivation. Corn, oats, and clover are the most important crops. Corn yields an average of 45 bushels per acre and in very favorable years 50 to 60 bushels, where fields are well managed. Corn on this type makes a more uniform growth and is less affected by variations in rainfall than on the other types of the area. This is probably due to the moisture-holding properties of this soil. The average yield of oats is about 50 bushels per acre, but often much larger yields are obtained. Red clover averages about $1\frac{3}{4}$ tons per acre, but sometimes the yields are larger. The clover usually occupies the land for two years. The type is well adapted to all the staple crops. The returns vary with seasonal conditions, tillage methods, and the previous management of this soil. Bluegrass grows luxuriantly and alfalfa has given profitable results where the land had been limed and the seed inoculated.

The land is usually broken in the fall and left rough until spring, when it is either disked or replowed and thoroughly prepared for the planting of crops. Barnyard manure is the fertilizer generally applied, but some acid phosphate has been used with profitable results.

With the exception of the Muscatine silt loam, this type represents a higher value of farm land than any other type in the county. At present (1921) the selling price of this type probably ranges from \$275 to \$350 an acre.

The prevailing methods of tillage and the crops planted appear to be well suited to the type. There are a few wet spots in the more level areas, most of them comparatively narrow, which would be improved if better drained by tiling.

CARRINGTON FINE SANDY LOAM.

The surface soil of the Carrington fine sandy loam is a dark-brown fine sandy loam with an average depth of about 10 inches. The subsoil is a brown to yellowish-brown rather heavy fine sandy loam, which quickly passes into a yellowish-brown fine sandy loam. The lower subsoil and the substratum below 36 inches usually contain some rather coarse sand to loamy sand. In many places the soil below 8 inches is a pale-yellow silt loam which is somewhat compact but becomes fairly friable when plowed.

The type occurs in small areas along the Butler County line, south of Wellsburg, near the Hardin County line west of Conrad, southeast of St. Peters Church, northeast of Bucks Grove, and near and southwest of Salem Church.

The drainage of both surface soil and subsoil is good, and in long periods of dry weather the more sandy areas are excessively drained. The topography is undulating to rolling. The Carrington fine sandy loam is not a very important soil agriculturally owing to its small extent, its total area being less than 1,000 acres. Practically all of it is under cultivation. Some of it is used to produce watermelons and early truck for local markets, which prove profitable crops under favorable seasonal conditions. The type is sometimes used for corn, oats, and other general crops. The yields are lower on this soil than on the Carrington silt loam, and the type has a lower selling value than the silt loam. Barnyard manure is about the only fertilizer used.

The planting of leguminous crops to be turned under as green manure, and the application of ground limestone and 200 pounds of acid phosphate per acre would probably be beneficial to this type.

CARRINGTON SILT LOAM.

The surface soil of the Carrington silt loam is a dark-brown silt loam which is nearly black when wet and has an average depth of 12 inches. The upper subsoil is a brown silt loam to silty clay loam which is somewhat plastic when wet but crumbles on drying. The lower subsoil is a yellowish-brown gravelly silty clay loam to a depth of 3 feet or more; in places it contains much coarse material, glacial pebbles, and boulders. In the northeastern part of the county and along the Black Hawk County line, boulders are very much in evidence.

The type is the second largest upland soil within the county. The largest continuous area is in the northern part in the townships of Fairfield, Beaver, Pleasant Valley, German, and Grant. Other areas of smaller size are located in all parts of the county.

The topography of the Carrington silt loam is generally somewhat more rolling than that of its associated upland type, the Tama silt loam. The surface varies from undulating to sharply rolling, but includes a few almost flat or level areas. The most sharply rolling land in the county is in German and Pleasant Valley Townships and is occupied mostly by this type of soil. Both surface drainage and underdrainage are good nearly everywhere, the level or poorly drained situations having been artificially drained.

The Carrington silt loam is an important type and all of it is in cultivation. Corn is the chief crop and generally produces good yields. Oats, clover, and timothy are the other leading crops. Bluegrass grows luxuriantly, and white clover and alsike clover have been grown with good results. Dairying and hog raising are carried on to some extent. The products of the dairy are usually sold to the local creameries. Hogs are fattened and shipped to market. Beef cattle are also raised and fattened for market on this type.

The yields of all crops are about the same as on the Tama silt loam where the type is well cultivated and a systematic rotation of crops is followed. The soil, however, is not quite as durable as the Tama silt loam, and in some localities it is in need of phosphorus. Mineral fertilizers have not been used to any great extent. On a few farms good results have been obtained with the application of phosphatic fertilizer. All available barnyard manure is used in conjunction with the growing of clover to maintain the soil fertility.

Although the type is recognized as having a somewhat lower agricultural value than the Tama silt loam, in farms with modern improvements it has an average land value about the same as the Tama silt loam.

The soil is generally productive, but crop yields may be increased by proper rotation. Manure is of great value and should be applied liberally each year. Where the soil is somewhat acid the application of ground limestone, in quantities shown to be necessary by tests of the soil, followed by the growing of some leguminous crop, to be turned under as green manure, and the use of a phosphatic fertilizer, would undoubtedly prove valuable in maintaining the soil fertility.

and increasing the yield of crops. The results obtained in other counties on this type of soil have proved that the use of phosphates is beneficial. The present method of cultivation seems well suited to this type.

MUSCATINE SILT LOAM.

The surface soil of the Muscatine silt loam consists of a very dark brown to almost black mellow silt loam, from 10 to 16 inches deep. This is underlain by a brownish-gray, drab, or slate-colored silty clay loam to silty clay, faintly mottled with brown, yellow, or gray. The lower subsoil to a depth of 36 inches is a compact brownish-gray or drab silty clay mottled with brown or gray. Some slightly elevated areas which resemble the Tama silt loam but were too small to map separately are included with the type. Usually the surface soil of these elevated areas is much darker in color than the typical Tama soil and the subsoil is somewhat heavier in texture.

The type is developed in the southwestern part of the county, between Grundy Center and Conrad, in the vicinity of Alice Church, west of Conrad for about 4 miles, near Whitten on the Hardin County line, and south of Pine Creek School.

The type occupies situations which were formerly shallow lake beds. The old inhabitants speak of this as "frog pond" land. The topography is level to flat, with occasional slight depressions (Pl. XXXVII, fig. 1). Many similar depressions include areas of the Fargo silty clay loam and were mapped separately. The type in its natural state, owing to its level topography, was originally poorly drained, but practically the entire acreage has been improved by tiling and a thorough drainage system.

The Muscatine silt loam is one of the most important types of the area, and is considered the most fertile soil. It is highly prized by the owners for its ability to withstand continual cropping without material reduction in yields. It comprises a total area of about 18 square miles, and all of it is in cultivation or used for pasture.

Heavy yields of all crops are obtained in favorable seasons under proper management. Many areas will yield around 80 bushels of corn per acre, and other crops, such as oats, timothy, and clover, give yields in proportion. Probably the average yield of corn for this type, taken year after year, would be from 50 to 60 bushels. Excellent pasturage is afforded and many cattle and hogs are raised.

This soil requires somewhat heavier draft than the Tama and other upland soils. Many tractors are used for plowing. In general the soil is handled about the same as the Tama silt loam. No fertilizer is used other than the available barnyard manure. A few areas might be improved by turning under leguminous crops, applying lime, and establishing somewhat better drainage.

This type of soil has the highest selling value of any land within the area. It sold for over \$500 an acre during the period of high prices. At present (1921) the type is held for \$275 to \$300 an acre.

SHELBY GRAVELLY SANDY LOAM.

The Shelby gravelly sandy loam in Grundy County is a brown gravelly sandy loam to an average depth of 10 inches, passing into a yellow to reddish-brown gravelly sandy clay or sticky gravelly sandy

loam. In many places the surface soil and subsoil contain a large proportion of coarse sand. Where the sand is of a finer texture the surface has a dark-brown color.

The Shelby gravelly sandy loam occurs in the southwestern part of Lincoln Township, mainly in the region of "pahas," on slopes where the sandy drift is exposed. The topography is sharply rolling, and the drainage of both surface soil and subsoil is good. In long periods of dry weather crops suffer from drought, owing to the open structure of the soil.

This type is unimportant because of its very small extent and its droughty character. The same crops are grown as on the Tama and Carrington soils. The yields obtained are usually less than on the other upland soils. Heavy applications of barnyard manure are turned under to produce crops. The type is valued for road-building material as much as for crop production. In addition to the liberal use of manure the turning under of green-manure crops, the application of lime where needed, and the use of a phosphatic fertilizer would probably aid in obtaining better yields.

CLYDE SILTY CLAY LOAM.

The Clyde silty clay loam surface soil consists of a black heavy silt loam or silty clay loam to a depth of 5 or 6 inches, which when dry assumes a loose and mellow structure, owing to the high content of organic matter. Beneath this is a subsurface layer of black rather heavy silt loam to silty clay loam extending to a depth of 10 or 12 inches. The upper subsoil consists of black silty clay loam to heavy silty clay, which is rather sticky when wet, but breaks into a granular structure when dry. This passes into dark-gray and then into gray silty clay loam, which in turn is underlain by a gray to light-gray silty clay, mottled with yellow and brown. Pebbles and gritty material occur in the lower subsoil, and in many areas there are numerous bowlders upon the surface and embedded in the subsoil.

The Clyde silty clay loam as mapped includes many small areas in which drainage is not as well established as elsewhere. In these areas the surface soil is a black silty clay loam to a depth of 8 or 10 inches, underlain by a gray to light-gray heavy silty clay to clay, mottled with gray and yellow and in places with reddish brown or red. Many of these are almost covered with bowlders and are used mainly for pasture. Another variation of the type consists of small areas in which there are no bowlders and the drift or till is encountered only in the lowest part of the 3-foot section.

The Clyde silty clay loam is developed in practically all parts of the county. The largest areas are in the northern part of German Township, and near Stout in Beaver Township, east and northwest of Dike, near the Black Hawk County line north of Zaneta, and northeast of Lincoln Center. It occurs along small draws extending for some distance up the slopes and into the uplands, where it spreads out into fan-shaped areas of considerable size.

The topography is flat or level on the more extensive areas, and in smaller areas it is depressed. The level areas, however, appear to have a fringe of somewhat higher land. The natural drainage is inadequate, because of the restricted drainage of the surface and the

rather impervious nature of the subsoil. Much of this type, especially in the larger areas, has been artificially drained by tiling. Many areas, however, still need artificial drainage to produce maximum yields of crops.

The Clyde silty clay loam is a naturally fertile and productive soil. Most of it is cultivated; the rest is used for pasture. Corn is the most important crop, and in favorable seasons produces excellent yields. Red clover is probably next in importance. Soybeans and rape are sometimes grown. White clover and bluegrass usually constitute the vegetation where the type is used mainly or entirely for pasture.

The use of phosphatic fertilizers and barnyard manure on the more recently drained areas would probably prove beneficial. The soil is generally acid, and lime should be used in conjunction with the growing of legumes.

FARGO SILTY CLAY LOAM.

The surface soil of the Fargo silty clay loam consists of a black silty clay loam, high in organic matter, underlain by a black silty clay extending to a depth of 14 to 18 inches. The subsoil is a yellow and gray or drab mottled silty clay which is highly calcareous. It is rather heavy and tenacious when moist, but on drying assumes a granular structure, owing to its high lime content. In some places the surface has a whitish coating; such places are known locally as "alkali spots." The soil in these spots effervesces freely with hydrochloric acid and becomes loose and ashy on drying.

The type occupies slightly depressed areas or situations somewhat lower than the Muscatine silt loam, which surrounds it in many places. The soil has been formed by the reworking of loessial material and subsequent weathering and conditions of poor drainage. The largest area lies just north of Stout. Other areas are located west of Colfax Center Church, northwest of Dike, northeast of Fern, and east and south of Pine Creek School.

The topography is usually flat or level with a very slight slope to the center. The soil is naturally poorly drained, but in most places artificial drainage has been established, which insures good drainage and aeration of both soil and subsoil.

Owing to its high content of organic matter and adequate supply of lime, the Fargo silty clay loam is very productive, and all of it is cultivated. Corn is the principal crop and under normal seasonal conditions produces excellent yields. Oats are sometimes raised, but on the "alkali spots" the oat crop has a tendency to lodge. The so-called alkali condition has been improved by thorough drainage and by growing and plowing under sweet clover, red clover, and alsike clover. Heavy applications of barnyard manure have also proved beneficial, especially where the manure contained a large proportion of straw.

The price of land of this type ranges about the same as that of Muscatine silt loam, but depends largely on improvements and the artificial drainage which has been established.

No mineral fertilizers have been applied, but probably the use of acid phosphate would prove beneficial, especially in connection with the growing of clovers.

WAUKESHA SILT LOAM.

The surface soil of the Waukesha silt loam in its typical development is a dark grayish brown silt loam with an average depth of about 12 inches. The subsoil is composed of brown to light-brown silty clay loam. Where the type has an unusual accumulation of organic matter the immediate surface layer is a black silt loam, the subsurface layer is usually a much darker brown than that encountered in the typical soil, and the subsoil is brown in color.

At the outer edges of the terraces bordering the stream bottoms, small spots of gravelly material which were not large enough to map separately are included with the Waukesha silt loam. Areas of this material of sufficient size to justify separation are mapped as O'Neill sandy loam. There are also included with the Waukesha silt loam some patches in which the lower subsoil is composed of a gritty sandy loam.

The largest areas of this type are in the vicinity of Dike, Reinbeck, and Morrison, and where Beaver Creek leaves the county. Other areas are mapped along Hammers Creek, Beaver Creek, and Blackhawk Creek and its tributaries.

The type occupies terraces or second bottoms well above overflow. The topography is nearly level or gently undulating (Pl. XXXVII, fig. 2). Both soil and subsoil have good drainage and aeration. A few areas are in basinlike situations which were formerly shallow lakes. The less well-drained situations have all been improved by tiling.

The Waukesha silt loam is all in cultivation. The friability of the surface soil, the favorable topography, and the rather high fertility make this type very desirable for general farming. Corn and oats are the main crops. Bluegrass, white clover, timothy, red clover, and alsike have given good results. The pastures afford excellent grazing for cattle. The feeding of beef cattle and hogs for shipment to the market is extensively engaged in, and dairying is also important. The yields upon this type are probably about the same as on the Tama silt loam.

The methods employed by the farmers in handling this soil appear to be well adapted to local conditions. No mineral fertilizers are used, but a liberal supply of barnyard manure is applied yearly. As on other types of the area, the yields might be increased, especially of the leguminous crops, by the application of ground limestone at the rate of 2 tons per acre, and by the use of phosphatic fertilizers.

Land of this type has about the same selling value as the Tama silt loam, depending upon local improvements and accessibility to towns.

O'NEILL SANDY LOAM.

The O'Neill sandy loam is a dark-brown sandy loam to an average depth of about 8 inches, passing into a dark-brown heavy sandy loam, which is underlain at about 18 inches by a yellowish-brown sandy loam. In places the substratum contains coarse sand or gravel.

The type as mapped near Dike consists of a dark-brown to black silt loam surface soil of 8 to 10 inches, underlain by 10 or 12 inches of brown silt loam or brown to light-brown silty clay loam, which in turn is underlain by a gravelly fine sandy loam to gravelly loam.

The O'Neill sandy loam occupies high terraces and occurs as broken strips along the east side of Beaver Creek, west and south of Dike,

south of Zaneta, northwest of Morrison, near Lincoln Center, northwest of Wellsburg, and south of Beaman. The topography is generally level, but in places the type lies somewhat above the associated terrace soils. The drainage of both soil and subsoil is good to excessive, and during periods of continued dry weather crops suffer from drought.

The type is not very important agriculturally, owing to its small extent and the fact that yields of all crops are lower than those obtained on other soils of the area. It is considered valuable for supplying gravel and sand for road building. All of it is either in cultivation or in pasture. Corn and clover are the chief crops, while crops of minor importance include oats, rye, and soybeans. The type is well suited to melons and other truck crops requiring a warm early soil.

The present method of handling this type appears to be well adapted to existing conditions. Probably the soil would be greatly improved by treating it with heavy applications of lime, then raising leguminous crops and turning them under as green manure.

The present valuation of this type depends largely on the supply of road-building material obtainable from the gravel and sand deposits of the lower subsoil. With the increased improvements of the public highways, the material obtained from this type will be in demand for surfacing the roads.

LAMOURE SILTY CLAY LOAM.

The surface soil of the Lamoure silty clay loam in its typical development has an average depth of about 12 inches and consists of a dark-brown to black, heavy, friable silt loam or silty clay loam, rich in organic matter. This is underlain by a dark-drab or black silty clay extending to a depth of 36 inches. In places the lower part of the 3-foot section contains faint mottlings of drab or gray and yellowish brown. The entire soil section is highly calcareous.

In the more poorly drained areas the subsoil is rather plastic, the mottlings are more in evidence, and the surface soil often is a rather heavy silty clay loam. When these heavier areas are brought under cultivation, after being properly drained to improve aeration and increase the capillary movement of soil, the surface soil becomes more mellow. In some of the better drained situations the type consists of a heavy silt loam to a depth of nearly 3 feet, the color is usually black from the surface down, and both soil and subsoil appear to have a higher content of lime than elsewhere.

The Lamoure silty clay loam is rather widely distributed over the county. It occurs on the first bottoms and is subject to overflow during excessive rainfall. Its largest developments are north of Colfax Center Church, north of Morrison, southwest of Lincoln Center, east and northeast of Fern, and between Fredsville and Stout. The material forming the type consists largely of alluvium of streams that drain calcareous soils.

The topography in general is nearly level with a slight slope toward the streams. There are some slight depressions, or basinlike poorly drained areas. The greater part of the type has been artificially drained. The natural drainage of unimproved areas is poor, both the surface drainage and underdrainage being inadequate.

The Lamoure silty clay loam is an important type in the county and practically all of it is under cultivation, only the poorly drained areas being left in pasture or in native hay meadows. It is recognized as a fertile soil, and the undrained areas are being artificially drained and rapidly put into cultivation. The most important crops are corn, red clover, and oats. Alfalfa, sweet clover, timothy, and bluegrass are sometimes grown. The average yields of all crops are usually somewhat better on this type than on the Wabash silt loam. Alfalfa has been grown only to a small extent, but does well where the natural drainage is favorable or where a thorough system of tile drainage has been established. The use of phosphatic fertilizers would probably prove beneficial in growing legumes.

WABASH SILT LOAM.

The surface soil of the Wabash silt loam consists of about 13 inches of dark-brown to black, friable, mellow silt loam, with a high content of organic matter. The organic matter usually imparts a dark color to a depth of 20 inches or more. The subsoil is a black silty clay, which is rather stiff and sticky when wet but has a granular structure under ordinary moisture conditions.

In some areas the subsoil is a dark-drab to gray heavy silty clay loam and the extreme lower part of the 3-foot section may be a somewhat sandy material of yellowish-brown color with faint mottlings. In a few included spots the surface soil consists of a black silt loam to an average depth of about 12 inches, overlying a grayish sand to very fine sandy loam. Along some of the larger stream bottoms the type supports a scattered timber growth. On the Black Hawk County line near Hicks the type is somewhat less well drained in places and the soil is a rather heavy silt loam to silty clay loam.

The Wabash silt loam occurs on the first bottoms of streams and constitutes the largest bottom-land soil within the area. The alluvial material has been derived principally from the loessial and silty glacial soils of this region. Usually both soil and subsoil have a low lime content. The type has its largest development where the Blackhawk Creek leaves the county northeast of Reinbeck. It also occupies the bottoms of Blackhawk, Beaver, Middle Fork Beaver, and North Fork Blackhawk Creeks.

The topography is usually flat, with a little slope toward the stream channel. There are a few slightly depressed situations which are poorly drained. The type is subject to overflow during exceptionally heavy rainfall, but natural drainage is fairly well established, and the less well drained areas are adequately drained artificially.

The Wabash silt loam is a very durable and productive soil. A large part of it is used for pasture. Bluegrass and white clover grow luxuriantly and form most of the pasturage; somewhat coarser grasses occupy the low spots. The pastures are used for grazing hogs, beef cattle, and dairy cows.

Where the type is cultivated, the most important crop raised is corn, while oats are raised to a small extent. In favorable seasons corn will yield from 40 to 60 bushels per acre.

MEADOW.

Meadow comprises alluvial soils which are so variable in texture, structure, and local drainage conditions that it is impossible to

separate them into distinct soil types. It includes soils ranging from sands to clays. The sands often occur in small patches varying in depth from 10 inches to 2 feet or more.

Meadow occupies narrow strips of overflow land northeast of Reinbeck on Blackhawk Creek and along North Fork Blackhawk Creek, and a narrow strip about 5 miles long on Beaver Creek. Most of it is forested with a scattering growth of hickory, ash, oak, maple, and some elm.

Meadow is productive soil and in some places where it is cultivated good crop yields are obtained. Most of it, however, is used for pasture. Bluegrass and white clover seem to thrive well and afford excellent grazing. Beef cattle are generally grazed during the summer months, and later are fattened on corn and shipped to market. Hogs do well in these pastures, as they find considerable mast in the wooded areas.

SUMMARY.

Grundy County is situated a little northeast of the center of the State. It has an area of 501 square miles, or 320,640 acres.

The surface consists of gently rolling prairie interspersed with broad level areas and prominent knolls known as "pahas." Drainage, both natural and artificial, is well established.

The county is well supplied with transportation facilities, with four lines of railroad so distributed that every farm is within easy reach of a station.

The public roads are well made and are in good condition at all times.

Good schools are conveniently located throughout the county, and excellent high schools are maintained in the larger towns.

Grundy Center is the county seat and Reinbeck is an important transportation center.

Blackhawk Creek is the largest stream in the area and, with its tributaries, drains the greater part of the county.

The climate is well suited to the production of corn and other feed crops.

The leading crops of Grundy County are corn, oats, clover, and timothy. The raising of hogs constitutes the largest single source of revenue on most farms. Dairying, the fattening of cattle, and the raising of draft horses are other important industries.

There are 1,725 farms with an average size of 163 acres. The average size of farms has increased, and the proportion of farms operated by tenants is greater than formerly. Modern labor-saving machinery is in use on all farms.

The average selling price of land is about \$275 an acre, but many individual farms have a higher value.

The soils of the county are formed from the glacial and loessial deposits. They are mainly dark-colored silt loams, with some silty clay loams and sandy loams. Most of the soils are maintained in a productive state by the use of rotations that include red clover, and by yearly applications of barnyard manure.

There are 12 different types of soil mapped in the county, the majority of them being high in organic matter.

The Tama silt loam is the predominating type of the area. It has a high agricultural value and produces excellent yields of all crops.

The Carrington silt loam is the next largest type and predominates in the northern part of the county. It is very fertile and produces good yields of crops. The Carrington fine sandy loam is a lighter textured soil, which produces lower average yields than the silt loam.

The Clyde silty clay loam occurs on the uplands at the heads of drainage ways and along small draws. It has a high content of organic matter and a heavy-textured subsoil. Much of it is reclaimed by artificial drainage and is very productive.

The Shelby gravelly sandy loam is of very small extent and occupies the crest of knolls. It contains an abundance of good road-building material.

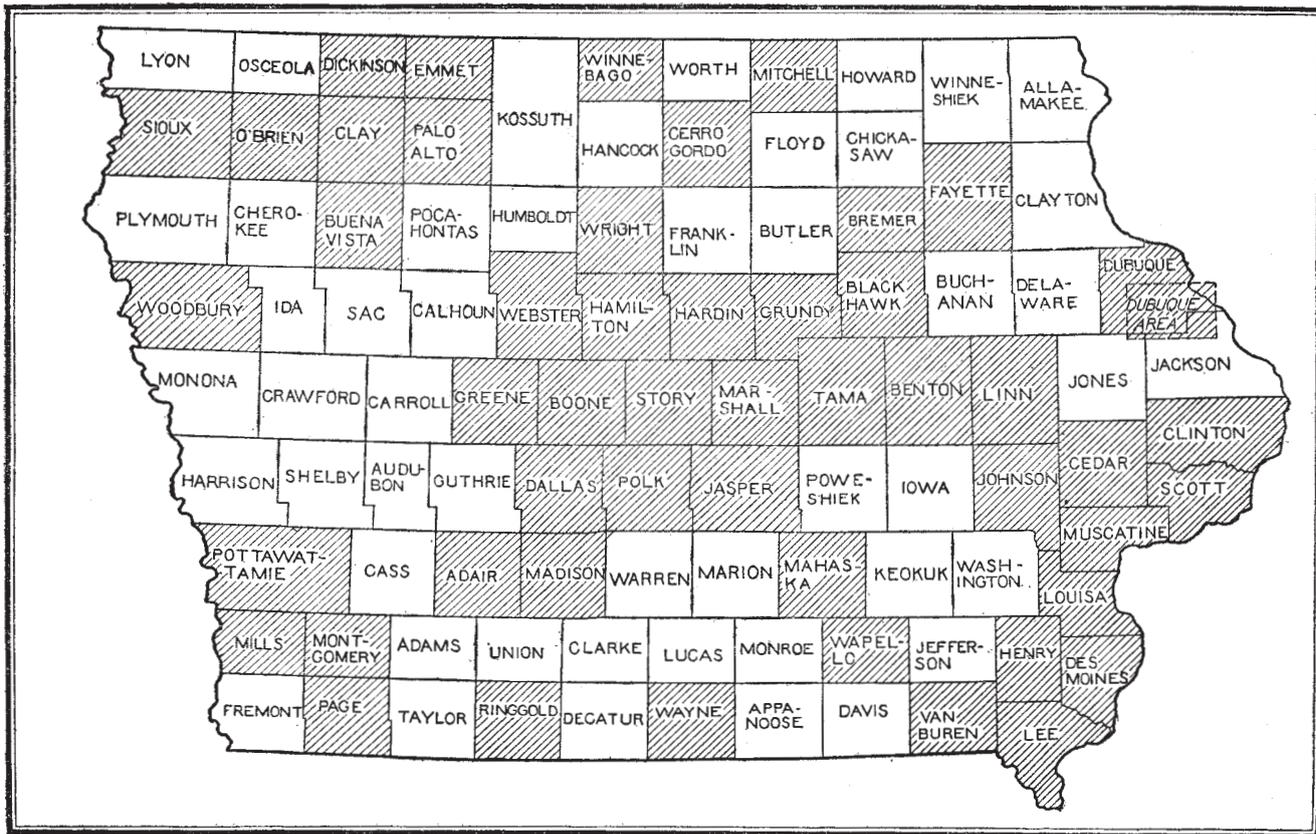
The Muscatine silt loam occupies broad, nearly level areas. It is naturally the most productive soil in the area.

Slightly depressed situations in the Muscatine silt loam are occupied by the Fargo silty clay loam, which has a high lime content and is also very productive.

The Waukesha silt loam is a very valuable and productive soil of the terraces or second bottoms. The O'Neil sandy loam is a terrace soil of small extent and droughty nature.

The Wabash silt loam is the most extensive bottom-land soil and is very fertile. The Lamoure silty clay loam is a less extensive bottom-land type and has a high lime content. Meadow includes bottom lands composed of soils of variable character, both in texture and in color.





Soils surveyed in Iowa, shown by shading.

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