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

SOIL SURVEY OF DALLAS COUNTY, IOWA.

BY

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[Advance Sheets—Field Operations of the Bureau of Soils, 1920.]

WASHINGTON:
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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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SOIL SURVEY OF DALLAS COUNTY, IOWA.

By CLARENCE LOUNSBURY, of the U. S. Department of Agriculture, in Charge, and P. E. NORDAKER, of the Iowa Agricultural Experiment Station.

DESCRIPTION OF THE AREA.

Dallas County, Iowa, is situated slightly southwest of the center of the State. It lies in the fourth tier of counties from the Missouri State line and in the fifth tier east from the Missouri River. The county is nearly square, having a breadth of about 24 miles and a length from north to south of nearly 25 miles. A correction line causes a slight increase in the length of the southern tier of townships. The county has an area of 589 square miles, or 376,960 acres.

Dallas County lies on the eastern slope of the divide separating the drainage of the Missouri River from that of the Des Moines River. The crest of this divide passes through Adair County, which touches this county at the southwest corner. The surface has a general incline toward the southeast over a drift-covered plain.

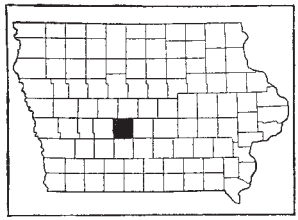

FIG. 34.—Sketch map showing the location of the Dallas County area, Iowa.

The county has two topographic divisions; one is the glaciated area, covering approximately the northern three-fourths of the county, and the other is the silty loess-covered southern part, occupying the remaining one-fourth of the county. The division line follows in general the southern slopes of the Raccoon and South and Middle Raccoon Rivers.

The northern area has a surface of physiographic immaturity consisting of broad areas of a flat or very gently rolling plain. This type of surface is especially developed in Washington, Lincoln, and Dallas Townships, where there is a succession of low ridges and domelike swells interspersed with irregularly elongated and saucer-like depressions, most of the latter originally containing small lakes and ponds. This plain is broken through the middle of the county by the valley of the North Raccoon River, on both sides of which are strips of land about one-fourth mile wide that are rough and broken. Farther northeast is the broad shallow valley of Beaver Creek. The northern slope of this creek is gradual and well matured, but to the south the rise is a little more abrupt and the brow is varied by a series of low morainic hills. Across the extreme northeastern part the slopes to the Des Moines River are abrupt, and much of the slope land, especially on the western side, about a mile in width, is deeply cut with ravines.

The loess-covered southern part of the county, including the course of the Raccoon River and the lower parts of its principal branches,

presents a much rougher and more diversified appearance. Here broad valleys have developed and numerous lateral ravines have been carved in the soft superficial deposits. The ravines are generally V-shaped and have extended back well into the upland. The ridge tops are flat and for the most part narrow. The slopes of the valley of the Raccoon River are rugged and abrupt along the southern side, but usually more gentle and gradual along the northern side.

The alluvial lands in the county are extensive; they include old terraces, lying above ordinary flood levels, and the first bottoms or present flood plains, subject to more or less frequent overflow. The terraces are developed in irregular areas along all of the larger streams and vary in width from a few rods to a mile or more. These terraces have a flat and benchlike surface, but some of the older and higher lying areas, such as those in the vicinity of Granger, have become slightly undulating from erosion of the surface and dissection by streams issuing from the uplands. Most of these formations lie from 5 to 20 feet above the flood plains, but in a few places they grade imperceptibly into lower bottoms. The first bottoms are developed along nearly all the streams of the county. These bottoms are nearly level, but varied somewhat in places by slight unevenness caused by shifting channels.

The general elevation of the county is between 1,000 and 1,100 feet above sea level.[1] There is a range from about 840 feet on the flood plains of the Des Moines and Raccoon Rivers to 1,144 feet at Dexter, the highest recorded elevation in the county. At Granger in the eastern part the elevation is about 900 feet, at Woodward in the northern part 1,069 feet, at Perry 969 feet, Dawson 1,044 feet, Waukee 1,032 feet, Dallas Center 1,073 feet, and Minburn 1,051 feet. Adel, on a terrace of the North Raccoon River, is 885 feet above sea level.

Nearly seven-eighths of the county is drained by the Raccoon River and its tributaries. The Raccoon and South Raccoon Rivers are confined largely to the southern tier of townships. Here the river valley largely follows a preglacial valley[2] and includes alluvial bottoms in places 1½ miles wide. The channel is generally nearer the south escarpment. The tributaries from the south are short and unimportant. The principal tributary is the North Raccoon River, which enters the county near the northwestern corner, flows eastward for 5 or 6 miles, then continues southeast through the middle of the county to its confluence with the main channel near Van Meter. It has a comparatively narrow alluvial plain, though between Perry and Dawson it is nearly a mile wide. West of the North Raccoon River the flat country is drained by the northward-flowing Fannys Branch, and by Mosquito and Panther Creeks, which flow southward into the Middle Raccoon and the South Raccoon Rivers, respectively. South of Dexter a small part of the extreme southwestern corner is drained by the North Branch of the North River.

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[1] Elevations from United States Geological Survey and railroad profiles.
[2] Report Iowa Geol. Survey, 1897, Vol. III.

The Raccoon River, from the eastern boundary to the forks, has, according to railway engineers, an average fall of 2 feet 11 inches per mile. The North Raccoon River is more swift, and from Jefferson (Greene County) there is an average fall of 4 feet per mile. The South Raccoon River has a fall of 6 to 8 feet in each mile. The Middle Raccoon River also has a rapid current. Some water power has been utilized, and at present a mill at Redfield and an electric-power plant at Adel are run by water.

The middle-eastern part is drained by Walnut Creek, which occupies a broad, saglike valley and flows southeasterly into Polk County, where it joins the Raccoon River.

The northeastern part of the county is drained by the Des Moines River and Beaver Creek. The larger part of this section is drained by Beaver Creek, which flows southeast and occupies a broad, shallow, preglacial valley, with an alluvial plain in the lower part about a mile wide. The principal tributaries are Slough Creek and Little Beaver Creek. The Des Moines River, which flows across the northeastern corner, occupies a rather gorgelike valley with a narrow flood plain.

Drainage is more thoroughly established in the southern part of the county and in the vicinity of the larger streams. In a large part of Washington, Lincoln, and Dallas Townships in the western part, and Sugar Grove, northeastern Adel, and southern Beaver Townships in the east-central part, the nearly level surface does not afford sufficient relief for ready drainage. Most of these areas were originally in a marshy condition and occupied by sluggish sloughs, small ponds, and shallow lakes. With the construction of drainage ditches and the installation of tile in recent years, most of these areas have been reclaimed for profitable agriculture.

Springs are numerous in many parts of the county, and well water is ordinarily obtained on the uplands at depths of 12 to 20 feet.

The land comprising Dallas County was originally included in the Sac and Fox Indian Reservation. After this territory was relinquished by the Indians by treaty, in 1845, the land was opened for settlement. The first settlers arrived in the fall of 1845 and located in Van Meter Township. Others came the following year, and a considerable influx took place in 1847 and 1848. The county was established February 16, 1847, and named in honor of George M. Dallas, then Vice President of the United States. The county seat was first called Penoach and later Adel.

The first settlers were largely native-born Americans from Illinois, Indiana, Ohio, and other eastern States. More recent arrivals were from northern Europe, mostly Germans and Scandinavians. The rural population is fairly well distributed over the county. In 1920 the county had a population of 25,120, of which 77.5 per cent is classed as rural. Of the rural population there is an average of 33.1 to the square mile.

Perry, with a population of 5,642, is located in the northern part of the county. Adel, the county seat, located in the south-central part, has a population of 1,455; Dallas Center has 884; Woodward, 868; Redfield, 770; and Dexter, 730. Of the smaller towns the more important are Bouton, Dawson, DeSoto, Granger, Linden, Minburn, Van Meter, and Waukee. All these and a few smaller places are

shipping points for grain and livestock. Bricks and drain tile are manufactured at Van Meter, DeSoto, Redfield, and Scandia, and a special type of building tile is made at Adel.

Coal has been mined in various places in the northern part of the county, especially in the northeastern part. One mine near Waukee has been opened up recently.

The county is well supplied with railroads. The line of the Chicago, Rock Island & Pacific Railway between Chicago and Omaha crosses the southern part. The main line of the Chicago, Milwaukee & St. Paul Railway crosses the northern part, and a branch line crosses the south-central part. The Minneapolis & St. Louis Railroad crosses the county in a northwest-southeast direction. All these roads, except the main line of the Chicago, Milwaukee & St. Paul, enter Des Moines. An interurban electric line, which hauls both passengers and freight, connects Perry and Woodward with Des Moines.

The principal wagon roads are kept graded and dragged in good condition. Most of the roads are of earth construction, but part of the route between Perry and the eastern county line is graveled. Roads generally follow section or other land lines, except along the rivers and in some of the rougher regions. Rural telephone and mail delivery service is well established in all parts of the county. Electric-power transmission lines in places furnish current for light and power.

The various towns of the county provide ready markets for various minor farm products, while livestock and grain are shipped to Des Moines, Chicago, Omaha, and other points. From Adel the distance to Des Moines is 22.1 miles, and to Chicago 379.1 miles. From Van Meter to Omaha the distance is 126.5 miles.

CLIMATE.

The climate of Dallas County is marked by wide extremes in temperature, but so well moderated in the various seasons that the region is ideally suited for the growing of the various grain and forage crops of the Corn Belt. The winters are rather cold and the summers are hot, with intermediate seasons well suited for planting and harvesting crops. Extreme temperatures, as recorded by the Weather Bureau station at Waukee, range from 112° F. in August to —36° F. in January. The mean annual temperature is 48.5° F. Winters with variable temperatures and a light snow covering sometimes cause more or less damage to winter grains, and fruits are sometimes injured by unfavorable spring temperatures. Hot winds in the summer occasionally lower crop yields, especially on the more droughty soils, but these losses are not common.

The annual rainfall averages 32.7 inches, a large proportion of which falls during the growing season. The heaviest precipitation occurs during May, June, July, and August, and is nearly 53 per cent of the total. The driest periods occur in late fall and winter, and are especially favorable for gathering corn and other late crops. The wettest year on record (1919) had a rainfall of 43.38 inches, and the driest (1910), 17.65 inches. Droughts are rare and they never cause a total crop failure. Windstorms and hail in occasional years have caused some damage, but tornadoes are rare.

There is usually a snowfall of 24 to 30 inches, which generally remains on the ground most of the winter.

The average date of the last killing frost in the spring is April 28, and of the earliest in the fall, October 7. Killing frosts are recorded as late as May 20 and as early in the fall as September 20. The average growing season is about 162 days, which gives ample time for maturing the various farm crops.

The first of the accompanying tables gives the normal monthly, seasonal, and annual temperature and precipitation as recorded at the Weather Bureau station at Waukee, and the second table gives similar data recorded at the station at Perry:

Normal monthly, seasonal, and annual temperature and precipitation at Waukee.

[Elevation, 1,039 feet.]

Month	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1919).
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	25.0	59	−26	1.21	0.27	0.95
January	19.2	60	−36	1.36	1.42	.10
February	21.8	65	−23	1.13	.34	3.11
Winter	22.0	65	−36	3.70	2.03	4.16
March	34.3	86	−15	1.53	.37	3.21
April	49.6	92	17	2.72	1.31	6.31
May	61.1	93	25	4.78	3.08	2.41
Spring	48.3	93	−15	9.03	4.76	11.93
June	70.0	100	38	3.94	1.46	6.04
July	75.0	106	43	4.59	.81	2.82
August	72.8	112	38	3.98	2.78	4.38
Summer	72.6	112	38	12.51	5.05	13.24
September	64.4	100	25	3.42	4.37	7.77
October	52.2	88	12	2.49	.89	2.29
November	36.3	77	0	1.55	.55	3.99
Fall	51.0	100	0	7.46	5.81	14.05
Year	48.5	112	−36	32.70	17.65	43.38

Normal monthly, seasonal, and annual temperature and precipitation at Perry.

[Elevation, 975 feet.]

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1919).
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	24.8	62	−34	1.19	0.95	2.42
January	18.7	57	−27	1.13	T.	2.23
February	21.3	62	−22	1.38	1.20	4.72
Winter	21.6	62	−34	3.70	2.15	9.37

Normal monthly, seasonal, and annual temperature, etc.—Continued.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910)	Total amount for the wettest year (1919)
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
March	34.0	85	−14	1.98	1.60	5.00
April	49.6	93	18	2.75	1.45	4.47
May	61.4	95	25	5.05	.90	5.99
Spring	48.3	95	−14	9.78	3.95	15.46
June	69.8	101	38	4.59	2.63	9.92
July	75.0	109	45	4.05	1.10	5.38
August	72.4	107	37	4.64	1.49	.31
Summer	72.4	109	37	13.28	5.22	15.61
September	63.8	103	24	3.14	4.45	5.03
October	51.3	87	13	2.74	2.55	2.66
November	35.5	78	−2	1.62	1.00	5.35
Fall	50.2	103	−2	7.50	8.00	13.04
Year	48.1	109	−34	34.26	19.32	53.48

AGRICULTURE.

From the time of the earliest settlements in 1845, general farming, consisting of the production of grain and livestock, has been the leading industry. For a number of years the early settlers were engaged mainly in providing subsistence, and their homes were largely self-sustaining.

Settlements were first located in forested regions, as the soil there was well drained and the impression prevailed that this land was more suitable for farming than the prairie land. The forest also provided shelter from winds and afforded protection from prairie fires.

Corn always has been the leading grain crop, followed by oats, wheat, barley, and rye. Wheat has been relatively less important since 1880 than before that time, owing to the ravages of insect pests, unfavorable seasons, and to greater interest in other lines of farming, especially the livestock industry. The agriculture at present consists of a combination of grain and livestock farming.

The following table shows the acreage and production of the principal cereal crops, as reported by the last five censuses:

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

Year.	Corn.		Oats.		Wheat.		Rye.		Barley.	
	Area.	Production.	Area.	Production.	Area.	Production.	Area.	Production.	Area.	Production.
	Acres.	*Bushels.*	*Acres.*	*Bushels.*	*Acres.*	*Bushels.*	*Acres.*	*Bushels.*	*Acres.*	*Bushels.*
1879	105,381	4,392,195	14,576	519,379	22,695	219,388	735	12,325	137	2,373
1889	100,883	4,880,042	40,578	1,877,324	1,581	21,259	866	15,260	175	5,121
1899	125,581	5,540,860	47,320	1,897,450	10,013	142,630	376	6,780	809	23,780
1909	121,014	4,494,432	50,251	1,542,576	3,117	49,953	341	4,389	1,593	26,216
1919	117,088	5,216,666	59,606	2,151,439	29,516	568,907	524	8,266	1,809	20,905

These records show no wide differences in average yields for the leading crops. It is probable that the soil has decreased somewhat in readily available fertility, and that yields have been maintained and in some instances increased by better methods of production and by improvements in soil drainage. Corn as early as 1879 had over twice the acreage of all the other cereal crops, and this ratio was substantially maintained until about 1919, when increased acreages of oats and wheat were grown, largely because of war demands.

Corn is grown on practically all the soils of the county, though naturally more successful on some soils than on others. Reid Yellow Dent is the most common variety, though Iowa Silvermine and some early varieties are also grown. Some corn is grown for silage, which has proven its value in winter feeding. The Iowa Yearbook for 1919 reports a total of 30,007 tons of silage contained in 284 silos. In the vicinity of Perry, and to some extent in other parts of the county, sweet corn is produced for canning. In 1919, 1,635 tons of sweet corn were grown on 839 acres. Canning establishments are located at Perry and Dexter, and at Grimes in Polk County.

The oat crop is the most important next to corn. It is as widely grown as corn, but occupies a smaller acreage. Besides providing a valuable product for feeding and for market, it is a convenient crop in the rotation to precede grass seeding. The principal varieties are Albion (Iowa No. 103), Kherson, and Green Russian. About half the crop is marketed.

Wheat is relatively a minor crop, but in response to the war-time demands it has been grown more extensively in recent years. Both winter and spring varieties are grown, but better success is usually had with winter wheat. The Iowa Yearbook reports that in 1919 about 85 per cent of the total acreage was in winter wheat, which yielded an average of 19 bushels per acre, and spring wheat yielded an average of 10 bushels. Practically all the wheat is marketed.

Rye is a relatively unimportant crop and is usually grown on the more sandy soils. Barley also is of minor importance. Buckwheat and flax are grown occasionally.

The chief hay crops are timothy and clover, either mixed or grown separately. The census reports 7,112 acres of mixed clover and timothy in 1919, yielding 9,954 tons, 4,451 acres of clover alone, and 4,657 acres of timothy. In the same year 239 bushels of clover seed was harvested, with an average of nearly two-thirds bushel per acre, and 648 bushels of timothy seed, averaging 4.6 bushels per acre. Some wild hay is cut from swales and poorly drained bottoms not otherwise utilized. Sudan grass and sorgho are sometimes grown for hay. Coarse forage, principally corn, was cut from 11,009 acres, yielding 37,500 tons. Practically all the hay and forage is fed on the farms.

Alfalfa has been grown by many farmers with varying degrees of success. Where the special soil conditions requisite for the successful growth of this crop have been provided, the stands are good. In 1919, 638 acres were reported producing the crop. Interest in alfalfa is gradually increasing, and as many soils of the county are suitable, the acreage could be greatly extended. Other legumes grown are soy beans, vetch, peas, beans, and peanuts.

Potatoes are grown in a small way for home needs, but not enough are produced to supply the local markets. In 1919, 12,601 bushels were grown on 370 acres. Watermelons, muskmelons, and miscellaneous truck crops are grown to some extent. Sorghum is grown for the sirup, of which 7,784 gallons were made in 1919.

A moderate degree of interest is taken in fruit growing. For the most part orchards are maintained to supply home needs, with an occasional surplus for market. Some fruit trees are sprayed and kept pruned, but too little care is given to the average farm orchard. Apples are the principal tree fruit, followed by cherries, plums, pears, and peaches. In 1919 there were 37,314 apple trees, which yielded 21,585 bushels. Grapes and several varieties of berry fruits are grown mainly to satisfy home needs.

The livestock industry ranks high in Dallas County. On January 1, 1920, according to the census, there were on the farms of the county 86,130 hogs, 42,335 cattle of all ages, 14,561 horses, 1,490 mules, and 17,152 sheep.

Hog raising is one of the most important sources of farm income. There are many purebred herds, and much interest is shown in their development. The leading breeds are the Poland-China, Duroc-Jersey, and Chester White. The Hampshires are preferred by some. Hogs consume a considerable part of the corn crop and are most profitably raised and matured when handled in connection with cattle feeding. Chicago and Des Moines are the leading markets. Cholera causes some loss, but this disease is being controlled to a large extent by vaccination.

Cattle raising has long been a leading industry. Most of the cattle are of the beef type, but in recent years more interest has been taken in milk production and some of the pure dairy types are kept. The beef cattle are mostly Shorthorns and Aberdeen Angus, with some Herefords. These are mostly grades, but a few purebred herds are maintained. Some feeders are shipped in. In normal years many carloads are received in the county, but recently the low price of beef cattle and high freight rates have left little or no profit in raising and finishing beef cattle, and the industry has temporarily declined. Cattle are kept on pasture during the summer months and in the fall are finished on roughage, corn, and other concentrates. The finished animals are usually put on the market in December and January.

Milk is produced from beef types of cows as well as from the dairy types. In the northern part of the county, especially in the vicinity of Woodward, there are a number of herds of dairy cattle, mostly Holsteins and Guernseys. In this part of the county whole milk is sent to the Des Moines markets, and a condensery at Perry receives about 16,000 pounds daily. In other parts of the county more cream is sold, which is gathered by trucks on established routes. In 1919 there were about 9,000 cows and heifers kept in the county for milk. In the same year the dairy products, excluding home use, were valued at $467,440.

Sheep raising is not well established, but receives some attention in the southern and other more rugged parts of the county. The leading breeds are Shropshires and Oxfords. Some western sheep of mixed breeding are shipped in for feeding. The wool produced in 1919 amounted to 64,797 pounds and was valued at $32,797.

The horses are mainly grades of the Percheron, Belgian, and Shire breeds, but a few are purebred. Most farmers raise one or more colts or mules each year to maintain their work stock and for sale.

Poultry, consisting largely of chickens, with some geese, ducks, and turkeys, is kept on practically every farm. With a few exceptions the flocks are of mixed breeding. Besides supplying the home requirements, large quantities of poultry products are sold. On January 1, 1920, there were 308,283 chickens in the county. The eggs produced in 1919 were valued at $782,587.

The general adaptation of the various crops to soils is usually understood. The dark-colored, well-drained silty and loamy prairie soils are adapted to corn and general crops. The dark-colored Webster soils when drained are especially adapted to corn but not so well suited for small grains, as the straw tends to grow too rank and lodge. The more rolling lands, which in many places are rather too rugged for intensive cultivation, such as the Shelby and Lindley soils, are most suitable for pasture and give especially good returns with apples and other orchard fruits. Well-drained bottom lands reasonably protected from overflows are fertile corn land, and bottoms less well drained and more subject to overflow are best utilized for pasture, as they furnish excellent grazing and water is available for stock.

Farm operations are ordinarily conducted in a reasonably efficient manner, though in many instances more consideration should be given to systematic rotations, sufficient fertilization, correcting of soil acidity, and maintenance of the supply of organic matter. However, more interest is being taken in these matters than formerly.

Seed corn is usually selected from the field and cured and stored in the best manner to conserve its germinating power. Many farmers test the seed before planting. The matured crop is husked from the standing stalks and hauled directly to the storage cribs. The stover then furnishes some roughage for cattle and other livestock. Some of the corn is "hogged down" and, with the aid of soy beans or other interplanted crops, provides a convenient means of fattening hogs. Corn for silage or for fodder is ordinarily cut by machine. Most of the grain is threshed in the field from the shock, but some is threshed at the farm buildings, especially if the grain is stacked. Most of the hay is stored in barn lofts, the surplus being stacked in the field or near barns or feeding lots.

Farm equipment in most cases is modern and well adapted for the business. Houses and outbuildings generally are well constructed, attractive, and kept in good repair. An increasing number of houses are provided with electric light, either from private plants or from power lines, have bath, running water, and other labor-saving conveniences. Barns are of moderate size, generally without basement, but usually of sufficient capacity to shelter stock and provide storage for feed. Silos are coming into general use. Power machinery is being used extensively. Tractors are used on many farms to handle the heavier implements, and numerous auto trucks have been found profitable in hauling produce and supplies. The cultural implements include sulky and gang plows, disk and smoothing harrows, checkrow planters, one-row and two-row riding cultivators, manure spreaders, corn harvesters, grain drills, grain

binders, and modern haying machinery. Corn elevators are in use on many farms. A sufficient number of threshing outfits are owned in the county to handle the grain crop readily. Fencing consists almost entirely of barbed wire, with woven-wire bases around hog lots and sheep pastures. Posts are principally wooden, but some iron-tube, angle-iron, and concrete posts are used.

Heavy draft operations by horse power are performed with teams of 3, 4, or 5 horses, depending on the texture and physical condition of the soil. The livestock on the average 160-acre farm consists usually of 6 to 8 horses, 10 cows, about 50 hogs raised for market, and 10 brood sows, and about 30 sheep, where they are kept. According to the 1920 census, the average farm had 81.1 per cent of its value in land, 9.1 per cent in buildings, 3.3 per cent in implements, and 6.5 per cent in domestic animals. The low percentage of the value of farm property in domestic animals is accounted for largely by the recent unprecedented rise in the value of farm land and the decline in prices of livestock and increase in freight rates following the World War, which has caused at least a temporary decline in the cattle and other livestock industries.

About three-fourths of the land is plowed in the fall. This applies especially to sod ground and stubble for winter grains and spring planting. The plowing of stubble ground for wheat or rye begins very soon after the grain harvest and may continue until the corn-picking season opens, or later as may be convenient. The depth of plowing is ordinarily 5 to 6 inches. Further preparation of the land consists in disking and harrowing until a suitable seed bed is made.

Corn raised for the grain is planted with checkrow planters, but corn for fodder or ensilage may be drilled. The crop is planted between May 1 and 20, if possible about May 10. The first cultivation about the time the plants break through the ground is done with a light harrow, and this is followed by about four interrow cultivations at suitable intervals until the crop is laid by, usually the latter part of June or first of July. Corn picking begins after the fall frosts have sufficiently deadened and dried the stalks and ears, and often continues well into December.

Land for oats and barley generally is not plowed, but is worked up with disk harrows and other pulverizing implements. Seeding is done during the first two weeks in April, and spring wheat is seeded a little earlier. Winter wheat and rye are sown in the latter part of September or fore part of October. Wheat is harvested during the latter part of June or early in July, and oats and barley a little later in July. Threshing usually follows upon the grain harvest.

Timothy is sown with wheat or rye in the fall, or with clover early in the spring on wheat or oat fields.

Crop rotations are generally recognized as essential to maintain the productiveness of the land, but suitable rotations are not always followed, especially on leased farms. Frequently corn is grown for several years on the same field, often without much apparent decrease in yield, but the practice is generally considered unfavorable to permanent fertility. A rotation considered by many farmers as

ideal consists of corn 2 years, oats 1 year, clover and timothy 1 or more years; rye or winter wheat in this rotation would follow oats.

Fertilizers consist principally of stable and barnyard manures. These are usually applied on land for corn or for winter grain. Sometimes a little commercial fertilizer, principally phosphate, is used. Acid conditions of the soil have not generally been appreciated, and very little lime is used. According to the census, 31 farms reported expenditures for fertilizers in 1919 amounting to $11,279, or an average of $363.84 per farm reporting.

The supply of efficient farm labor has been inadequate for some time, but at present is more plentiful. Most of the laborers are native-born white. The wages [3] of competent single men are $50 to $65 a month with board. Married men get $65 to $75 a month, the use of house and garden, and a supply of milk and poultry products. Day laborers in the harvest season get from $3 to $4 a day. Prices for corn picking were 6 and 7 cents per bushel in 1920, but these prices vary somewhat with the supply of labor and price of corn. The census reports a total expenditure of $940,760 for labor in 1919 on 1,573 farms.

In 1920 the average size of farms was 153.6 acres, and the tendency has been toward an increase in size. Farms much smaller than 100 acres are usually not efficiently managed. In some of the more rolling parts of the county, where there is considerable pasture and forest land, many farms have 200 to 240 acres. In 1920 there were 2,320 farms, comprising 94.5 per cent of the area.

Since 1880 there has been a gradual increase in the number of tenant farmers from 28.2 per cent of the total number to 46.1 per cent in 1920. The share system of renting land is more common than the cash system. This is usually on halves, where the owner and renter each contributes half the expenses and retains half the returns, the renter furnishing his tools and work stock. On a cash basis, land rented for the season of 1920 at $10 to $15 an acre. Sometimes there is a combination of the share and cash systems. Pasture land rents from $4 to $7 an acre. Farm contracts begin on March 1.

Prices of land vary considerably with the topography, soil, location, improvements, and distance to markets. Desirable well-improved land sells for $300 to $350 an acre, and some sold as high as $400 during the recent boom in prices. Some of the rougher land best suited for timber and pasturage is valued as low as $75 to $85 an acre. The average assessed value of land in 1920, as reported by the census, was $234.63 an acre.

SOILS.

Dallas County is situated in the Great Prairie region of the Central West, a region in which the topography and climate have promoted a luxuriant grass vegetation. The considerable areas of flat, nearly level, or undulating country have been retentive of moisture favorable to an herbaceous vegetation, and the wind-swept plains have facilitated the spread of fires through the grassy growth and

[3] The wages given are those that prevailed in 1920, when the field work of this survey was in progress. Since then they have become somewhat lower.

thus discouraged any extensive encroachment of forest growth. The more rolling areas, having greater relief, better drainage, and more thorough aeration, have permitted trees to become established, and with the topographic changes effected by erosion some spread of the timbered areas has gradually taken place.

These conditions form a basis for the broad classification of the soils of the county into light-colored and dark-colored soils. The light-colored soils have developed in those areas originally forested, as the tree growth has been unfavorable for the accumulation of much organic matter. The soil is characterized by a fine granular structure, often silty and floury, and underlain usually by material of somewhat heavier texture. The soils recognized as belonging to this classification are the Clinton and Lindley series on the uplands and the Sarpy series on the first bottoms.

The dark-colored soils include those developed on the prairies of the uplands and the dark-colored alluvial soils of the bottoms. These dark-colored soils are divided into two groups, based on the character of the material as influenced by the drainage conditions in the soil profile.

One of these groups is composed of soils having good surface and subsoil drainage. The surface soil consists of dark-brown to black friable material, underlain by a somewhat heavier, but friable, light-brown to yellowish-brown subsoil material, which grades into a coarsely granular and imperfectly weathered substratum of either glacial till or loessial deposits. Some of these soils have had their original supply of lime carbonates leached out to a depth of several feet, while other soils still have much of this original supply at some point within a depth of 3 feet. The soils included in this group are various members of the Tama, Carrington, Clarion, Shelby, Waukesha, and Buckner series, and lighter textured members of the Wabash series.

The soils of the second group were developed under conditions of poor drainage which have prevailed to a greater or less degree over considerable periods. The surface soils are predominantly very dark, usually nearly black. The subsoils are dull gray, usually mottled gray, brown, and yellow, dense and rather plastic, and generally heavier in texture than the surface material. These soils have developed in places under shallow-lake conditions, in other places where the soil section has been more or less saturated for most of the year, and to some extent where the deficient drainage has been confined largely to the subsoil. In this group are the soils of the Grundy, Webster, Bremer, and Lamoure series, and the heavier Wabash types. Muck and peat may also be included in this group.

While it is believed that such factors as weathering, moisture content, and supply of organic matter have been dominant in soil-making processes, the nature of the parent material has an important bearing on the soil characteristics.

All the soil materials in the county are transported and have been deposited by glaciers, wind, or water. The indurated rocks of the county are covered nearly everywhere with a heavy mantle of glacial drift consisting of a more or less heterogeneous mixture of clay, sand, and gravel, which has been left by ancient ice sheets that once covered the region. At least two advances of glaciers have occurred

in the county. The oldest, the Kansan,[4] is represented in the southern part of the county, practically all of it lying south of the Raccoon, South Raccoon, and Middle Raccoon Rivers. This formation shows evidence of being the oldest drift in the county, as indicated by the development of valleys and ravines through erosion, and the great depth of weathering. The effects of weathering may be seen in many road cuts and along streams, where the color through oxidation has been changed from the original dark blue, which is found at depths of 30 to 40 feet, to a dull-red or brownish appearance. This drift contains many bowlders of granite, gneiss, quartzite, limestone, diabase, and diorite. All these rock materials have no relation to the underlying bedrock.

North of the limits of the Kansan drift, the material is a more recent deposition known as the Wisconsin drift, which covers four-fifths or more of the county. The surface of this drift deposit has undergone but slight alteration from erosion, as observed in the wide stretches of flat, undulating, and poorly drained country, and the drift has a fresher and less oxidized appearance than the Kansan. The occurrence of calcareous materials relatively close to the surface in many places indicates that leaching has not removed the more soluble materials so completely as in the Kansan deposits. These glacial materials have weathered to produce the Carrington, Clarion, Webster, Lindley, and Shelby soils.

Overlying the Kansan drift is an accumulation of fine, floury material which is presumed to have been deposited by wind action. This deposit, known as loess, varies in thickness from about 10 to 20 feet or more. Over smooth areas, where prairie conditions have prevailed, the dark-colored soils classified in the Tama and Grundy series have been developed, and on the forested and more rolling locations the light-colored Clinton series is identified.

The rock strata underlying the drift material for the most part occupy nearly horizontal positions. The rocks belong to the Des Moines stage of the Upper Carboniferous series. These beds are made up of shales and sandstones, with occasional bands of limestone and veins of coal. Sandstone is abundant in the vicinity of Redfield. In the southwestern part of the county in Union and Adams Townships are rocks of the Missourian stage, which consist of very compact and noncrystalline limestone. The underlying rocks of the area are exposed in outcrops along the valleys of the larger streams, but aside from small accumulations of materials, weathered from these outcrops, these rocks exert very little influence on the soils of the county.

Along the streams of the county the bottom lands are composed of a mixture of reworked materials of both glacial and loessial origin. Some of these bottoms lie at elevations above present overflows. The greater part of the bottom land, however, is subjected to periodic inundations and continues to receive some sediments during overflows. Most of these bottom soils are of relatively fine texture. In places the subsoils of the terraces or second bottoms are composed of beds of gravel and sand. The Waukesha, O'Neill,

[4] Statements concerning geology based on Annual Report, Iowa Geological Survey, 1897, Vol. VIII, A. G. Leonard.

Bremer, and Buckner series are developed on the second bottoms, and the Wabash, Lamoure, and Sarpy series on the first bottoms.

The various soils of the county are separated into series on the basis of color, character of subsoil, topography, drainage, and origin. The soils of each series are divided into soil types on the basis of texture or the relative coarseness and fineness of the surface soil. In Dallas County 15 soil series are represented by 27 types and 2 phases.

The following series descriptions, while covering the conditions for this county, also apply to other regions where the soils occur.

The types of the Carrington series are dark brown to black in the surface soil and yellow to light brown in the subsoil. They are derived from the weathering of glacial till. The topography is gently undulating to rolling. Neither soil nor subsoil is highly calcareous, and does not effervesce with hydrochloric acid. Two types, the fine sandy loam and the loam, with a shallow phase of the latter, are mapped in Dallas County.

The surface soils of the Clarion series are dark brown to black. The upper subsoil grades downward from a dark brown into a brown. The texture is heavier than that of the surface soil, being usually a silty clay loam. The lower subsoil is grayish brown to gray, approaching the color of the glacial drift from which it is derived. This is sufficiently calcareous to effervesce with acid, and streaks of lime and lime concretions are common. This series is derived from calcareous drift and usually occurs on slopes where the leached and weathered zone is less than 3 feet. It differs from the Carrington in the darker color of the surface soils and the gray color and high lime content of the lower subsoil. Two types, the loam and fine sandy loam, are mapped.

The types in the Webster series are characterized by their black surface soils and the gray to yellowish-gray, heavy subsoil. The subsoil is calcareous and usually effervesces with hydrochloric acid in the lower depths. The surface soils are darker colored than those of the Carrington and Shelby series. The surface is nearly level to undulating. The series has been formed through the weathering of glacial drift under conditions of poor drainage. Two types are mapped, the Webster clay loam and silty clay loam.

The types in the Shelby series are characterized by dark-brown to almost black soils, a brown to light-brown, heavier, upper subsoil, and a lower subsoil of light-brown to pale-yellow, loose, sandy, or gravelly clay. In places there is a substratum of loose sand and gravel. The surface is normally shallower than in the Carrington types. The subsoil may be highly calcareous. The topography varies from gently to steeply rolling. One type, the Shelby loam, is mapped.

The Lindley soils are light brown to grayish brown or brownish gray in the surface layer. The subsoil is a light-brown to yellowish-brown, compact, heavy material, which is mottled with gray and dark brown in the lower part. The series is developed where erosion has been active enough to prevent the accumulation of much organic matter. The topography is rolling to steeply rolling. The soils were originally covered with a growth of oak and hazel brush. Two types occur in the county, the Lindley loam and fine sandy loam, with a rough phase of the latter.

The types of the Conover series are gray to light grayish brown in the surface soils. The upper subsoil is a grayish-brown to brown compact gritty loam or clay loam. The lower subsoil is a grayish-yellow to mottled brown and yellow clay less compact than the overlying layer. The silt loam is the only type mapped in this series.

The surface soils of the Tama series are dark brown, and the subsoil is yellow to yellowish brown. The structure is loose and friable. The series is developed from loess deposits. There is not sufficient lime in soil or subsoil to effervesce with acid, and whatever lime the material may have contained has been leached to a depth of 36 inches or more. The topography varies from gently to sharply rolling. The Tama silt loam is mapped.

The surface soils of the Grundy series range in color from brown through dark brown to black. The lower part of the surface layer is lighter in color than the upper part, giving a suggestion of a gray subsurface layer. The upper subsoil is heavy, rather plastic when wet and hard when dry, and grayish brown in color mottled with dark drab and yellowish brown. This passes gradually into a layer of somewhat lighter color and texture. The topography is gently rolling. The soils are derived from the silty material overlying the Kansan drift. The Grundy silt loam is mapped in this county.

The types in the Clinton series are characterized by lighter colored surface soils than those in the Tama series, the range being from light brown to grayish brown. The subsoil, which is heavier than the soil, is yellowish brown to brown. In the lower subsoil the material is a plastic silty clay to clay loam, and the color is mottled with gray. The topography is rolling to strongly rolling. The series has the same origin as the Tama, but has been formed under conditions of greater erosion and was originally forested. It differs from the Lindley series in surface appearance mainly in its more uniform texture and the absence of coarse material. Only one type, the silt loam, occurs in the county.

The surface soils of the types included in the Waukesha series are dark brown to black. The subsoil is light brown to yellowish brown and heavier in texture than the surface soil. Neither soil nor subsoil is calcareous. This series occupies bench-like areas along streams and consists of reworked material of mixed origin. The areas are above overflow and have good drainage. The loam and silt loam types are developed in this area.

The Buckner series consists of types with brown to dark-brown surface soils and lighter colored friable subsoils. The surface is level, but drainage is good. The fine sandy loam is the only type mapped in the county.

The Bremer series comprises soils that are dark brown to black in the surface section and dark grayish brown to dark brownish gray in the subsoil. The subsoil to a depth of 3 feet or more is as heavy as or heavier than the soil. There is not enough lime in any part of the soil section to cause effervescence with hydrochloric acid. The soils are confined to terrace or outwash plains and more recent water-laid material, now lying above overflow. They differ from the Wabash soils in occupying positions above overflow. Three types are mapped—the loam, silt loam, and silty clay loam.

The O'Neill series differs from the other terrace soils in having a substratum of gravel or sand within the 3-foot section. The surface soils are dark brown to nearly black and rest on a light-brown to brown subsoil. The soils are inclined to be somewhat droughty. The O'Neill fine sandy loam and the loam are mapped in this county.

The Wabash soils differ from the Bremer only in their physiographic position. They are developed in first bottoms and are subject to overflow. A distinguishing feature is the high content of organic matter. This series is represented in the county by the fine sandy loam, loam, silt loam, and silty clay loam.

The Lamoure types are distinguished from the Wabash mainly by their high lime content, both in the soil and subsoil. The surface soils are very high in organic matter and dark colored, and the subsoil is dark drab to light drab or yellowish drab. The types are level and poorly drained. One type, the silty clay loam, is mapped.

The Sarpy series includes types with brown to brownish-gray or grayish-brown soils, underlain by lighter textured subsoils, in places passing into loose sand within the 3-foot section. Both soil and subsoil are calcareous. The surface soils are somewhat deficient in organic matter. The soils of this series are subject to overflow. The fine sandy loam and the silt loam occur in this area.

Soils made up of the organic remains of water-loving plants and grasses accumulated in ponds or lakelike depressions are classed as Muck and peat.

The various soils encountered in Dallas County are described in detail in the following pages of this report. Their distribution is shown on the accompanying map. Their actual and relative extent are given in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Carrington loam	161,408	43.1	Bremer silt loam	3,648	1.0
Shallow phase	1,024		Waukesha loam	3,392	1.0
Webster clay loam	51,392	13.6	Sarpy silt loam	2,496	.7
Clarion loam	36,800	9.8	Grundy silt loam	2,240	.6
Tama silt loam	24,192	6.4	Carrington fine sandy loam	1,024	.3
Webster silty clay loam	13,696	3.6	Bremer silty clay loam	1,024	.3
Shelby loam	12,416	3.3	O'Neill fine sandy loam	1,024	.3
Clinton silt loam	11,328	3.0	Lamoure silty clay loam	576	.1
Lindley loam	10,624	2.8	Bremer loam	448	.1
Wabash loam	5,952	1.6	Buckner fine sandy loam	320	.1
Wabash silty clay loam	5,248	1.4	Wabash fine sandy loam	256	.1
Sarpy fine sandy loam	5,248	1.4	Muck and peat	256	.1
Waukesha silt loam	4,800	1.2	Conover silt loam	256	.1
Wabash silt loam	4,352	1.1			
O'Neill loam	3,968	1.0	Total	376,960	
Clarion fine sandy loam	3,904	1.0			
Lindley fine sandy loam	1,920	1.0			
Rough phase	1,728				

CARRINGTON FINE SANDY LOAM.

The surface soil of the Carrington fine sandy loam consists of about 12 inches of dark-brown or dark grayish brown, mellow fine sandy loam. The subsoil is a lighter colored, somewhat more compact fine sandy loam, which, at about 24 inches, is a light-brown or yellowish-brown compact fine sandy loam or gritty loam, and below 30 inches a yellowish-brown fine sandy clay. In places the lower

subsoil is a fine sandy loam or loamy fine sand. In its virgin condition the surface soil has a fair supply of organic matter.

The Carrington fine sandy loam is inextensive and occurs in rather small scattered areas. Prominent areas lie about 2½ miles east of Kennedy and about 3 miles south of Adel. The type occupies hilltops and adjoining slopes and usually has a higher elevation than adjoining areas of Carrington loam. The surface is more or less rolling and the drainage is good. The soil retains moisture well in seasons of well-distributed rainfall, but in the drier seasons may be somewhat droughty.

This soil is used to some extent for crop production, but more generally for pasture. Some of it has a timber growth largely of elm, oak, hickory, and walnut. Cultivated areas are used in growing corn, oats, and other crops. On fields in good tilth with a good supply of organic matter, the yields of crops are about the same as those obtained on the Carrington loam.

CARRINGTON LOAM.

The Carrington loam has a surface soil of 10 to 12 inches of dark-brown friable loam, with enough fine and medium sand in places to impart a gritty feel. With increase in depth the color becomes lighter and the structure more compact, and at about 20 inches the subsoil is a light-brown, compact, friable, heavy loam or clay loam, which at about 30 inches often becomes somewhat sticky or less friable. As a rule the subsoil contains no stains or mottlings. In places there are small quantities of fine gravel or coarse materials or scattering bowlders in soil and subsoil, but not enough noticeably to modify the structure or to interfere with cultivation. The surface soil is well supplied with organic matter.

Typically, the soil and subsoil are not sufficiently calcareous to effervesce with acid, but small areas of the Clarion loam, which is calcareous, may be included, as in many places the patches were too small to separate on the map. In a few places the surface soil is a silt loam and the subsoil has a more silty compact structure. These areas, however, are small and not of sufficient importance to be considered separately.

The Carrington loam is fairly evenly distributed over the northern three-fourths of the county. It is intimately associated with the Webster soils and in all cases occupies the higher lying ground. In places it occupies isolated knolls and low ridges in the flat country. It is also associated with the Clarion loam, to which it is closely related, and in general occupies somewhat smoother country. The surface as a whole varies from undulating to rolling.

The natural drainage is usually good. Some poorly drained places occur along the contacts with the Webster soils or along certain lower slopes adjoining some of the bottom types. Surface washing as a rule is not serious. The soil warms up early in the spring, and both soil and subsoil retain capillary moisture well.

The Carrington loam is the most extensive soil type in the county and is well developed agriculturally. Probably 80 to 90 per cent is cultivated land, the remainder being reserved for pasture. The type originally had a growth of prairie grasses over most of its extent, while on some of the rolling land there was a timber growth,

principally of oak, elm, ash, hickory, and locust, with hazel brush and other undergrowth.

This soil is widely used in producing the staple crops of corn, oats, wheat, barley, hay, and a variety of minor crops. Hog raising is important, as the corn is used extensively in fattening and finishing. Probably a larger proportion of the corn and grain produced on this type is fed than is the case on the Webster soils. More hay is produced, as the Webster soils are more extensively used for corn. Timothy and clover constitute most of the hay, but wild grass is sometimes cut. Alfalfa generally does well where the soil has received suitable preparation. Some beef cattle are grazed, and in places, especially in the northern part of the county, dairying has some importance.

Corn ordinarily yields about 40 to 45 bushels, though much higher yields are obtained in favorable years and on land in a high state of fertility. Oats and barley yield 35 to 45 bushels, and winter wheat 15 to 25 bushels. Clover and timothy mixed yield 1½ to 2 tons, and timothy alone, 1 to 1½ tons. Sweet corn is grown in places and yields 2 to 3 tons per acre.

The value of crop rotations is generally recognized, and most of the farmers at least alternate corn with oats and seed down to clover occasionally. A rotation frequently followed consists of corn 2 years, oats 1 year, and clover 1 year. Sometimes wheat or barley is introduced following oats. On rented farms less attention is paid to rotations, and yields of corn usually decline after this crop is grown several years in succession.

The chief fertilizer is barnyard manure, which is generally fully utilized. Phosphates are used to some extent as fertilizer, and lately lime has been employed.

The selling price of this type of land ranges from $250 to $300 an acre.

Carrington loam, shallow phase.—The shallow phase of the Carrington loam is developed on the steeper slopes and more rolling areas, where the typical surface material is only a few inches thick or in places has been entirely removed by erosion. The soil is lighter in color than in the typical areas and the texture is more variable. Sandy and gravelly variations are common. When plowed the furrow discloses the light-brown to yellowish-brown silty loam or clay loam subsoil material.

This phase is of small extent and occurs in comparatively few scattered areas. A typical area lies along the slopes leading to the North Raccoon River in the northwestern part of the county, and others are near the Polk County line east of Waukee. It is developed along some of the steeper and rolling slopes leading to the larger stream courses, and to some extent at the heads of smaller branches where erosion has been active.

The phase is used mainly for pasture land, and very little is cultivated. Some areas are forested with the same species found on portions of the typical Carrington loam. Cultivated crops as a rule do not give as satisfactory yields as on the typical soil. The soil of the shallow phase is somewhat more difficult to work, and the cultivated slopes, being subject to continued washing, are difficult to maintain in good condition. This phase is best suited for permanent pasture and as far as possible should be utilized for this purpose.

CLARION FINE SANDY LOAM.

The Clarion fine sandy loam has a surface soil of 10 to 12 inches of brown to dark-brown fine sandy loam. This grades into a lighter brown and somewhat more compact but friable fine sandy loam. At about 24 inches the subsoil is a yellowish-brown compact loam containing some sand, gravel, and lime concretions or fine, grayish, limy material. The subsoil at varying depths effervesces freely with acid, but the surface soil rarely effervesces. A few places are somewhat gravelly on the surface; the more important of these are indicated on the map by gravel symbols.

The Clarion fine sandy loam occurs in the northeastern part of the county between the Minneapolis & St. Louis Railroad and Beaver Creek, the most important development being in the northern and western parts of Grant Township. The type occupies positions more often higher in elevation than those of the Clarion or Carrington loams. Much of the type in northern Grant Township occupies kame hills and ridges and some of the slopes. The topography thus varies from rolling to rugged. Both surface and subsoil drainage are thorough, but with the exception of a few loose gravelly variations the subsoil is sufficiently compact to retain enough moisture for crops.

Probably 50 to 60 per cent of this soil is cultivated more or less regularly, and the remainder is used for pasture. Parts of it have some original timber growth. The smoother areas are used in the production of various farm crops. Corn is the leading crop, followed by the other grain and forage crops. In seasons of normal rainfall the yields are about as good as on the Clarion loam. Good bluegrass pastures are maintained, and the raising of beef cattle is an important industry.

The sandy character of the soil makes it easy to work, and less power is necessary than on the heavier soils. It can be worked under a wide range of moisture conditions with little danger of impairing the structure in the way of baking or forming clods. The lime in the subsoil supplies an important requisite for the growth of legumes, alfalfa in particular.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the type:

Mechanical analyses of Clarion fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
333925	Soil, 0 to 10 inches	1.2	8.4	7.3	28.6	16.4	23.4	14.6
333926	Subsoil, 10 to 36 inches.	2.3	7.5	6.0	24.3	19.1	27.9	12.9

CLARION LOAM.

The surface soil of the Clarion loam consists of 10 to 12 inches of dark-brown friable loam or silty loam. The subsoil is a light-brown friable loam, which at varying depths between 16 and 24 inches becomes a friable grayish-brown loam with a high content of carbonate of lime that effervesces freely with acid. Lime nodules or

concretions are more or less abundant. Locally there is some rounded gravel in the subsoil or distributed through the 3-foot section. In many places the calcareous material is found only in the lower subsoil, and in such places the material of the soil and subsoil otherwise is practically identical with that of the Carrington loam.

The Clarion loam is extensively developed between Minburn and Bouton, in the vicinity of Woodward, on the slopes along Walnut Creek, and along the east side of Panther Creek in Colfax Township and extending northward to the North Raccoon River. Numerous smaller areas occur throughout the middle and northern parts of the county. The type is closely associated with the Carrington loam, which it resembles in surface appearance. The identity of the Clarion loam being based principally on its having a calcareous subsoil, it was in many places difficult to outline the different areas satisfactorily on the map as there were numerous changes to the Carrington loam, often within a few yards. For this reason many small tracts of the latter soil are included.

The topography varies from rolling to sloping; it will average somewhat more rolling than the Carrington loam, and more of it occupies slopes leading toward stream courses. The drainage is generally well established and there is very little need for tiling.

This soil is extensively used for general farming, though not quite so large a proportion is in regular cultivation as of the Carrington loam, and more of the rolling and sloping land is kept in pasture. Most of the type originally supported a good stand of prairie grasses, and some of the more rolling areas were occupied by forest of the same character as on the Carrington loam.

All the usual farm crops are successfully grown. Corn easily leads, while oats and other crops are less important. Clover produces good stands. Hog raising is an important industry, and beef cattle and occasionally sheep are grazed. In the northern part of the county, in the vicinity of Perry and along the line of the interurban railway, dairying is carried on quite extensively and milk is shipped to Des Moines.

The crop yields and general soil management do not vary much from those prevailing on the Carrington loam. The somewhat more rolling surface in places makes the drainage a little more free and the soil is somewhat earlier. The generally abundant supply of lime within the 3-foot section gives favorable conditions for the growth of clover, alfalfa, and other legumes. Many good stands of alfalfa are on this soil, and the acreage of this crop might well be extended.

WEBSTER CLAY LOAM.

The surface soil of the Webster clay loam consists of 10 to 12 inches of dark-brown or nearly black friable clay loam, which is abundantly supplied with organic matter. This grades quickly into a dark-drab or dark grayish brown, compact, moderately friable clay loam or loamy clay. At depths varying from 20 to 30 inches the subsoil becomes mottled with brown and gray and is usually streaked with gray, calcareous, silty clay material, which effervesces freely with acid. The surface soil tends to bake and crack when dry. In some locations adjacent to some of the lighter textured soils the immediate

surface has enough fine sand and silt to be noticeably loamy. Gravel and bowlders are not common in the 3-foot section.

So-called alkali or infertile spots occur in some of the depressed areas where drainage has been poor and seepage long continued. Some of these places have a thin light-colored incrustation upon drying out. The extent of these alkali areas is small, and the individual strips or spots are usually but a few yards wide. Their presence, however, forms a problem in bringing the land to a uniform state of productivity.

The Webster clay loam has a more or less general distribution throughout the northern three-fourths of the county. It is associated with the Carrington and Clarion soils and occupies lower lying and flatter positions of the upland in narrow strips and broader irregular-shaped areas in places alternating with areas of the above-named soils. Locally it occupies low gentle slopes leading to stream courses or bottom positions of doubtfully alluvial character. Considered in connection with the adjacent Carrington and Clarion soils the surface has a characteristic billowy or "saucerlike" configuration.

In its natural condition the type has deficient surface and subsoil drainage. The low nearly level surface renders the run-off slow, and few natural drainage courses have been established. Formerly it contained numerous swales, and in places shallow lakes, some of which covered a number of acres. Most of the type now has artificial drainage, both by means of open ditches and tile. Practically all the swales and shallow lakes have been drained and constitute valuable land. The more pronounced slopes have better natural drainage, but most of these have been tiled to advantage. Properly drained areas are retentive of moisture in quantities well suited for the best development of crops.

The Webster clay loam, when drained and reclaimed, is valuable farming land. The greater part of it is improved, and there is practically no waste land. The original vegetation consisted of a luxuriant growth of coarse marsh and prairie grasses.

The soil in its improved condition is well adapted to a wide range of crops. Corn leads in importance and occupies a large acreage annually. Small grains, mostly oats and wheat, are produced to a considerable extent, but are not so well adapted because the straw growth is rank and tends to lodge. Clover and timothy make good stands and yield a high quality of hay. Hog raising is an important industry in connection with the corn crop. Some beef cattle and a few cattle of the dairy type are raised. Dairying has some importance in the northern part of the county. Occasional tracts of this soil are pastured, but practically no improved land is retained in permanent pastures. Farm buildings are not often located on this soil, as the higher lying Carrington or Clarion soils, which usually form a part of each farm, furnish more desirable building sites. Orchards and other fruits also give better results on the higher soils.

The yields of corn usually range from 40 to 50 bushels, and in favorable seasons 75 to 80 bushels are often obtained. Oats yield from 35 to 40 bushels, and winter wheat about 18 to 20 bushels. Mixed clover and timothy yield from 1¾ to 2 tons per acre. Millet, Sudan grass, and sorgo are occasionally grown.

The soil requires relatively heavy equipment for breaking and other preparation. Five-horse and six-horse teams give best results, though tractors are supplying the motive power on a number of farms. The soil requires care in its handling, as when it is worked with too much moisture it forms clods which break down with difficulty. Owing to its heavy nature and slow drainage the soil is slow to warm up in the spring, and plantings and cultivations are sometimes delayed.

No well-planned crop rotations are generally followed. Corn is often grown several years in succession, though the more careful farmers alternate corn with oats and sometimes introduce wheat and seed with mixed timothy and clover one or two years. Fertilizers are confined to occasional applications of stable manure.

Land of this type sells for about $300 an acre when well improved and well located.

WEBSTER SILTY CLAY LOAM.

The surface soil of the Webster silty clay loam consists of 10 to 14 inches of very dark brown or nearly black silty clay loam or silty loam. This grades downward into a dark-brown compact clay loam or loamy clay, which at 18 to 20 inches usually becomes mottled with gray and brown. Below 24 to 30 inches the subsoil is a grayish-brown or dull-gray loamy clay, which contains lime concretions and some rusty-brown mottlings and concretionary material. Both soil and subsoil are calcareous, and the subsoil in nearly all cases effervesces with acid.

Included with the type on slightly higher lying positions are small patches of soil approaching the characteristics of the Clarion loam or Carrington loam. Adjacent to these soils and to others of lighter texture the surface soil contains enough sand to approximate a loam texture.

The Webster silty clay loam is well developed in an area lying northwest of Adel and in irregular-sized areas along the divide between Redfield and Dawson. Smaller areas are found elsewhere in the county.

The type occupies about the same topographic positions as does the Webster clay loam, but usually in broader areas. The surface varies from nearly level to slightly sloping or undulating. The type has poor natural drainage and unless tile drained is late in warming up in the spring. Most of it has been improved and tiled to the extent that it has been brought under regular cultivation. It is managed in about the same way as the Webster clay loam and often is cultivated in connection with that type.

Crop yields are fully as good as those obtained on the Webster clay loam, and on well-drained loamy variations corn yields better than on the more typical developments. Small grains usually give excellent yields, but the rank-growing straw has a tendency to lodge. Clover produces excellent stands and, with timothy, gives good yields of hay. Some slough and prairie grass is cut for hay.

SHELBY LOAM.

The surface soil of the Shelby loam consists of 8 to 12 inches of brown to dark-brown friable loam or silty loam. This grades into

a compact brown or yellowish-brown gritty loam, slightly mottled in places with brown, yellow, and light gray, which at 20 to 24 inches changes to a yellow, plastic, gritty clay mottled with rusty brown and grayish brown. Streaks of sand or mixed sand and assorted gravel are common in the lower subsoil and may occur anywhere in the soil section.

The surface soil varies considerably from place to place. In small spots it is sandy, approximating a fine sandy loam, and in other spots it may be as heavy as a silt loam. On slopes where erosion has been more or less active the soil is thinner and the color lighter, while in depressions and at the foot of the slopes the soil is deeper and the color darker. In the lower subsoil and substratum lumps or nodules and streaks of lime and calcareous materials are numerous. In a few places there are small exposures of limestone.

A sandy variation, approximating the Tama loamy fine sand mapped in Polk County, occurs in a few spots in the southern sections of Boone Township. This usually is a brownish loamy fine sand or fine sandy loam, which overlies a lighter brown fine sand. It occurs in small irregular patches on lower slopes and on points of ridges.

The Shelby loam is most typically developed in the southern part of the county, where it occupies the valley slopes below the higher lying Tama silt loam and above the low-lying stream bottoms. Other areas are mapped in the more northern parts of the county, usually associated with the Carrington loam.

The surface varies from sloping to steep and broken. The run-off is rapid on the steeper slopes, and the surface is dissected with ravines and gullies. The drainage on the steeper places is excessive and is ample elsewhere.

Because of its unfavorable topography the type is not extensively cultivated. The steeper and more broken areas are kept in pasture or hay land or reserved for timber. The native growth consists largely of white, black, and bur oak, hickory, elm, and hazel brush. The improved and cultivated land is managed in about the same way as the Tama silt loam. Crop yields will average about the same, though there is perhaps a greater variation in yields owing to lack of uniformity in the character of the soil profile. The pastures, largely of bluegrass, are usually good. Many cattle and hogs and some sheep are grazed.

In many places sweet clover grows luxuriantly, which indicates that alfalfa would succeed on most cultivated areas of the type. Several good orchards are located on the type, and the soil appears well adapted for apples and a variety of small fruits.

LINDLEY FINE SANDY LOAM.

The surface soil of the Lindley fine sandy loam is a light-brown to light grayish brown, moderately friable fine sandy loam to very fine sandy loam 8 to 10 inches deep. This passes quickly into a light-brown or light yellowish brown, compact and rather stiff fine sandy clay, which at 20 to 24 inches becomes a light-brown, stiff, and moderately plastic, sandy gravelly clay, noticeably mottled with brown or rusty brown and slightly with ashy gray. Very fine sandy loam variations occur on flatter or slightly lower positions.

Practically all of this type is mapped in the northeastern part of the county, bordering the Des Moines River, and most of it within 1½ miles of the stream. It occupies projecting ridge tops, which alternate with the deeply cut ravines included in the rough phase of this type. The surface is fairly smooth or undulating, and the drainage is good.

This is not an important soil agriculturally. About three-fourths of it is cultivated, some is used for pasture, and the rest is in forest consisting largely of white and black oak, elm, and hickory.

The usual farm crops are grown, but less successfully than on the darker colored soils. Corn gives relatively low yields and not a very thrifty growth of stalks. Small grains do relatively better. Bluegrass thrives in pastures, and clover also does well. Lack of organic matter appears to be the principal deficiency of this soil.

Lindley fine sandy loam, rough phase.—The surface soil of the Lindley fine sandy loam, rough phase, ordinarily consists of 8 to 10 inches of brown to dark-brown gritty loam, and in places fine sandy loam. This is underlain by light-brown, compact, gritty loam, which changes at 20 to 24 inches to a lighter brown fairly friable loam or clay loam. The subsoil at varying depths usually effervesces with acid. The surface soil on some of the steeper slopes is thinner and somewhat lighter in color, while at the base of the slopes the more or less colluvial deposits are deeper and in places darker in color.

This phase occupies the steeper slopes of the deeply cut ravines leading back from the Des Moines River into the uplands within the area of Lindley fine sandy loam. The surface is rough, steep, and occasionally precipitous. The drainage is excessive.

Little use is made of this phase except for pasture. Cleared areas afford fairly good grazing. The greater part of the type supports a mixed growth of white, black, and bur oaks, elm, hickory, and various other species.

LINDLEY LOAM.

The Lindley loam has a surface soil of about 6 to 10 inches of light-brown or grayish-brown, gritty, friable loam, slightly sandy. The subsoil is a lighter brown or yellowish-brown, gritty, stiff, somewhat plastic sandy clay, and below 18 to 20 inches is noticeably mottled with gray and darker brown, the general color becoming lighter and the mottling more pronounced with increase in depth. Small rounded stones and gravel are common on the surface and throughout the soil section.

There is considerable variation in the soil from place to place. On many of the steeper slopes the typical surface material has been washed away, leaving a gravelly, gritty, or stiff sandy clay. At the foot of slopes the colluvial deposits often are a heterogeneous mixture of soil materials differing considerably in their texture, structure, and arrangement.

The Lindley loam is developed mainly in the southwestern part of the county, bordering the Middle Raccoon and South Raccoon Rivers and on the valley slopes of some of the minor tributaries. Narrow strips are found along part of the course of the North Raccoon River. In places it occupies slopes intermediate between the higher lying Clinton silt loam and the alluvial soils of the valley

floors. The surface is typically steep or abrupt. Ravines here and there branch back into the uplands. Part of the area occupying the ridge lobe lying west of the lower course of Panther Creek has a fairly smooth surface. The surface drainage is excessive and the underdrainage is usually good.

Owing to the broken, hilly topography only a small proportion of the total area is in cultivation. A considerable part is pastured, but the greater part is forested with white and black oaks, elm, hickory, ash, and other deciduous trees, with some hazel, sumac, and red haw.

Cultivated land of this type, when well cared for, gives profitable returns of the general crops. Corn yields from 25 to 40 bushels, and oats about the same. Clover usually succeeds well.

The soil is handled in much the same way as the Shelby loam and Clinton silt loam. Stable manure is applied when available, and some care is taken in plowing and cultivating hillside fields so as to minimize surface washing.

Land of this type has a comparatively low value. During the season of survey (1920) the rougher land was valued at $75 to $80 an acre and the smoother tillable land at $175 to $200 an acre.

The principal need on the type appears to be prevention of hillside erosion. The steeper slopes should be kept in pasture or grass as much as possible, and winter cover crops should be grown on the steeper cultivated fields. The naturally low supply of organic matter should be increased by growing clover or other legumes.

CONOVER SILT LOAM.

The surface soil of the Conover silt loam consists of gray to light grayish brown floury silt loam, 6 to 8 inches deep. It is underlain to a depth of 18 or 20 inches by a yellowish-gray to grayish-brown compact loam, mottled with gray, brown, and yellow. The lower subsoil is a yellow, grayish-yellow, or mottled gray, brown and yellow, tough, compact, gritty loam. The surface soil is light gray and appears almost white when dry and much darker colored when wet. The content of sand and fine gravel increases with depth, and below 30 inches the subsoil is usually more friable.

The Conover silt loam is confined to narrow strips of level to undulating upland bordering the Des Moines River. The type is extensively developed in Boone County, but extends only a short distance into Dallas County.

The Conover silt loam was originally in forest but the greater part has been cleared and put in cultivation. Corn, oats, wheat, and clover are the principal crops ranking in the order named. Crop yields do not differ greatly from yields on the more nearly level part of the Lindley fine sandy loam with which it is closely associated.

TAMA SILT LOAM.

The Tama silt loam has a surface soil of dark-brown to nearly black, mellow silt loam, from 8 to 16 inches in depth, averaging about 14 inches. Below this the color becomes gradually lighter and the structure a little more compact, and below 22 to 24 inches the subsoil is a light-brown or yellowish-brown, compact, moderately

friable, heavy silt loam to light silt loam. The lower part of the 3-foot section commonly contains stains or faint mottlings of rusty brown or reddish brown. There is very little coarse material in soil or subsoil.

The soil and subsoil do not contain enough carbonates to effervesce with acid, and whatever the soil may have contained originally has been leached out. In a few places the substratum, as observed in some of the road cuts, shows lime concretions and streaks of calcareous material.

The Tama silt loam is confined to the southern part of the county, where it is the predominating upland type south of the Raccoon and South Raccoon Rivers, and joins more extensive areas of the type in Madison County. It also occurs north of the river in Boone and Van Meter Townships within 2 to 3 miles of the river.

The type is developed in the higher parts of the upland and occupies the divides and some of the slopes, where it frequently grades into the Shelby loam. The surface is undulating to gently rolling or somewhat sloping. On the wider and flatter divides south of Raccoon River the darker soil with heavier subsoil is mapped as Grundy silt loam, and the separation between these two types is somewhat arbitrary in places. North of the river, where the Tama silt loam joins the Carrington loam, the transition often grades through a quarter mile or more. The natural drainage is good.

The Tama silt loam is almost all in improved farms and under cultivation. The soil is easy to cultivate and retains moisture well, so that crops usually do not suffer from drought where the land has had sufficient preparation and tillage. Nearly all the type was in prairie, but a few localities once had a scattering forest growth of the same character as on the Clinton silt loam.

Farming is of the usual grain and livestock type. Improvements are good and equipment is well suited for efficient work. Corn is the leading crop, followed by oats, wheat, timothy and clover. The corn is largely used for fattening hogs. The production and grazing of beef cattle has been of importance.

Corn yields from about 35 to as high as 60 or 70 bushels, but averages 40 to 45 bushels; oats yield 40 to 50 bushels; and winter wheat, 20 to 25 bushels per acre. Mixed clover and timothy yield from 1 to 2½ tons. Timothy and clover sometimes are grown for seed. Various minor crops are raised occasionally, such as rye, barley, sorghum, Sudan grass, rape, vetch, and alfalfa. Fruits, potatoes, and other vegetables are grown for home use.

As a rule no definite crop rotations are followed. Corn may be alternated with oats, but frequently corn is grown several years in succession. Practically no commercial fertilizer is used. Stable manure is generally used, and occasionally timothy and clover sod is plowed under, and thus the supply of organic matter is fairly well maintained.

Land values in recent years have been advancing, and at present (1920) land of this type sells from $300 to $350 an acre.

The use of lime would undoubtedly insure better stands of clover and other legumes, especially alfalfa. More systematic rotations should be adopted with the view of maintaining the usually ample supply of organic matter.

GRUNDY SILT LOAM.

The surface soil of the Grundy silt loam is a dark-brown to almost black, friable silt loam, 8 to 15 inches deep, and averaging about 12 inches. This is underlain by a dark grayish brown heavy silt loam or silty clay loam, slightly mottled in places with yellow or yellowish brown. At 22 to 24 inches the subsoil becomes a yellowish, dense, plastic silty clay mottled with gray and rusty brown. The lower subsoil usually contains brownish and black soft iron concretions.

The Grundy silt loam is not extensive and is mapped only south of the Raccoon River within the Tama silt loam region. It occupies the flatter middle parts of divides and occurs in strips and elongated areas. Some of the areas extend southward, joining developments of the type in Madison County.

The surface is nearly level or very slightly undulating. Consequently no well-defined drainage channels have developed and the run-off is slow. The impervious subsoil retards the internal drainage. When dry the soil, especially in grass land and pastures, tends to form cracks.

Practically all of the type is improved and in cultivation. Where sufficient drainage is provided the soil is easy to cultivate and is very productive. Corn gives excellent yields, and other crops, such as oats, wheat, barley, and timothy and clover, all do well. The straw of small grains tends to grow rank and lodge. Average yields of corn are usually somewhat above those obtained on the Tama silt loam and the returns on other crops are profitable.

The Grundy silt loam in Dallas County is practically all managed in connection with adjoining areas of Tama silt loam, and farm practices in handling the soil are about the same. More care must be exercised in working the soil when it has the right amount of moisture, as when too wet it tends to puddle and when too dry the hard surface breaks up less readily.

CLINTON SILT LOAM.

The surface soil of the Clinton silt loam consists of about 8 to 10 inches of grayish-brown or light grayish brown silt loam of friable, smooth, floury structure. The subsoil is a compact, less friable, light-brown silt loam or silty clay loam, which at 20 to 24 inches becomes a light-brown, compact, slightly plastic silty clay loam or silty clay. The lower part of the subsoil is usually somewhat mottled with deeper brown and ashy gray and commonly contains concretions and concretionary matter. The soil section is remarkably free from grit and coarse materials, but on some of the slopes the surface soil contains a relatively large proportion of very fine sand. The supply of organic matter is low, especially where the land has been some years in cultivation. The soil is acid in reaction, though it is probable that in earlier times it was calcareous.

The Clinton silt loam is confined to the southern part of the county. It occurs along the south side of the Raccoon River, between its south and middle forks, and north of the river in two areas in Boone and Van Meter Townships. It is associated with the Tama silt loam, but occupies the higher parts of the more outlying ridges and upland fronts bordering the river.

The topography is rolling to somewhat hilly in places. The tops of many of the divides have a fairly even surface well suited for farming. Drainage is well established, and many stream branches have cut into the terrain, thus forming the characteristic topography. On some of the cultivated slopes the surface is gradually being eroded away. Owing to their elevated position on ridges and their dissection by ravines, many of the fields are small and irregular and consequently somewhat difficult to cultivate and manage.

Most of the type suitable for cultivation has been cleared of its original timber. The remaining forests consist principally of white and black oak, hickory, elm, and hazel brush. The type is sometimes referred to as "white-oak land," as the adjoining darker colored types more commonly have bur oak.

This soil is successfully used for the general farm crops. Where proper methods are used in maintaining its fertility, such as systematic crop rotations in which clover or other legumes are included, good yields are obtained. Corn yields from 35 to 40 bushels, but in favorable years on land in good tilth yields as high as 75 or 80 bushels are sometimes obtained. Oats, wheat, and hay are the other important crops. The price of this land is usually a little lower than that of the Tama silt loam.

WAUKESHA LOAM.

The surface soil of the Waukesha loam is composed of 8 to 12 inches of dark-brown, friable, gritty loam. The subsoil is a dull-brown, somewhat more compact, friable loam, which grades into the lower subsoil of light-brown, compact, gritty loam. In places a little sand or gravel occurs on the surface or through the soil section, but as a whole the texture is fairly uniform. On most of the flatter areas the color is somewhat darker, while on some of the more elevated positions on breaks leading to stream courses, and on terrace fronts the soil is usually somewhat lighter in color. The type resembles the Carrington loam, and in places the terrace grades imperceptibly into the upland and the soil into that type.

Most of the Waukesha loam is in the northeastern part of the county. The largest area lies in the vicinity of Granger. Smaller tracts lie along Beaver Creek and a few along Raccoon River and its forks.

The surface is nearly level or somewhat undulating. The large area near Granger lies 40 to 50 feet above the Beaver Creek flood plain. Most of the other areas lie much lower, generally not over 10 to 20 feet above the adjacent flood plains. The drainage is good, except in an occasional small depression. There are no well-developed drainage ways other than the streams originating in the uplands. The soil and subsoil retain moisture well in droughty seasons.

Nearly all the type is well developed and ranks high as an agricultural soil. It is handled in practically the same way as the Carrington loam, and the yields obtained are about the same. Corn, oats, wheat, barley, clover, and timothy include most of the crops grown. Hog raising is important, and the production of beef cattle and incidental dairying are minor industries. The soil is easily tilled, warms up fairly early in the spring, and drains out readily after rains.

WAUKESHA SILT LOAM.

The Waukesha silt loam has a surface soil about 12 inches deep consisting of dark-brown friable silt loam, which when moist is nearly black. This grades through a few inches into a lighter brown, compact, but friable silt loam or silty clay loam, which becomes lighter in color with increase in depth and in the lower part of the 3-foot section is light brown to yellowish brown.

Generally there is little or no mottling in the subsoil, but in a few of the lower lying positions there is some faint mottling with brown and yellow, and in places the prevailing color of the lower subsoil is grayish brown. On some positions along the terrace fronts the lower subsoil is somewhat lighter in texture, being moderately sandy or gravelly, and locally the substratum contains beds of sand and gravel, such variations being an approach to the O'Neill soils. The soil and subsoil are not calcareous.

This soil is developed mainly in rather narrow discontinuous benches, 10 to 15 feet higher than the first-bottom soil. The largest single area lies below Van Meter along the Raccoon River and varies from about one-half mile to over 1 mile in width. Smaller areas occur at various points along the upper course of this stream, and a few along Beaver Creek and the Des Moines River.

The surface is nearly level or very slightly undulating. Practically none of it is subject to overflow from first-bottom backwaters, but some of the streams issuing from the higher uplands which cross the more extensive terraces often spread over limited areas in times of freshets. Otherwise the type has fairly good drainage. The soil withstands droughts well.

The Waukesha silt loam is the most important terrace soil in point of acreage and of agricultural value. It is nearly all improved and most of it in regular cultivation. Small areas are sometimes reserved for pasture, and there are a few small groves, mostly elm, walnut, hackberry, and an occasional oak. It is said that part of the type was originally treeless and supported a rank growth of bluestem and other prairie grasses.

The type is used largely for the production of corn. Oats, wheat, clover, and timothy are also grown. Hog raising is important, and much of the corn is used in fattening, though some surplus corn is marketed.

Corn yields vary from 35 to 70 bushels or more per acre, averaging about 50 bushels; oats average between 35 and 45 bushels, and wheat about 20 bushels per acre. Mixed clover and timothy yield from 1½ to 2 tons. Alfalfa has been successfully grown in a few places.

No definite crop rotations are followed. Corn may be grown 1 to 3 years, followed by oats and sometimes wheat, and finally by clover and timothy 1 or 2 years. Corn is often grown a number of years in succession. Stable manure is applied occasionally.

Land of this type is valued upwards of $300 an acre. While the cash value is about the same as that of some of the more rolling upland soils, such as the Carrington loam, some farmers consider the Waukesha silt loam less desirable because it does not drain off so readily.

BUCKNER FINE SANDY LOAM.

The surface soil of the Buckner fine sandy loam consists of 10 to 15 inches of brown to dark-brown mellow fine sandy loam. This grades below into a lighter brown somewhat more loamy fine sandy loam, which changes gradually into a light-brown or yellowish-brown rather loose fine sandy loam in the lower part of the subsoil. The surface soil in the smoother and more level locations has a fair supply of organic matter and a darker color, while on more rolling land the surface color is lighter.

The Buckner fine sandy loam occurs in a few widely scattered localities and has a small total area. A representative development is found about one-half mile north of Ingersoll. The type generally occupies comparatively low terraces, though in a few places it lies 30 or 40 feet above the flood plain. The surface varies from nearly level to gently undulating. The drainage is good and for the most part not excessive.

The type is productive and a large part of it is in cultivation. It is easy to cultivate, warms up readily in the spring, and responds well to manuring and judicious management. The usual crops ordinarily give satisfactory yields. The soil is well adapted to early truck crops, but is used for these crops only in a small way.

BREMER LOAM.

The surface soil of the Bremer loam consists of 12 to 14 inches of nearly black, friable, heavy loam. This grades into a dark-brown or dull-brown, compact, heavy loam or clay loam, and at 20 to 24 inches into a brown or light-brown, slightly plastic loamy clay or gritty, stiff loam, mottled with rusty brown and ashy gray. The surface soil is well supplied with organic matter.

This type occurs in small areas on comparatively low terraces along the larger streams. It occupies positions similar to the Bremer silt loam and has about the same topographic features. Practically all of it is smooth and well suited for cultivation. It has good natural drainage and practically all is above normal overflows. Upland drainage sometimes brings a little surface wash, but water does not stand on the areas for any considerable periods of time.

The Bremer loam is practically all in cultivation. It is used largely for corn, but small grains and other crops are grown to some extent. Crop yields and general practices are about the same as those common to the other Bremer soils. Its somewhat lighter texture makes it a little easier to cultivate, and the slightly freer drainage enables the soil to warm up a little more readily.

BREMER SILT LOAM.

The surface soil of the Bremer silt loam consists of 8 to 10 inches of dark-brown to nearly black, compact, friable silt loam. The subsoil is a dark-brown, compact, moderately stiff clay loam or silty clay loam, which at 24 to 30 inches becomes a dull grayish brown, stiff, and moderately plastic silty clay, more or less mottled with yellowish brown and rusty brown and varied with thin grayish streaks. Small, dark-colored, soft or mealy iron concretions are common in the subsoil.

The Bremer silt loam occurs as fragmentary second bottoms along the larger streams, usually in strips not over one-fourth mile in width, though the area just north of Dawson and the one near Ingersoll are somewhat broader.

The surface is nearly level or very slightly sloping and generally elevated only a few feet above the adjoining flood plain. In some places there is no noticeable terrace margin and the surface grades imperceptibly into the first bottoms. Parts of lower lying areas at times may be subject to overflows and other parts receive some wash from upland drainage ways; otherwise the surface drainage is good. The underdrainage is rather slow because of the dense character of the subsoil.

This is recognized as one of the more desirable soils in the county, especially for corn, and probably 85 to 90 per cent of it is regularly cultivated. Along a few of the drainage courses there are fringes of trees, chiefly elm, oak, and hickory.

Besides corn, the chief crop, oats, wheat, and hay are grown. Corn ordinarily gives yields equal to those obtained on the Waukesha silt loam, and small grains give about as good yields. Small grains are a little more likely to lodge. Good stands of clover are easily obtained. Cattle and other livestock are pastured to some extent, but not as much as on adjoining first-bottom types.

This type is managed in about the same way as the Waukesha silt loam, and parts of it are usually cultivated in connection with adjoining areas of upland soils. The soil is fairly easy to cultivate if handled with the proper content of moisture, but if worked when too wet it is especially liable to form clods. Its slow drainage usually makes it a little late in warming up in the spring. The smooth, level surface favors the use of tractors and other labor-saving implements. Land of this type has been selling for $250 to $300 an acre.

BREMER SILTY CLAY LOAM.

The surface soil of the Bremer silty clay loam is composed of 10 to about 14 inches of very dark brown or nearly black heavy silt loam or silty clay loam. The soil has a high content of organic matter, and although compact, it works up friable under cultivation. The subsoil is a more compact silty clay loam or clay loam of dark brownish gray color, becoming mottled with brown and yellow at 20 to 24 inches, and at about 30 inches is a dense, rather plastic, brownish-yellow silty clay mottled with dark brown. Practically no sandy or coarse material is found in the 3-foot section.

This type is of small extent. It occurs along the Raccoon River north and east of Dawson, in one area about 2 miles southeast of Redfield, and two others along the south side of Beaver Creek.

It occupies smooth nearly level positions on rather low second bottoms, practically all above overflow. The drainage of soil and subsoil is fairly good, though the slow run-off from some of the flatter positions often causes delay in working after rains as well as making the soil rather slow in drying out in the spring. The type closely resembles the Wabash silty clay loam and differs from it chiefly in its more elevated positon.

The Bremer silty clay loam is very productive and is practically all cultivated. Corn is extensively grown, and grain and forage

crops all give satisfactory and profitable yields. The soil, being heavy, requires more draft power and more thorough use of pulverizing implements, than do soils of lighter texture. The selling value is about the same as that of the Bremer silt loam.

O'NEILL FINE SANDY LOAM.

The surface soil of the O'Neill fine sandy loam is a dark-brown to brown, mellow, fine sandy loam, 12 to 16 or more inches deep. The subsoil is a brown, somewhat more compact, fine sandy loam, which gradually becomes lighter colored and coarser textured with depth. At an average depth of about 30 inches it passes into a bed of light-brown coarse gravel and sand, which continues downward usually several feet. In places the loose gravelly subsoil is encountered at 18 or 20 inches, and in other places gravel is practically absent, the lower subsoil consisting largely of loamy fine and medium sand.

This type occurs in a number of small areas, either closely associated with the O'Neill loam or in other isolated terrace positions. It has about the same elevation and general topography as the O'Neill loam. Most of it is smooth enough for easy cultivation. The drainage is thorough, the rainfall being largely absorbed by the soil. The porous subsoil permits a free escape of the soil moisture, and consequently the soil quickly becomes droughty.

A considerable proportion of the type is under cultivation and a part is in pasture. Grass usually makes a thin stand and the pasturage is inferior. Some corn is grown, as well as oats, rye, and other small grains. When the soil is brought to a good state of fertility and carefully managed so as to conserve moisture, fairly satisfactory yields are obtained, though as a whole the yields are lower than those obtained on most of the heavier textured soils. In places truck crops such as melons, cantaloupes, cucumbers, tomatoes, and cabbage are grown in a small way, and for this purpose the soil seems best adapted.

O'NEILL LOAM.

The surface soil of the O'Neill loam is composed of 8 to 10 inches of dark-brown gritty loam, which passes into a compact dark-brown to brown gritty loam to heavy sandy loam. At 22 to 24 inches there is usually a light-brown, coarse, gritty loam, which grades at 28 to 30 inches into a bed of light-brown coarse gravel or loose sandy gravelly loam. The lower subsoil is usually loose and rather porous, though in places it contains some fine soil material. The surface soil generally has a fair supply of organic matter, but in some localities the surface is more sandy and of a lighter brown color and the content of organic matter is evidently lower. The soil and subsoil contain no lime carbonate.

This type is associated with other second-bottom soils and is fairly well distributed along the larger streams. Important areas lie just southwest of Perry, about 2 miles southeast of Bouton, and across the Des Moines River east of Scandia. The elevations above the flood plains vary from a few feet to 50 or 75 feet, as in the case of the area east of Scandia. The materials composing these soils have been deposited by relatively swift glacial-outwash waters and by

swift river currents, and the heavier surface materials probably have been accumulated by the action of both wind and water.

The surface is usually gently undulating to level, or in some places slightly sloping. The drainage is good, as the surface waters that do not escape through surface channels soon seep through the porous materials to the substratum. Except where the sandy and gravelly layers come relatively near the surface, the soil is not ordinarily droughty, and in seasons of well distributed rainfall the soil holds moisture well. The type, however, is not so retentive of moisture as are the Bremer and Waukesha soils.

Probably 85 to 90 per cent of the type is in more or less regular cultivation and some small areas are used for pasture. Corn, oats, and wheat are the leading field crops. In seasons of normal rainfall and where careful methods of cultivation have been followed, yields are about the same as those obtained on the Waukesha soils. Some of the type near Perry is used for sweet corn, which is sold to the cannery.

WABASH FINE SANDY LOAM.

The surface soil of the Wabash fine sandy loam consists of about 8 to 12 inches of dark-brown or almost black, friable fine sandy loam. This is underlain by a dark-brown more compact fine sandy loam, which gradually becomes lighter colored and is a light-brown compact fine sandy loam or light loam in the lower subsoil. In its virgin condition the surface soil is well supplied with organic matter. In a few places, especially in the area near Moran, the surface has received several inches of upland wash consisting of brown or grayish-brown fine sandy loam or sandy loam, and in places gravelly or loamy variations. These recent deposits usually overlie the dark-colored heavier Wabash materials.

The Wabash fine sandy loam is of small extent and is mapped principally in three areas, one about 3 miles southeast of Adel, one along Mosquito Creek north of Redfield, and another along Beaver Creek south of Moran. The type has been developed in bends of streams or along their courses where the currents have been relatively swift. The surface is usually fairly smooth. It is subject to overflow, but drains off readily and between overflows has good drainage.

Part of the type is in cultivation and is used mostly for corn. Other parts are in pasture and more or less forested with walnut, elm, and oak. The soil is easily cultivated and warms up early in the spring. It is retentive of moisture and crops are seldom affected by droughts.

WABASH LOAM.

The surface soil of the Wabash loam is composed of 12 inches or more of dark-brown, and in some places almost black, friable loam or gritty loam. This grades into a subsoil of dark-brown, fairly stiff heavy loam which at about 24 inches becomes a lighter brown stiff loam or in some cases a sticky fine sandy loam. The surface soil usually has a high content of organic matter. The type is somewhat variable in texture. In places near the stream channels the soil is more sandy, and changes from the sandy to a more loamy con-

dition within short distances. Toward the outer margins the texture is generally heavier. Both soil and subsoil contain no lime carbonate.

The Wabash loam is fairly well distributed over the county and occurs more generally along the smaller and somewhat swifter flowing streams, such as Walnut Creek. Most of the bottoms do not exceed one-fourth mile in width. They are subject to annual overflow, though in some instances overflows occur at longer intervals.

The surface is flat and fairly smooth, but here and there are variations in relief caused by the presence of old channels and depressions. The natural drainage is rather deficient.

Not over 15 or 20 per cent of the type is cultivated, and the remainder is used for pasture. Fringes of trees, like those on the Wabash silt loam, are common, particularly along the streams.

Where sufficiently drained and reasonably free from overflows, good results are obtained with the general farm crops. Corn does especially well and in favorable seasons produces high yields. The soil is easy to cultivate, warms up reasonably early in the spring, and can be worked under a relatively wide range of moisture conditions. The cultivated areas on any one farm are small and are usually managed like the higher lying adjacent soils.

WABASH SILT LOAM.

The surface soil of the Wabash silt loam consists of 12 to 16 inches or more of dark-brown to nearly black friable silt loam. This grades into a nearly black or dull dark brown compact silt loam, which in the lower part of the subsoil becomes a dull-brown or dark grayish brown compact silt loam. The surface soil is well supplied with organic matter, especially where the type is associated with the dark-colored prairie soils, but where the bottoms have received wash from the Clinton and Lindley soils the color is usually lighter. Adjacent to stream channels the soil section includes loamy and sandy materials at various depths.

The Wabash silt loam occurs along many of the smaller streams such as Bear Creek and upper Panther Creek and along the Raccoon Rivers, particularly about 2 miles west of Perry, 2 miles south of Redfield, and near Van Meter. The surface is flat and nearly level, but is somewhat uneven in places, especially where remnants of old stream channels are found. Practically all the type is subject to annual overflows, though some parts are overflowed less often than others. The drainage conditions are rather poor.

Owing to the liability to overflows the type is not extensively cultivated. Most of it is in permanent pastures and some is in forest. Walnut, elm, locust, hickory, and oaks are common species.

On the cultivated land good results are obtained with corn, oats, wheat, and occasionally forage crops such as sorgho and Sudan grass. Corn is more often grown and sometimes is grown on the same field several years in succession. When not damaged by overflows the yields of corn are often as high as any in the county. The uncultivated areas support good stands of bluegrass and wild grasses and furnish excellent grazing for cattle and other livestock. Some wild hay is cut.

The soil is fairly easy to handle, and where drainage is well established it works up readily into good tilth. The slightly lighter texture makes tillage possible under a somewhat wider range of moisture conditions than is possible on the related silty clay loam type.

WABASH SILTY CLAY LOAM.

The surface soil of the Wabash silty clay loam consists of 12 to 16 inches of nearly black moderately friable silty clay loam or clay loam. This grades into a dark-brown or nearly black, compact, and rather plastic clay loam or loamy clay. In places below 30 inches the subsoil contains some sand but remains compact and stiff. In other places the lower subsoil has faint brownish and grayish variations and occasionally small concretions.

In a few of the depressions and along the outer margins of the bottoms the soil is somewhat heavier and generally consists of a dark-brown compact clay loam or silty clay, underlain by a dark-brown or dark grayish brown, compact, moderately plastic clay, containing faint mottlings of brown and bluish gray and small dark-colored iron concretions.

The largest and most typical area is along Beaver Creek. Smaller areas lie along Beaver Creek and in a few other isolated first-bottom positions. The large Beaver Creek area at one point is over 1 mile wide, while the other areas do not average over one-fourth mile wide.

The surface in practically all areas is nearly level and smooth. It is low lying, consequently water drains from the surface slowly, and the dense subsoil retards free underdrainage. After rains and overflows, water often stands for some time in the flatter and slightly depressed positions.

Owing to the improvements in the way of ditching and the straightening of stream channels now in progress, more of the type is being cultivated than formerly. Good results are obtained with the principal farm crops on the better drained areas.

The principal crops are corn, which leads in importance, and wheat and oats. Forage crops, such as Sudan grass and sorgho, are sometimes grown. Pastures of bluegrass and native grasses furnish good grazing.

This soil is somewhat more difficult to handle than the lighter textured soils. It requires relatively heavy equipment, and plowing and cultivating must be done when it is not too wet, otherwise clods form which are difficult to break down. The retarded drainage makes the soil slow to warm up in the spring.

LAMOURE SILTY CLAY LOAM.

The surface soil of the Lamoure silty clay loam is a very dark brown or nearly black silty clay loam or clay loam, well supplied with organic matter, 10 to 12 inches deep. This changes gradually into a subsoil of dull dark brown, rather stiff and plastic loamy clay, which at around 28 or 30 inches becomes a gray or brownish-gray clay usually mottled with brown or lighter gray and rusty-brown concretionary matter. The surface soil and the upper subsoil contain

fine particles of lime. The surface soil is highly calcareous, but the lower subsoil shows less evidence of lime. The broader areas have heavier textures than some of the narrower strips where the surface has received sandy wash from sandy or more loamy uplands.

This type occurs in a few small areas, mostly in the northeastern part of the county, the most important being at and near Zook and Granger and north of Ingersoll. A small area lies about 2 miles northeast of Dawson. The type has been formed by the deposition of more or less calcareous glacial-drift materials along the drainage courses. The low, poorly drained positions have not favored the leaching out of the lime content as much as in the Wabash soils.

The surface is generally smooth and nearly level. The type is subject to overflow at varying intervals, and in its natural condition is poorly drained. Except in the drier seasons, the water table is usually within the 3-foot depth. In places ditching and tiling have greatly improved the drainage.

Most of this type in Dallas County is used for pasture. Good stands of bluegrass and native grasses provide excellent grazing. A few places have been drained and in these places general crops give satisfactory results. This type, except for its being subject to overflow, resembles the Webster soils in its agricultural adaptations and is managed in much the same way.

SARPY FINE SANDY LOAM.

The surface soil of the Sarpy fine sandy loam generally consists of 10 to 12 inches of brown or grayish-brown fine sandy loam. This passes gradually into a light-brown fine sandy loam or loamy fine sand. Coarse sand and gravel are encountered commonly in the lower subsoil and to some extent in the upper part of the soil section. Considerable textural variation is found, depending on the location. Adjacent to the rivers in a few narrow strips in the bends are deposits of loose sand and gravel which are modified in character with each important rise in the stream. If these were of sufficient extent, they would be mapped as Riverwash.

This soil type is associated with the Sarpy silt loam and in places occupies the whole width of the first bottom. A few areas exceed one-fourth mile in width, though most areas are narrower. The type is extensive between Dawson and Perry and for several miles down the river. The surface is flat and fairly smooth and the drainage is good.

Probably 70 or 75 per cent of the type is in cultivation, the remainder being in pasture and forest. Corn is the most important crop. Small grains and sorgho are grown to some extent. The yields are fairly good in seasons of well-distributed rainfall, but in dry seasons they are likely to be low. Sandburs and cockleburs are common, and the seeds of these and other weeds are disseminated by the overflow waters.

SARPY SILT LOAM.

The surface soil of the Sarpy silt loam to a depth of 8 to 10 inches is a brown or dull grayish brown, somewhat compact, but fairly friable silt loam. This grades through 6 to 12 inches into a light-brown, friable very fine sandy loam or loam, and at 24 to 30 inches

into a light-brown fine sandy loam or loamy fine sand. In places the silt loam material extends to a depth of 30 inches or more, but is underlain by lighter textured deposits. The surface soil has a moderate amount of organic matter, but is not so well supplied as the Wabash soils.

The Sarpy silt loam occurs on first bottoms along the Raccoon River and the Des Moines River. In places it occupies positions bordering the uplands, and the Sarpy fine sandy loam lies between it and the river; in other places it occupies the entire width of the bottom. Its typical position is in the bends of the streams, where the land is protected from the swifter overflow currents. It is developed mainly in detached areas, usually not over one-fourth mile wide.

The surface is nearly level or slightly sloping, and in places uneven, owing to the presence of abandoned channels. With the exception of a few swales and old sloughs, the drainage is good, and overflows do not often come in the growing season to seriously injure crops. The soil retains moisture well, though in a few places where the coarse substratum is especially loose or lies close to the surface the soil is sometimes droughty.

Probably half or more of the type is under cultivation, the rest being reserved for pasture and for timber. Elm, walnut, locust, willow, cottonwood, and red haw are typical species. Native grasses and bluegrass furnish good grazing.

Corn is the most important crop, followed by oats and wheat. Forage crops, such as Sudan grass and sorgho, and occasionally truck crops, are grown. Hog and cattle raising are important livestock industries. Corn gives yields averaging 45 to 50 bushels, oats from 35 to 45 bushels, and wheat about 20 bushels. Mixed clover and timothy yields average about 1½ tons.

Well-located and improved land reasonably free from overflow is valued at $250 to $300 an acre. Less desirable land, more subject to overflow, is priced at $100 to $200 an acre.

MUCK AND PEAT.

Muck and peat consist of dark-brown to black masses of more or less decomposed organic matter which vary in thickness from about 8 inches to more than 36 inches. In most places at some depth within the 3-foot section the organic material in the lower part passes into an inch or two of bluish-black mucky clay which gives way to a light-gray or light bluish gray, sticky, plastic sandy clay slightly mottled or stained with brown or yellowish brown. The surface material in the deeper and broader areas generally has a distinctly fibrous character. At the margins of most areas and in the shallower places there is some admixture of clayey and sandy materials washed from near-by slopes. The subsoil is highly calcareous and effervesces freely with acid.

Muck and peat are found in shallow depressions, formerly small lakes or ponds, in which the remains of plants have gradually accumulated. Only a few small scattered areas are of sufficient size to map, notably about 3½ and 6 miles south of Dawson and northeast of Dallas Center. The positions are about the same as those occupied by the Webster soils, and the material represents an ex-

treme development of those soils. The natural drainage is poor, and for much of the year the organic mass remains in a saturated condition. Practically all the areas can be drained, and some have been improved by drainage.

Little or no special use has been made of reclaimed areas other than the growing of the general crops. Muck and peat are well adapted to growing various truck crops, such as cabbage, onions, celery, tomatoes, and mint.

SUMMARY.

Dallas County is situated in the southwest-central part of Iowa, in the fourth tier of counties north of the Missouri State line. It is nearly square and contains 589 square miles, or 376,960 acres.

The surface is that of an even drift-covered plain, which in the southern part of the county has received a mantle of silty material or loess. Along the larger streams the country has become somewhat dissected and rolling, but back from these drainage ways the surface is flat to gently undulating. The drainage conforms to the southeasterly slope of the region and is carried by the Raccoon River and its branches, by Beaver Creek, and by the Des Moines River, which ultimately receives all the drainage waters. The general elevation ranges from 1,000 to 1,100 feet above sea level.

Settlement began in 1845. The population has increased steadily, and in 1920 was 25,120.

Good railroad transportation is afforded by four steam roads and one electric line, which give access to the larger markets.

The mean annual temperature is 48.5° F. The mean annual rainfall is 32.7 inches, which is suitably distributed for the growing of all the staple crops. The average growing season covers a period of about 162 days.

The agriculture of the county consists of combined grain and livestock farming. Corn is the leading crop, followed by oats, wheat, barley, clover, and timothy.

Hog and beef-cattle raising are the important livestock industries. Dairying is carried on to some extent, especially in the northern part of the county. Some attention is given the sheep industry and to horse breeding.

Farms are well improved and generally suitably equipped with buildings and machinery. Systems of rotation and fertilization are not well worked out, especially on rented farms. Fertilizers used consist principally of barnyard manure.

In 1920 there were 2,320 farms in the county, with an average size of 153.6 acres. About 46 per cent of the farms are operated by tenants. Share renting on halves is more common, but some land is rented on a cash basis.

The price of good, well-located farm land is not far from $300 an acre.

Most of the soils of Dallas County are dark colored, being coextensive with the prairie areas. The rougher forested areas have soils of light color. All the soil materials are transported, having been deposited by glaciers, winds, and water. There are recognized in the county 16 soil series, with 28 types and 2 phases, besides Muck and peat.

The dark-colored upland soils are classed in the Carrington, Clarion, Webster, Shelby, Tama, and Grundy series. The first four series have soils of glacial origin and the last two include soils of loessial origin.

The Carrington loam is one of the leading upland types. It has an undulating to gently rolling surface and good drainage and is important for producing corn and other farm crops. A shallow phase is found on slopes and the more rolling positions and is used largely for pasture.

The Carrington fine sandy loam occurs in rather small scattered areas. It is successfully used for general farming.

The Clarion loam is associated with the Carrington loam and occupies slightly more rolling or sloping country. It differs from the Carrington chiefly in being calcareous in the subsoil. It has about the same agricultural value.

The Clarion fine sandy loam has a somewhat larger area than the Carrington fine sandy loam and differs from it chiefly in containing calcareous material in the subsoil.

The Webster clay loam, when well drained, is especially adapted to corn, for which it is largely used. It occupies low-lying positions on the uplands, associated with the Carrington and Clarion loams. It is calcareous. The Webster silty clay loam occupies similar topographic positions and has much the same value.

The Shelby loam occurs mainly in the southern part of the county in association with the Tama silt loam. It is fairly well suited to the staple field crops, but a considerable part of it is used for pasture land because of its rough or steep topography.

The Tama silt loam is the leading upland soil in the southern part of the county. It has a smooth surface and is well adapted to the general farm crops. It is noncalcareous.

The Grundy silt loam has a small extent, being contained within the areas of Tama silt loam. It has a heavy dense subsoil. It is farmed in about the same way, and with improved drainage has about the same value, as the Tama silt loam.

The light-colored upland soils are included in the Clinton and Lindley series. The former is of loessial origin and the latter is largely of glacial origin.

The Clinton silt loam is developed along the Raccoon River in the southern part of the county. It is associated with the Tama silt loam but has a rougher topography, and the unimproved parts are in forest. It gives good returns with the general crops but is better adapted to small grains than to corn.

The Lindley loam is mapped mostly in the southwestern part of the county and, like the Shelby loam, has a rugged topography. It is largely used for pasture and timber, but smoother parts are cultivated successfully.

The Lindley fine sandy loam occurs along the Des Moines River. It is used with fair success in growing the general crops. A rough phase occupies steep slopes and is used for pasture and forest.

Most of the bottom soils, both the terraces and first bottoms, are dark colored. The Sarpy soils are light colored.

The Waukesha silt loam is an old terrace soil, and the most extensive of the terrace types. It is ordinarily well drained and aerated

and compares favorably in agricultural value with the Carrington loam and Tama silt loam.

The Waukesha loam is found mostly on high terraces and resembles the Carrington loam except in origin and topographic position.

The Buckner fine sandy loam is small in extent and widely scattered. It is easy to cultivate and gives fair yields of general crops.

The Bremer silty clay loam is a low terrace soil that differs from the Wabash silty clay loam mainly in its more elevated position. It is of small extent, but practically all is cultivated, and it is a productive soil for corn and other grain and forage crops. The Bremer loam and the silt loam, the latter the most extensive of the Bremer types, have agricultural values similar to those of the silty clay loam.

The O'Neill loam is developed on high terraces and is used for the leading field crops. The loose porous subsoil makes the type somewhat droughty, but in seasons of normal rainfall profitable yields are obtained. The O'Neill fine sandy loam has a small area and is associated with the loam type. It is rather droughty and is best adapted to truck crops.

The first-bottom soils are classed in the Lamoure, Wabash, and Sarpy series. The Lamoure soils differ from the Wabash soils mainly in being calcareous and having poorer natural drainage. The Sarpy soils are of lighter color and have light-textured subsoils.

The Lamoure silty clay loam, where improved in drainage, is an excellent corn soil. Most of the type in Dallas County is used for pasture.

The Wabash silty clay loam and the silt loam are found along the larger streams. Owing to the liability to overflows, only a small part, not over 20 or 25 per cent, is cultivated. These soils give excellent yields of corn where reasonably protected from overflows. Most of the areas are in pasture.

The Wabash loam is developed mainly along the smaller streams and is used chiefly for pasture. The Wabash fine sandy loam is of small extent and is used mostly for corn.

The Sarpy silt loam is mapped along the Raccoon River and the Des Moines River. About half of it is successfully used for corn, small grain, and forage crops; the remainder is in forest or pasture.

The Sarpy fine sandy loam is closely associated with the Sarpy silt loam, and a large part is used for corn and other crops.

Muck and peat represent accumulations of organic matter developed in small lakes or ponds. Only a few scattered areas are mapped. When drained and intelligently managed these areas can be made productive, especially for various truck crops. The main use at present is for pasture.

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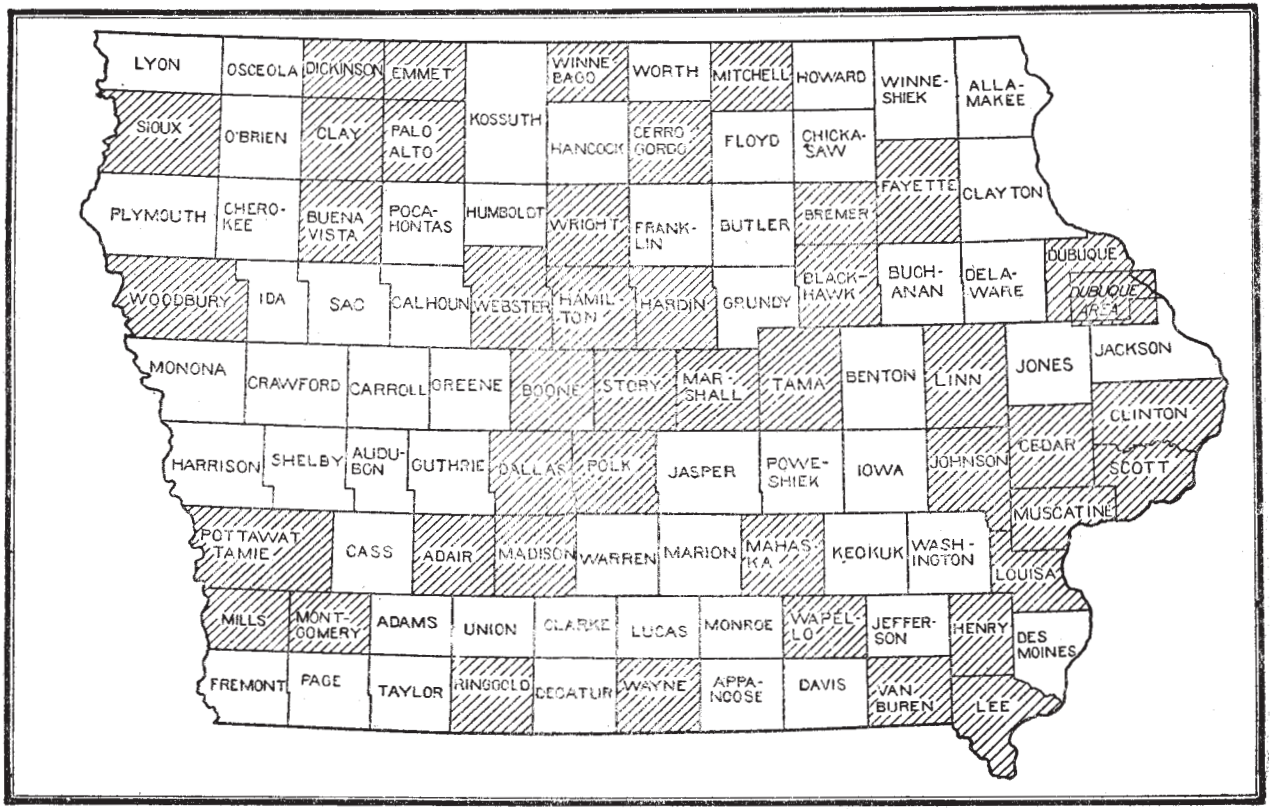

Areas surveyed in Iowa, shown by shading.

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