U. S. DEPARTMENT OF AGRICULTURE

BUREAU OF SOILS

IN COOPERATION WITH THE IOWA AGRICULTURAL EXPERIMENT STATION

SOIL SURVEY OF DELAWARE COUNTY IOWA

BY

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[Advance Sheets—Field Operations of the Bureau of Soils, 1922]

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[PUBLIC RESOLUTION—No. 9.]

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

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

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

Approved, March 14, 1904.

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

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MAP

Soil map, Delaware County sheet, Iowa.

SOIL SURVEY OF DELAWARE COUNTY, IOWA

By CLARENCE LOUNSBURY, of the U. S. Department of Agriculture, in Charge, and BRYAN BOATMAN, of the Iowa Agricultural Experiment Station

DESCRIPTION OF THE AREA

Delaware County is situated in northeastern Iowa and lies directly west of Dubuque. The northeastern corner is about 8 or 10 miles from the Mississippi River. The county is cut into approximately symmetrical north and south halves by the second correction line. It includes 16 congressional townships, the 8 townships north of the correction line being slightly larger than those south of it. The land area is 571 square miles, or 365,440 acres.

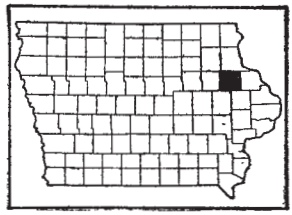

FIG. 1.—Sketch map showing location of the Delaware County area, Iowa

Delaware County has two main topographical divisions. The first, occupying about two-thirds of the area, in general in the southwestern part, owes its configuration to the geologically recent Iowan glaciation. The smaller division, lying northeast of a rather sinuous line beginning near the northwestern corner of Elk Township and extending in a southeasterly direction to a point near the southwestern corner of Bremen Township, is the loessial area, which is underlain by the Kansan drift, or in a few localities by native rock.[1]

The first division is characterized by a succession of gently rounded eminences and broad swales, usually distributed in a fingerlike arrangement which have not developed well-defined drainage channels. The heads of the sloughs are depressions which mark the beginnings of drainage courses leading to the larger streams. This topography shows no erosional forms, the irregularities of the surface being due mainly to the molding of the glacial ice. The Iowan drift plain is best developed southwest of the Maquoketa River, in Adams, Hazel Green, Prairie, Milo, and Coffins Grove Townships. Northeast of the river this drift plain is well represented in Delaware, Honey Creek, Oneida, and Bremen Townships.

Certain minor exceptions from the topography may be noted. Near the margin of the Iowan glaciation low, domelike, rocky knobs project above the drift, indicating that the movement of the drift was not active enough nor deep enough to obliterate them. Other areas marked by weathered crags and irregular rock masses, occupying many acres in some places, show little evidence of glaciation. A typical example of the former is in the northwest quarter of south-

[1] The statements in this report in reference to topographic development and geology are based largely on material contained in the Geology of Delaware County, Iowa, by Samuel Calvin, Iowa Geological Survey, Annual Report, 1897.

west quarter of section 2, Delaware Township, and of the latter in the southwest quarter of section 2 and the southeast quarter of section 3, Delhi Township. Along the margin of the Iowan drift are elongated hills or ridges, either isolated or more or less connected, some of which extend for miles. These ridges, known as "pahas," usually have a core of rock or of Kansan drift, over which rests a thin mantle of loess. Good examples of this formation are found in sections 3, 4, and 12, Honey Creek Township, and in sections 6, 7, and 18 of Elk Township. In places sand ridges or dunelike formations occur in the Iowan drift area. A typical sand ridge lies in the southeast corner of section 1, Delaware Township, and another is about 1 mile northwest of Earlville.

The loessial area lying northeast of the Iowan drift has suffered considerable erosion during two separate periods, the first during a long interval between the deposition of the Kansan drift and the deposition of the loess. Over the deeply carved drift the loess was deposited, leaving a surface whose form was governed to a large extent by the preloessial surface. Erosion has progressed into this loess and has carved the surface into ridges and narrow valleys, so that there are no sloughs, the drainage is nearly perfect, and water courses are well defined. The margins of these regions, where the loess hills begin and the Iowan drift ends, are always higher than the adjacent drift plains. In places the difference in topography is very marked—on one side a gently undulating plain without trace of erosional topographic forms, on the other side sharply rounded hills and V-shaped valleys, the whole surface deeply trenched by erosion. Within this region are two deep valleys, 200 to 280 feet in depth, in which flow Elk Creek and Little Turkey River. These valleys are not limited to erosion in drift or loess, but are gorges cut through ledge after ledge of Niagara limestone into the underlying Maquoketa shales, and their origin is believed to be preglacial.

Within the Iowan drift region are two areas which evidently never were invaded by the Iowan ice flow. One of these occupies the central part of Richland Township and the other embraces three-fourths of Delhi Township and parts of Milo, North Fork, South Fork, and Union Townships. The topography is mainly erosional, partly resembling that of the loess region and partly that of the driftless area. Excepting the deeper valleys, the land has a higher average elevation than that of the Iowan drift plain. Both these areas are traversed by the Maquoketa River. In each there are deep deposits of loess, exhibiting the rounded hills, steep slopes, and sharp valleys that result from erosion. In each are spaces free from both loess and drift, in which steep rocky cliffs, isolated towers, and other features of driftless topography are characteristically developed.

Well-defined terraces, composed largely of stratified sands and gravels, occur along most of the streams within the Iowan drift margin, but nearly all owe their origin to outwash from the Kansan glacier. The terraces vary in elevation from 10 to 50 feet above the adjacent streams. The rise to the uplands is usually gradual. Narrow bands of first-bottom lands border most of the streams, but their total area is small in proportion to the area of the county.

The average elevation of the county is between 1,000 and 1,100 feet above sea level, but individual elevations range from a maximum of about 1,200 feet about 1 mile south of Colesburg and 1 to 2 miles north of Forestville to a minimum of about 820 feet at the county line where the Maquoketa River enters Jones County.

The Maquoketa River, which carries nearly all the drainage of Delaware County, enters the county in Richland Township and flows southeast, leaving the county in South Fork Township. Above Forestville the valley for some distance is a rock-walled gorge cut into Niagara limestone and retains its gorgelike character for 2 or 3 miles below Forestville. In the southern part of Richland Township the stream enters the Iowan drift plain, and 2 miles below Manchester it leaves the plain to follow a canyon in the highlands that extend to the southern boundary of the county.

The tributaries of the Maquoketa River from the west are mostly small prairie streams that have their headwaters in the sloughs of the Iowan drift plain. The most important of these, Prairie Creek, which has its source in Buchanan County and flows for the most part in a shallow depression a little below that of the adjacent prairie, joins the river a mile above Manchester.

Buck Creek and its branches drain the undulating prairie of Hazel Green Township and parts of Milo and Adams Townships. The upper branches have no well-defined channels, but in the western part of Union Township the creek enters a gap in the loess-covered plateau and continues in a deep valley, sometimes within rocky walls, until it joins the river.

From the east, Honey Creek, with its principal tributary, Lindsey Creek, drains most of Honey Creek Township and the northern part of Delaware Township. Starting as a simple prairie stream, it flows in a shallow channel, but below a point near the southern part of Honey Creek Township it has a broader valley.

Plum Creek, the largest affluent of the Maquoketa in Delaware County, originates from many ramifying branches in northern Oneida and Bremen and southwestern Elk Townships. It flows southward through an uneroded drift plain until east of Earlville it penetrates the Delhi plateau and flows through rock gorges and loess hills for the remainder of its course.

The North Fork Maquoketa River, near the eastern county boundary, flows southward through a deep valley, except that for a short distance below Rockville it passes through a part of the smoother Iowan plain. Its chief affluent is Bear Creek, which flows southward in a moderately shallow valley until it enters the river at Dyersville.

The northern parts of Elk and Colony Townships are drained by Elk Creek and Little Turkey River, which flow northward in deeply cut valleys.

Buffalo Creek, which carries the drainage in the southwestern part of the county, is a prairie stream that flows in a broad depression in the drift. The insignificant amount of erosion it has accomplished is in striking contrast to the extensive erosion wrought in the valley of Little Turkey River in the northeastern corner of the county.

Water power has been developed along the course of the Maquoketa River and one or two of its tributaries. At present water power is

utilized at Forestville, Manchester, Hopkinton, and at a mill about 1 mile above Manchester.

Delaware County, originally a part of Dubuque County, was established December 20, 1839, and became fully organized in 1844. For a number of years the county seat was at Delhi, but since 1880 it has been at Manchester. The first settler is said to have arrived in 1836, and in the immediately succeeding years increasing numbers of settlers established themselves in the county. Most of the early settlers came from the Eastern States and some from Ireland and Scotland. Later, Germans settled in the eastern part of the county, and Bremen Township is inhabited largely by people of this nationality and their descendants.

In 1920 the county had 18,183 inhabitants, of which 3,111 are classed as urban. The population is fairly evenly distributed over the county, and the rural population averages 26.4 persons to the square mile.

Manchester, the county seat, with a population of 3,111, is the largest town. Hopkinton, with a population of 759, is next in size. Lenox College is located there. Other important towns are Edgewood, Earlville, Greeley, Ryan, Delhi, Colesburg, and Masonville. Dyersville, with a population of 1,933, lies just over the line in Dubuque County. All these towns have creameries and, with the exception of Colesburg, are shipping points.

Delaware County is well supplied with railroads, no point being more than about 10 miles from a station. Two lines leading to Chicago, the Illinois Central and the Chicago Great Western, cross the county in an east-west direction. A branch of the Illinois Central leads south from Manchester to Cedar Rapids. A short line, the Manchester & Oneida Railway, connects with the Chicago Great Western at Oneida. A branch of the Chicago, Milwaukee & St. Paul Railway, connecting Cedar Rapids and Calmar, passes through the county, connecting with the Illinois Central at Delaware, and with the Chicago Great Western at Oneida.

One graveled road leads east and west through the county, and other extensions are under way. The other important roads are well graded and kept dragged. Rural mail delivery and telephone service are established everywhere in the county. Rural schools are well kept and to some extent school districts have been consolidated with those of near-by towns.

Chicago, 228.6 miles from Manchester, constitutes the chief market for livestock and other products of the county. Some of the butter goes to New York and other distant points.

CLIMATE

The precipitation and temperatures in the county are ordinarily favorable for the best crop production. The mean annual rainfall, as recorded at Delaware, is 30.9 inches, and over 70 per cent of this falls during the growing season from April to September, inclusive. The rainfall is heaviest early in the season, but is usually favorably distributed during the remainder of the growing period. In occasional years droughts occur during July and August. The lowest precipitation occurs during December, January, and February, with

an average total of 3.13 inches. During these months there is an average snowfall of 25 to 30 inches. Little snow falls in April, and usually farming operations can be started during the latter part of March.

The mean annual temperature is 45.7° F. The lowest temperature recorded at Delaware is —28° F. in January, and the highest is 103° F. in July. The coldest weather occurs in January and February, with a mean temperature of about 17.2° F., and the warmest weather occurs in July. The average date of the first killing frost in the fall is October 5 and of the last in spring, May 3. The earliest recorded killing frost in the fall occurred on September 12 and the latest in the spring, May 27. This allows an average growing season of about 155 days, during which all ordinary farm crops can safely mature.

The following table shows the more important climatic data, as compiled from the records of the Weather Bureau station at Delaware:

Normal monthly, seasonal, and annual temperature and precipitation at Delaware

[Elevation, 1,083 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1901)	Total amount for the wettest year (1911)
	°F.	°F.	°F.	Inches	Inches	Inches
December	22.0	59	−19	1.34	1.07	2.10
January	15.8	54	−28	.90	.74	.41
February	18.7	59	−26	.89	.55	2.90
Winter	18.8	59	−28	3.13	2.36	5.41
March	31.2	81	−14	1.69	2.16	.78
April	46.7	85	15	2.86	1.18	3.48
May	58.9	89	25	4.50	1.70	5.33
Spring	45.6	89	−14	9.05	5.04	9.59
June	67.8	97	37	3.95	2.72	3.17
July	73.0	103	44	3.69	1.52	5.31
August	70.0	99	35	3.76	.62	7.64
Summer	70.3	103	35	11.40	4.86	16.12
September	61.9	100	28	3.38	3.77	2.83
October	49.1	86	16	2.30	2.17	5.43
November	33.6	72	−3	1.64	.48	3.23
Fall	48.2	100	−3	7.32	6.42	11.49
Year	45.7	103	−28	30.90	18.68	42.61

AGRICULTURE

The early settlers found wide stretches of prairie, with timber growing on the rugged slopes and along the watercourses. In places the forest had much undergrowth and in others there were openings with some brush and grass. Settlements were first made as a rule

along the streams and in forest areas, where water and fuel were available and where protection was afforded from prairie fires.

The first settlers subsisted by hunting and trading with the Indians, but soon began to grow crops in a small way. All domestic animals roamed at large on the prairies and in the woods. Cattle were sold to buyers who drove them to eastern markets.

Early crops are said to have been uncertain, as the corn grown was not acclimated and failed to ripen, though in a few years satisfactory varieties were developed. Wheat was early an important crop and grain of fine quality was produced on the virgin soils. Yields ranged from 25 to 40 bushels, depending on the way it was planted and the care it received. As the land became less productive, more attention was given to dairying, which became more profitable than wheat production. The butter produced was packed in tubs of about 120 pounds and marketed in the fall and winter at Mississippi River points. The county early became the banner county in the State for dairy products and was awarded first premium on butter at the Centennial Exposition at Philadelphia in 1876. Delaware County is reputed to have had the first cooperative creamery in the country. This was situated on Spring Branch and began operations in 1872.

The table below shows the acreage and production of the leading crops of the county, as compiled from the last five decennial reports of the Federal census:

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

Year	Corn		Oats		Wheat		Rye		Barley	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
1879	88,370	3,654,947	33,099	1,194,034	16,779	106,065	1,324	16,874	973	16,052
1889	72,721	2,668,768	40,202	1,659,636	1,475	14,607	1,066	14,906	1,467	47,130
1899	93,508	3,796,720	50,759	1,954,080	1,214	19,910	1,378	18,130	6,750	227,690
1909	94,708	3,381,940	41,570	1,356,882	321	6,243	1,328	19,030	15,325	329,433
1919	73,897	3,101,056	57,777	1,822,427	2,708	41,780	2,433	35,500	6,103	132,207

Corn always has been the leading crop, followed by oats and timothy and clover. The other crops which are produced in varying quantities from year to year include wheat, rye, barley, buckwheat, potatoes, sorgo, and a variety of fruits and vegetables to meet the home needs, with a small surplus for sale in local markets.

At present practically all the corn is fed upon the farms, and occasionally corn or mill feed is purchased as the need arises. Corn is grown on practically all soils, but is produced more extensively on the Tama silt loam and the better areas of the Carrington soils.

Most of the oat crop is fed to work stock and other farm animals, though a surplus is sometimes marketed. Since the discontinuance of the war demands for wheat, the acreage of wheat has been much curtailed, but when grown it is largely a cash crop. Part of the rye crop is marketed. Barley is a subsistence crop. On some farms, especially along the Chicago Great Western Railroad, sweet corn is produced for canning. It is shipped to Dyersville, Dubuque County. In 1919, according to the Iowa Year Book, 492 acres were devoted to sweet corn, yielding a total of 751 tons of green corn.

Hay is produced for home consumption. In 1919 there were 42,088 acres devoted to tame grasses, yielding 70,501 tons. Of this total, 14,723 tons were timothy alone, 53,104 tons timothy and clover mixed, and 2,327 tons clover alone. Also 7,460 bushels of timothy seed were produced from 1,650 acres, and 799 bushels of clover seed from 877 acres. Wild hay was cut in 1919 to the extent of 7,133 tons from 5,308 acres. Alfalfa is grown in occasional fields in an experimental way.

The principal sources of farm income are the animal industries. On many farms, especially on the better corn soils, the income from hogs easily leads. On January 1, 1920, according to the census, there were 75,963 hogs on farms, 8,065 sheep, and 53,001 head of cattle. The number of hogs is usually about 50 per cent greater in July than in January. The cattle include 22,750 dairy cows, 16,710 other dairy cattle, and 13,541 beef cattle.

Dairying is an important industry in practically all parts of the county. Of the dairy breeds the Holstein leads, with a few Guernseys. Considerable milk is produced from Shorthorns and cows of mixed breeding. The cream is separated on the farm and is transported to the creameries about each alternate day by collectors on established routes. Cream testing 25 to 30 per cent butterfat is preferred, but it varies more or less. At the creameries, which are located in most of the towns, the butter manufactured is packed in about 64-pound tubs and shipped to New York or other eastern points. The creamery at Thorpe at present receives whole milk. In the neighborhood of the larger towns a few dairies supply patrons with whole milk.

Of the beef breeds of cattle, Shorthorns are most numerous, though there are some Herefords and a few Aberdeen Angus. Some cattle are shipped in as feeders and later reshipped in finished condition.

Potatoes never have been an important crop, but farmers usually grow enough for home use and often a small surplus for local markets. Potatoes to supply the needs of towns are shipped in to some extent. According to the United States census there were 969 acres of potatoes in 1919, yielding a total of 46,660 bushels.

Sheep raising is usually an incidental industry, being more general on farms on the rougher lands. Most of the sheep are grade Shropshires, but many purebred sires are used. The census gives the value of wool sold in 1919 as $23,148.

The average farmer, in addition to supplying his home requirements, turns off on the market from 30 to 50 fattened hogs annually and a few sell as many as 75 or 100. The leading breeds are Poland-China, Duroc-Jersey, and Chester White, with a few others, chiefly Berkshire and Hampshire. Cholera is the chief drawback in hog raising, and some losses are usually suffered annually from this disease. Vaccination is generally practiced with good results.

The breeding of horses is confined mostly to raising one or two colts annually to maintain the efficiency of the work stock and have an occasional animal for sale. A few mules are raised. The low price of horses in recent years has discouraged horse breeding, though one or two breeders in the county have made a specialty of this industry. Percheron and Belgian horses are most common.

The usual line of poultry, consisting of chickens and often turkeys, geese, and ducks, is raised on practically every farm. Some of the poultry is purebred or nearly so, the chickens being mainly Plymouth Rocks or Leghorns. Eggs and poultry are handled largely through dealers in the local towns. In 1919 the total value of poultry and eggs produced was $825,777. The census reported 331,178 chickens and 8,696 other poultry on farms on January 1, 1920, and the egg production for 1919 as 1,470,108 dozen.

On the average 160-acre farm there are about 12 to 15 cows, more or less in milk, with varying numbers of steers and other young cattle, about 60 hogs, 7 to 8 horses, and 100 to 200 chickens. Sheep are kept in variable numbers on some farms.

Only the broader relationships of soils to crops, such as are encountered in general experience, are recognized. For instance, the Tama silt loam and better areas of the Carrington soils are recognized as well suited to corn, as well as small grains and other general crops. The Clyde silt loam, when drained, and the well-drained, heavier stream-bottom soils are also well adapted to corn, but less well adapted for small grains, as the plentiful supply of organic matter induces a rank growth of straw and the crop is likely to lodge.

As a rule systematic crop rotations are not followed, though their value is recognized and alternation of crops is generally practiced. In some instances corn is grown a number of years in succession with little diminution in yield. Many farmers in their experience have found a 4-year or 5-year rotation well suited to most of the soils of the county. This consists of corn one or two years, oats one year, and timothy and clover two or three years, the latter crops being seeded with the oats as a nurse crop.

In the preparation of the land for corn, only a small part is fall plowed, though the amount of such plowing varies with the weather and pressure of other work. The land is turned 5 to 6 inches, usually with a three-horse to six-horse team, but an increasing proportion of the plowing is now done with tractors. When oats follow corn the seed bed is usually prepared by disking and is seldom turned. Corn is planted if possible during the first 10 days of May. Oats and barley, including the grass, are sown during the first week in April. Winter wheat, when grown, and rye are sown if possible about September 20. Corn is cultivated four or five times until early in July, when the crop is "laid by." The corn is generally gathered from the standing stalks after it has matured and seasoned, though a small part is cut and shocked to preserve the fodder. Corn for silage is usually sown in drills and cut with corn harvesters at the time of silo filling.

The corn is mainly of the dent varieties, Reid Yellow Dent being common, with much Silver King and Silvermine and some "calico" corn. Oats are largely Kherson, Albion (Iowa No. 103), and Richland (Iowa No. 105); the Iowar is found to be a heavy yielder. Wheat is usually the Turkey variety, and rye the Rosen.

Most of the farm buildings are well constructed, painted, and well suited for their purpose. Barns are of moderate size, and many are of the basement construction common in dairy regions. A few dairymen have power milkers, litter carriers, and other labor-saving equipment. Practically every dairy farm has one or more silos. Many

houses are equipped with electric or acetylene light and modern plumbing. The land is fenced largely with barbed wire and to some extent with woven wire, especially woven-wire bases where hogs are confined.

The important farm implements include sulky and gang plows, disk harrows, spike-tooth harrows, check-row corn planters, one-row and two-row cultivators, grain drills, mowers, tedders, hayrakes, loaders, stackers, grain binders, corn harvesters, corn elevators, manure spreaders, and occasionally motor trucks. Enough threshing machines are owned in the county to handle the grain crop seasonably.

The fertilizers used are principally stable manures, which are generally well conserved and utilized. Manure is mostly applied on land for corn, and to some extent for wheat or rye, or as top-dressing. A few farmers use about 200 pounds per acre of 16 per cent acid phosphate on the corn crop. Lime is being used to some extent to correct soil acidity. For 1919 the census reports 38 farms using commercial fertilizers at an average expenditure of $117.05 per farm.

At present (1922) the supply of farm labor is somewhat scarce, though much more plentiful than for several years past. Wages paid vary around $40 to $45 with board and washing for single men. Married men receive about $50 and the use of a house, garden, milk, and opportunity for raising poultry. Day laborers are paid from $2 to $2.25 a day. During the season of 1922 prices for corn picking were about 4 cents a bushel where an elevator was used and 4½ cents when the corn was shoveled into the crib.

According to the 1920 census, about 95.2 per cent of the area of the county is included in farms, and 80.1 per cent of the farm land is rated as improved. The average size is given as 152.3 acres. The range in size varies from about 80 acres on some of the better lands to 250 to 300 acres in some of the more rugged parts of the county.

In 1920 the census reported 59.5 per cent of the farms operated by owners, 40.1 per cent by tenants, and 0.4 per cent by managers. Since 1880, when 78 per cent were operated by owners, there has been a gradual decrease in the number of farms so operated. When land is rented the share rent is more common, the tenant furnishing tools and work stock and receiving one-half the produce. In some cases the renter receives three-fifths of the produce. When cash rent is paid, this ranges from $5 to $10 an acre. Sometimes there is a combination of share and cash rents when the farm has an abundance of pasture or wooded land. Farm contracts begin and end on March 1.

Since the cessation of boom prices that prevailed during the progress of the World War, comparatively little land is changing hands. The assessed value of land in farms in 1920 is given by the census as $154.16 an acre. The average value of all farm property was given as $32,470 per farm, of which 72.3 per cent was invested in land, 14.8 per cent in buildings, 4.3 per cent in implements, and 8.6 per cent in domestic animals. The best lands are considered to be worth around $250 an acre, the prices ranging downward according to condition of improvements, distance to market, and kind of soil, to $50 or $60 an acre for some of the more rugged or forested areas not well suited for cultivated crops.

SOILS

Delaware County, Iowa, is situated in the prairie region of the Middle West, where the relatively smooth topography of most of the region and the abundant moisture supply have afforded suitable environment for a luxuriant grass vegetation. The predominance of poorly drained land and the annual sweep of fires have tended to retard tree growth. Where erosion has developed a greater relief, with the resulting improvement of the drainage of the soil, some encroachment of forest from the sheltered, more broken locations has taken place. Under these conditions the soils of the smoother uplands have developed under a grass cover and the soils of the more rugged areas along stream valleys have assumed a distinctive character under a forest cover.

The soils of the county may be considered under two main divisions: (1) Those developed under an excess of soil moisture and (2) those developed under optimum soil-moisture conditions. There has been sufficient moisture in all the soils to leach away the soluble salts, including the lime carbonate and other carbonates which evidently once were present in abundance, at least in some of the soils.

The first of the above groups includes soils of prevailingly dark color, commonly nearly black, with a surface layer varying from about 8 to 20 or more inches, which rests on somewhat heavier material, varying in color, in degree of oxidation, and more or less mottled with yellow, gray, and brown. These soils, which are not extensive in Delaware County, include the Clyde silt loam, Bremer silt loam, and the heavier members of the Wabash series.

Of the second group of soils there are two subgroups, one dark colored and another light colored.

The first of these subgroups has soils varying in color from dark brown to nearly black. The surface soils range in depth from about 8 to 18 inches and rest on well-oxidized material of light-brown to yellowish-brown color, usually heavier than the surface soil. Drainage conditions in soil and subsoil are good. The soils in this subgroup embrace the Tama, Carrington, O'Neill, Waukesha, Judson, and the more loamy soils of the Wabash and Cass series. These soils predominate in the county and support the greater part of the agriculture of the area.

The second subgroup of well-drained soils have profiles similar to those of the first subgroup except in the color of the upper part. The surface soils consist of light-brown to grayish-brown or brown material, 8 to 12 inches deep, and are underlain by brown or yellowish-brown, somewhat heavier material, rather compact in some of the heavier textured soils and coarsely granular in others. These light-colored soils are nearly coextensive with the forested areas as they existed at the time of the arrival of white settlers. This subgroup includes the soils of the Clinton, Fayette, Lindley, and Genesee series.

The soils mentioned in these groups are differentiated into soil series on the basis of differences in the color and structure of the soils and in the source, character, and processes of accumulation of the materials composing the soils. Each series consists of a num-

ber of soil types which differ from one another in the texture or relative coarseness or fineness of the surface soil.

The materials from which the soils of the county are developed fall mainly into two divisions: (1) those derived from silt deposits commonly correlated by geologists as loess, and (2) those derived from glacial drift.

The typical loess formation is found in the northeastern part of the county, where it forms a mantle over the older rocks. It occurs also in the vicinity of Delhi and extends southward along the river to the southern boundary of the county. A few other islandlike or "paha" formations consist of loess or fine-grained material closely resembling loess. Altogether about one-third of the area of the county is loess covered.

The material is of uniform yellowish color, and in the 3-foot soil section its original lime content is entirely leached out. This formation gives rise to a dark-colored prairie soil, the Tama silt loam, in part at least to the Dodgeville silt loam, and in the forested areas to three light-colored soils, the Clinton silt loam, the Clinton very fine sandy loam, and the Fayette silt loam.

The glacial depositions vary greatly in age in different parts of the county, there being an old series described by geologists as Kansan and pre-Kansan in age and a younger series described as Iowan in age.[2]

The older drift differs from the younger in its more thoroughly leached condition and in its oxidation in places to a reddish color. Associated with these old drift deposits are extensive beds of gravel known as Buchanan gravels. This gravel appears to have been carried to some extent over upland positions as well as through the valleys.

The greater part of the county, approximately two-thirds, is covered with the Iowan drift, which gives rise to broad areas of soils. This material consists of a light-yellow clay, originally calcareous, but considerably changed by weathering and oxidation. The freedom from erosion, as indicated by the smooth, undulating topography, and the presence of bowlders of various sizes scattered over the surface, also characterize this formation.

The Iowan formation gives rise to four dark-colored soil series, the Carrington, Shelby, Thurston, and Clyde, and one light-colored series, the Lindley.

Beneath the drift deposits are beds of consolidated limestone. These are exposed in small areas in various parts of the county and have weathered into soils which have been identified as members of the Dodgeville and Gasconade series.

The larger streams are flanked by terraces, in places exceeding a mile in width. Most of these are glacial terraces formed from outwash material of the Buchanan gravels and evidently some outwash from the Iowan drift. Some of the lower terraces appear to be made up of more recent materials washed from the adjacent uplands. These terraces give rise to soils of the O'Neill, Judson, Waukesha, and Bremer series.

[2] Geology of Delaware County, Iowa, by Samuel Calvin, Iowa Geological Survey, Annual Report, 1897.

The larger streams have developed flood plains or first bottoms of greater or less width, which are still receiving sediment composed of reworked material washed from the adjacent glacial and loessial uplands. The soils occupying these bottoms are classified in the Wabash, Cass, and Genesee series.

The types of the Carrington series have dark-brown surface soils and a yellow to light-brown subsoil. They are derived through weathering of the glacial till, though the silty types may be modified to some extent by loess. The topography is gently undulating to rolling and the drainage is usually good. Neither the soils nor the subsoil are calcareous. The Carrington sandy loam, fine sandy loam, loam, and silt loam are mapped in Delaware County.

The types of the Clyde series are dark gray, dark brown, or black, and the subsoil is gray or yellow, usually mottled. These soils have been developed from glacial drift under conditions of poor drainage and require artificial drainage before they can be farmed. They are noncalcareous and usually show strong acid reaction to litmus paper. The Clyde silt loam is mapped.

The surface soils of the types included in the Shelby series are dark brown to almost black in color and usually rather shallow. The subsoil is composed of yellow, reddish-brown, or brown sticky sandy clay, in places containing coarse sand and gravel. The subsoil is rarely calcareous. The material is of Iowan drift in this area, but usually Kansan drift in other regions. One type, the sandy loam, occurs in this county.

The Lindley series comprises soils that are generally yellowish brown, ranging from gray on the one hand to brown on the other. The subsoil is lighter colored, being generally brownish yellow. The Lindley series differs from the Shelby in the lighter color of the surface soils. In Delaware County the sandy loam is mapped.

The types grouped in the Clinton series are characterized by gray or dark-gray surface soils and a light-brown or yellowish-brown compact subsoil, which is not highly calcareous. The topography is rolling to broken and drainage is well established. The series is derived by weathering from loess. Two types are mapped, the very fine sandy loam and the silt loam, with a steep phase.

The surface soils of the types included in the Tama series are dark brown to black and the subsoil is light brown to yellowish brown. The structure is loose and friable. The topography varies from gently to sharply rolling. The series is derived from loess where the lime carbonate has been leached from the upper 3 feet. The silt loam and a light colored phase of this type are mapped.

The Fayette series includes types with prevailingly light-brown soils and a yellow to brownish-yellow subsoil. They are derived from loess beds thick enough to form the subsoil as well as the surface soils, the underlying glacial till lying deep enough to have no marked influence on the general character of the soil. The topography is gently rolling to hilly and the surface drainage is thorough. These soils differ from the Clinton in having a looser, more friable subsoil. One type, the silt loam, is mapped.

The surface soils of the types in the Dodgeville series are dark brown to black and the subsoil is yellowish brown, buff, or brown. The soils are essentially residual in origin from limestone, but

usually contain an admixture of loessial material near the surface. Bedrock is usually encountered within the 3-foot section. Two types, the silt loam and sandy loam, are found in the county.

The types grouped in the Gasconade series are characterized by the dark-gray to black color of the surface soil and by the plastic structure of the heavy clay subsoil, which is mottled brown, yellow, and red. These soils are of residual origin and are underlain by a substratum of chert-free limestone from which they have been derived. The Gasconade loam is mapped.

The surface soils of the types in the Thurston series are dark brown. The subsoil is yellowish brown to brownish yellow or occasionally reddish brown and contains beds of sand and gravel. The types are excessively drained and droughty, and usually have a rolling to bumpy topography. As found in Delaware County, they are derived from cross-bedded sand and gravel belonging to the Buchanan gravels. The sandy loam is developed in this county.

The O'Neill series includes types with dark-brown to black surface soils and a lighter colored sandy to gravelly subsoil. The series occupies high terraces, and the topography varies from nearly level to somewhat eroded. The types are derived by weathering from glacial outwash or terrace material and are inclined to be droughty. The sandy loam and the loam are mapped in this county.

The Waukesha series comprises types characterized by dark-brown to black surface soils and a light-brown to yellow subsoil. The subsoil is heavier in texture than the soils, but not compact and impervious. The soils of this series contain no lime carbonate, and even the lower subsoil does not effervesce with acid. These soils occur on terraces over the present limit of overflow and are well drained. The Waukesha silt loam is mapped.

The surface soils of the types of the Bremer series are black and the subsoil is dark gray to almost black, or drab mottled with yellowish-brown and black iron stains. The subsoil is as heavy as or heavier than the soils, and in the heavier types it is tough and plastic. The series is confined to terraces, outwash plains, and other smooth areas of water deposition now above overflow. The soils are poorly to fairly well drained. They differ from the Wabash soils in occupying positions above overflow. One type, the silt loam, occurs in this county.

The Judson series comprises soils of alluvial and colluvial origin. The surface soils are dark brown to almost black and the subsoil is lighter brown. Neither soil nor subsoil is calcareous. The Judson series occurs on terraces above overflow and on colluvial slopes along the foot of bluffs. The material consists of wash from loess or silty drift soils. The Judson loamy sand is mapped in the county.

The Wabash series includes types with soils of dark-brown to black color and a high content of organic matter, over a dark-drab to gray, heavy subsoil. Both soil and subsoil contain little if any lime carbonate. The materials are derived principally from the loessial and silty glacial soils of the Central Prairie States. They are subject to overflow, but natural drainage is well established in some areas. The Wabash loam and silt loam are mapped.

The Cass series includes types having dark brown to black soils and a lighter textured subsoil, which may pass within the 3-foot section into loose sand and gravel. Both soil and subsoil are noncalcareous. The types of this series are subject to overflow, but drain off rapidly when the floods have subsided. The Cass loam is recognized in this county.

The types in the Genesee series consist of brown, grayish-brown, or dark-brown alluvial sediments. Though there is usually little variation in texture to a depth of 3 feet, the subsoil may be either lighter or heavier than the soil. Both soil and subsoil are lacking in lime carbonate. The Genesee soils occupy first bottoms and are subject to annual or frequent overflow. The fine sandy loam is mapped.

The soil types mapped in Delaware County are described in detail in subsequent pages of this report. Their distribution is shown on the accompanying soil map. The table below gives the actual and relative extent of each soil type:

Areas of different soils

Soil	Acres	Per cent	Soil	Acres	Per cent
Carrington loam	83,904	22.9	Genesee fine sandy loam	2,816	0.8
Tama silt loam	50,688	14.9	Wabash loam	2,752	.8
Light-colored phase	3,776		Fayette silt loam	2,368	.6
Carrington silt loam	45,440	12.4	Waukesha silt loam	2,240	.6
Clinton silt loam	33,152	11.9	Dodgeville silt loam	1,792	.5
Steep phase	10,368		Clinton very fine sandy loam	1,216	.3
Clyde silt loam	35,008	9.6	Gasconade loam	1,088	.3
Carrington sandy loam	28,224	7.7	Bremer silt loam	704	.2
O'Neill loam	12,544	3.4	Carrington fine sandy loam	576	.2
Wabash silt loam	12,224	3.3	Thurston sandy loam	384	.1
Lindley sandy loam	11,584	3.2	Peat	128	.1
Shelby sandy loam	7,744	2.1	Judson loamy sand	128	.1
Dodgeville sandy loam	5,632	1.5			
O'Neill sandy loam	4,928	1.4	Total	365,440	
Cass loam	4,032	1.1			

CARRINGTON SANDY LOAM

The Carrington sandy loam has a surface soil of 12 to 16 inches of dark-brown friable sandy loam. Below this the material changes into a lighter brown sandy loam which at about 22 to 24 inches becomes a somewhat heavier, light-brown sandy loam or heavy sandy loam. On some of the flatter or low-lying areas slight mottling or staining is present in places in the lower part of the 3-foot section. In some of the more elevated positions or on the lee side of hills the surface soil is lighter in color, approximating a grayish-brown to dull-brown sandy loam or loamy sand which at 10 to 12 inches passes into a yellowish-brown loamy sand, and with increase in depth continues of about the same texture but gradually assumes a lighter yellowish color. Normally the lower part of the 3-foot section is somewhat gravelly, though usually not porous enough to produce exceptionally droughty conditions.

On a few of the more exposed locations or ridges and knolls the material apparently has been drifted by the wind, and in places "sand blows" or "blow-outs" have been formed. These loose, deep, sandy areas are of small extent; if sufficiently extensive they would probably have been mapped separately as Carrington sand.

The two most prominent areas of this sandy soil occur about one mile northeast of Earlville and about one-half mile east of Thorpe. The type as mapped also includes patches of rather heavy soil, resembling the Clyde soils, along some drainage ways and in small depressions.

The Carrington sandy loam is developed mainly within a belt several miles wide extending northwest and southeast through the county, though small areas occur in the southwestern part. It is associated with the Carrington loam. The type occupies high ridges and slopes, and in general the surface is more or less rolling. The largest compact area contains about 5 square miles and lies southeast of Edgewood. The drainage is generally adequate, except in occasional depressions and along drainage ways.

The Carrington sandy loam is extensively farmed, and nearly all the typical areas are well improved. Probably 70 to 75 per cent is improved. Some of the more rugged parts are kept for permanent pasture and other tracts, especially along some of the larger streams, are forested largely with various species of oak.

This type is used for general farming. It is easy to cultivate and generally produces good crops, although on an average the yields are not so high as on the heavier soils. Most farms include soils of other types, especially Carrington loam and Clyde silt loam. Corn is the leading crop, and dairying and hog raising are important industries. Corn yields ordinarily from 30 to 35 bushels, oats around 35 bushels, and timothy and clover hay from 1 to 1½ tons per acre. Fairly good bluegrass pasture is afforded. Stable manure is utilized to good advantage, but little or no commercial fertilizer is used. Average land values range from $100 to $150 an acre.

The chief need of the soil appears to be the maintenance of the supply of organic matter, especially on the looser more open variations. This is best accomplished by the use of manure and the growing of leguminous crops. Areas subject to drifting by the wind should receive especial care in this respect and should be cropped infrequently.

CARRINGTON FINE SANDY LOAM

The surface soil of the Carrington fine sandy loam is a dark-brown or dark grayish brown fine sandy loam, 10 to 12 inches deep. Below this the subsoil gradually becomes lighter in color and consists of a more compact fine sandy loam passing into light-brown to yellowish-brown fine sandy loam. In many places the lower part of the 3-foot section is loamy fine sand. As a rule the soil has a fair supply of organic matter.

The Carrington fine sandy loam has a total area of less than one square mile. It occurs mostly in very small scattered tracts, sometimes associated with Carrington sandy loam or loam types. The largest area contains about one-half square mile and lies southeast of Rocky Ridge School. The areas occupy low ridges and slopes.

At least 80 or 85 per cent of the type is under cultivation and is managed about the same way as adjacent soils. It is closely related to the Carrington sandy loam and has about the same value, though the more loamy variations approach the value of the Carrington loam.

CARRINGTON LOAM

The surface soil of the Carrington loam consists of 12 to 16 inches of dark-brown friable loam. In places the texture is appreciably gritty with medium and fine sand. Below the surface soil the material soon becomes a light grayish brown loam which changes gradually and at 18 to 20 inches is a yellowish-brown compact loam or clay loam. In the lower part of the 3-foot section the color is a lighter yellowish brown and the structure in places is somewhat less friable. Small stones and gravel more or less rounded are generally present in the soil section and the surface often has a scattering of cobbles and bowlders. Most of the bowlders have been removed from cultivated fields.

In many places at a depth of 30 to 36 inches or more sandy or gravelly material is found and the subsoil resembles that of the Shelby loam. In some of the flatter positions and minor drainage depressions the surface soil is darker and more silty in texture and usually has an acid reaction, and the subsoil is less friable and may contain slight mottlings of yellow and gray. This variation represents an approach to the Clyde silt loam, with which the Carrington loam is frequently associated.

The Carrington loam is the predominating soil in all but the northeastern part of the county. Its continuity is broken more or less by bordering areas of Clyde silt loam, or stream-bottom types, areas of Carrington sandy loam, and other types.

The surface varies from undulating to more or less rolling, and almost none is too rough for cultivation. A few steeper slopes along streams are subject to erosion. The natural drainage is good and the liberal supply of organic matter makes the soil fairly retentive of moisture.

This is one of the most important soils of the county. Probably 90 per cent of the type is under cultivation and practically all is tillable. Corn leads among the crops, followed by oats and hay. From one-third to one-half of the type is planted to corn. The corn yields from 40 to 45 bushels per acre on the average, though yields of 60 to 70 bushels or more are frequently obtained. Oats yield from 35 to 40 bushels and timothy and clover hay 1 to 2 tons per acre. Barley, wheat, rape, millet, and a few other minor crops are sometimes grown. Timothy and clover are grown occasionally for seed. Practically all the corn and most of the oats and other crops are consumed on the farm, being used in connection with dairying and hog raising, the chief industries.

A four-year or five-year rotation, consisting of corn one or two years, followed successively by oats one year and clover and timothy two or three years, is usually followed by the best farmers. Most farmers use efficient methods in the preparation of the land and later cultivation and care of the growing crop. Fertilizers are confined mostly to stable manure, though acid phosphate and lime are used in small quantities.

Farms on the Carrington loam generally have a prosperous appearance and are well improved as to buildings, fencing, and state of fertility. Land prices vary from $150 to $250, depending on the location, condition of improvement, and the extent of other more or less desirable soils in the particular farm.

In general the farm practices seem well adapted to the soil and crops, though in many instances deeper plowing and more attention to crop rotations, especially with the view of maintaining the supply of organic matter, would be advantageous.

CARRINGTON SILT LOAM

The surface soil of the Carrington silt loam is a dark-brown to nearly black friable silt loam, 10 to 14 inches deep. Below this the subsoil changes into a grayish-brown or dull-brown moderately compact silt loam, and at 20 to 24 inches consists of a light-brown or yellowish-brown silty or gritty loam or silty clay loam, which continues to 36 inches or more. The lower subsoil is usually somewhat plastic when moist but crumbly when dry. In places the lower subsoil is more or less sandy, but rounded gravel and small stones are less common in the soil section than in the Carrington loam.

This soil type occurs mainly in the southern part of the county, where it is associated with the Carrington loam and to some extent with the Tama silt loam. In many places it was difficult to establish definite boundaries between the Carrington silt loam and the loam type.

The surface is smooth and varies from undulating or sloping to gently rolling. Drainage is well established. The type is well improved and nearly all of it is being cultivated. It is easy to till and farms appear uniformly thrifty. In value it compares favorably with the Carrington loam, with which it is associated, and the farm practices, crops, and yields are about the same.

CLYDE SILT LOAM

The surface soil of the Clyde silt loam consists ordinarily of 8 to 12 inches of black friable silt loam high in organic matter. This passes below into a nearly black or dark grayish brown, compact, and slightly plastic silt loam or silty clay loam, which becomes somewhat mottled with yellow, brown, and gray at 20 to 22 inches and becomes more mottled and more plastic with increase in depth. In places the lower 6 or 8 inches of the 3-foot section consist of yellowish-gray to bluish-gray plastic clay more or less mottled and stained with brown, rusty brown, and gray. Here and there the lower subsoil contains considerable sand or gravel or both. Granitic bowlders and cobbles frequently are found strewn on the surface. The soil is nearly always more or less acid and as a rule no limestone material occurs within the soil section.

Where this soil adjoins sandy soils the surface soil, especially along the outer margins, is usually somewhat sandy, approximating a loam texture.

The Clyde silt loam has a fairly large total area in Delaware County, though most of the individual areas are not large. It is typically developed within the Carrington soil region in strips and fingerlike projections bordering minor drainage ways usually extending up on adjoining slopes, and in sags and depressions. Along many of the minor stream branches some alluvial material, which is difficult to identify and show on the map, is undoubtedly included. In some places where areas of O'Neill loam adjoin, it was necessary

to fix the lines of separation rather arbitrarily, as the types grade into each other. In general the surface is depressed or flat or somewhat sloping and the natural drainage poor. The surface of many of the more poorly drained locations is rather hummocky and boggy.

In its natural undrained state the type has value mainly for hay and pasture and the quality of hay and grass is inferior. An increasing acreage is being tile drained, and when so improved it makes excellent farming land. Probably about 30 per cent of the type at present (1922) may be considered improved. On drained land corn does well and produces from 45 to 60 bushels per acre. Small grains yield well, but the straw makes a rank growth and tends to lodge. Hay yields from 2 to 3 tons.

Where good drainage has been established the soil readily works up into a mellow seed bed, but if handled when too wet it bakes and becomes cloddy. This soil is somewhat more difficult to cultivate than the Carrington loam or silt loam. Little fertilization is practiced except for some applications of manure.

Improved land of this type at present is valued at $125 to $200 an acre.

SHELBY SANDY LOAM

The Shelby sandy loam has a surface soil of 10 to 14 inches of dark-brown to grayish-brown sandy loam, which is predominantly gritty with medium-textured sand. The subsoil is a somewhat heavier sandy loam of light-brown color. At 28 to 30 inches there appears a layer of more sandy and looser material, sometimes gravelly, of light-brown to yellowish-brown color, which continues to depths of 36 to 48 inches or more. About 1 mile southeast of Rockville there is a much sandier variation with a dark grayish brown loamy sand surface soil, passing at depths of 8 to 16 inches into loose light-brown or yellowish loamy sand, which continues to 36 inches or more.

This type is mapped in the southeastern part of the county, mainly in North Fork and South Fork Townships. The principal developments are west of Rockville, between the North Fork of Maquoketa River and Plum Creek, and in the vicinity of Sand Spring and Hopkinton. The surface is rolling and generally more elevated than most of the adjoining soils. The drainage is excessive and the soil is droughty in dry seasons.

Some of the areas once supported forest, and scattering groves of oaks still remain in places. Probably 60 per cent of the type may be considered improved. The better variations produce about the same as the Carrington sandy loam, but the sandier and looser variations are much inferior and give indifferent yields of crops.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Shelby sandy loam:

Mechanical analyses of Shelby 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*
335210	Soil 0 to 10 inches	0.8	35.4	12.8	25.0	2.8	16.6	6.7
335211	Subsoil 10 to 28 inches	.3	10.1	16.1	33.6	4.8	25.2	9.8
335212	Subsoil 28 to 36 inches	.4	9.2	16.7	41.6	4.8	19.0	8.1

LINDLEY SANDY LOAM

The surface soil of the Lindley sandy loam consists usually of a loose grayish-brown sandy loam or loamy sand. At 12 to 15 inches this grades into a yellowish-brown loamy sand of varying degrees of coarseness which continues downward to three feet or more. The subsoil varies somewhat in that below 24 to 28 inches it may be a loose sandy or in places gravelly material, or in some of the lower-lying positions a sticky yellowish sandy loam. The soil on elevated situations exposed to strong winds usually is sandy and loose and each high wind shifts the sand more or less when the soil is laid bare by cultivation. A few rock outcrops of small extent are included.

This type is developed mostly within about two miles of the Maquoketa River and along the lower courses of tributary streams. The chief areas lie just north of Hopkinton, south of Earlville, and northwest of Dundee. The topography varies from gently rolling to rolling and somewhat rugged or broken along stream courses. The drainage is thorough and the soil is rather droughty.

In its original condition the Lindley sandy loam was forested largely with red, bur, and white oaks. Probably 60 per cent of the type is improved and the remainder is used for timberland or pasture or for both. Corn, oats, timothy, and clover are the principal crops. Corn yields from 25 to 40 bushels, oats 25 to 35 bushels, and hay 1 to 1½ tons per acre. Watermelons are grown successfully, as well as other vegetables and truck crops. The selling value of the land averages about $100 an acre.

Land of this type needs improvement in the way of increasing the supply of organic matter. The tillage operations should be followed that will reduce wind erosion as much as possible and cover crops should be utilized to reduce the tendency of the sand to drift.

The results of mechanical analyses of samples of the soil and subsoil of the Lindley sandy loam are given in the following table:

Mechanical analyses of Lindley 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*
335213	Soil 0 to 10 inches	1.2	18.6	22.3	32.5	4.9	16.1	4.5
335214	Subsoil 10 to 36 inches	.8	14.2	20.6	37.2	6.5	15.2	5.7

CLINTON VERY FINE SANDY LOAM

The surface soil of the Clinton very fine sandy loam consists of about 10 or 12 inches of light-brown fairly friable very fine sandy loam. In virgin or wooded areas the surface layer of 2 or 3 inches is darker owing to accumulations of leaf mold. Below the surface horizon is a lighter brown compact very fine sandy loam, which with increase in depth becomes of heavier texture and denser structure and usually becomes a silty clay loam between 30 and 36 inches. In places the lower part of the 3-foot section is a little lighter in texture owing to the presence of fine and very fine sand.

The greater part of this type is included in an area east of the North Fork of Maquoketa River along the Dubuque County line. Two small areas lie about 2 miles northwest of Hopkinton. The type occupies high, rolling, to hilly country. It was originally forested, but most of it is cleared and about 60 per cent is improved.

The usual staple crops are grown successfully. The soil is easily cultivated and moderately productive. Potatoes appear to do better on this soil than on the Clinton silt loam. The content of organic matter being naturally low, the principal need appears to be the incorporation of manure or other forms of organic matter.

The results of mechanical analyses of samples of the soil and subsoil of the Clinton very fine sandy loam are given in the table below:

Mechanical analyses of Clinton very 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*
335215	Soil 0 to 12 inches	0.1	0.6	1.7	12.6	32.7	42.3	9.9
335216	Subsoil 12 to 36 inches	.0	.2	.8	6.6	37.2	45.7	10.4

CLINTON SILT LOAM

The surface soil of the Clinton silt loam is a light grayish brown to light-brown, smooth, friable, silt loam with an average depth of about 8 inches. In uncleared areas the surface layer of 2 or 3 inches is much darker colored owing to the presence of decayed root fibers and leaf mold. Many fields long cultivated have a light ashy appearance when dry. The subsoil is a light-brown or yellowish-brown, less friable and more compact silt loam, which at 18 to 20 inches grades into a compact, rather dense, brittle, silt loam or silty clay loam. Both soil and subsoil within the 3-foot section always show an acid reaction to simple field tests.

The principal developments of the Clinton silt loam are in the northeastern part of the county northeast of Greeley and east of Colesburg. One large area lies south of Delhi, mostly along the western side of the Maquoketa River and extending to the Jones County line.

The typical soil, as distinguished from the steep phase discussed below, is somewhat rolling and occupies the tops of the higher ridges and more gentle slopes. Most of the ridge tops are rather narrow and often occur as fingerlike lobes. In a few places there are funnel-shaped depressions 6 to 12 feet deep and from 12 to 30 or more feet in diameter, where the soil material evidently has filtered down into cavities in the underlying limestone rocks. Typical examples of this may be seen in the east half of section 1 of Colony Township. The drainage is well established and surface water causes some erosion, though not to the extent common on the steep phase.

Practically all of this type was forested with several kinds of oak, elm, walnut, cherry, and a number of minor species. Probably 60 per cent or more of it is cleared and successfully used in general farming. Dairying and livestock raising are important industries, especially when carried on jointly on the Clinton silt loam and its steep phase.

Corn is the important field crop, yielding on the average from 40 to 50 bushels per acre. Oats are the chief small grain, and the average yields are not far from 35 or 40 bushels per acre. Other grains do well, but are not regularly grown. Timothy and clover do well and yield from 1½ to 2 or more tons per acre. Clover ordinarily makes an easy catch. Pastures furnish excellent grazing with bluegrass and some white clover. Apples and other orchard fruits are important minor products. Fertilization is confined principally to applications of stable manure. Land of this type is valued at $150 to $200 an acre.

Clinton silt loam, steep phase.—Much of the soil of the steep phase has about the same characteristics as the main type. However, owing to the much more rolling and steeper topography, surface washing has removed more or less of the original surface soil and either carried it to lower, more gentle slopes or deposited it as alluvium along stream courses. Where the surface soil has been removed the color is light brown rather than grayish brown, and some of the soil along lower slopes has a darker color than that of the typical soil.

This phase occurs in close association with the main type and nearly all of it lies at a somewhat lower elevation. It includes the slopes of the stream valleys and the more or less deeply cut branching ravines. Along the slopes of many of the valleys are rugged bluffs and conspicuous limestone rock outcrops, many of which are precipitous. The locations of these outcrops are shown on the map by symbols.

Some of this phase is being cultivated, but the greater part, at least 75 or 80 per cent, remains either in forest or permanent pasture. Most of the cultivated land is too steep for regular use, as surface washing is active when the soil is broken. Care is usually taken to reduce erosion by locating corn rows laterally on slopes, and the strips of land occupying the beds of drainage depressions are left in sod to prevent gullying. Crops and methods otherwise are about the same as those followed on the main type. Land of this phase is valued at about $60 to $100 an acre.

TAMA SILT LOAM

The Tama silt loam has a surface soil of dark-brown, nearly black when moist, friable, even-textured silt loam. Below 12 to 14 inches the material grades through 3 or 4 inches of dull-brown silt loam into a compact light-brown silt loam, which with increase in depth becomes slightly lighter colored and continues compact but friable in structure. In some of the flatter locations and slight depressions the subsoil below about 28 or 30 inches is less friable, approximates a silty clay loam in texture, and is mottled with light gray and yellowish brown.

On the more rolling areas the surface soil is a little shallower, but on areas of gentle incline or along lower slopes, some of which appear to be partly colluvial, the depth is greater, often 18 or 20 inches, before lighter colored material is encountered. The soil and subsoil in practically all cases give an acid reaction to litmus.

The largest and most typical development of Tama silt loam extends in a southeasterly direction from west of Greeley through

Petersburg to the Dubuque County line, and north from Petersburg to the Clayton County line at Colesburg. Smaller areas lie north of Hazel Green, northeast of Hopkinton, east of Delhi, and in a few other places.

The type occupies gently rolling to undulating uplands. The drainage is good, and the even texture and good aeration of the soil, with the abundant supply of organic matter, enable the soil to withstand droughts well. Most of the type has a sufficiently gentle slope to make surface washing negligible.

The Tama silt loam occupies prairie country and originally supported a luxuriant grass growth. Nearly all of it is now well improved and at least 95 per cent of it is under cultivation. It is considered about the best general farming land in the county, especially for the production of corn. Other grains, hay, and forage crops produce excellent yields. Of the animal industries, hog raising leads and dairying also is important.

Yields of corn average well above 50 bushels per acre, and yields of 75 to 80 bushels or more are not infrequent. Oats yield 45 to 50 bushels on an average. Although wheat, barley, and rye are not grown much at present, they generally give profitable yields. Timothy and clover make good stands and yield from 1 to 2 tons. Clover alone often yields as high as 2½ tons per acre. Sorgo, millet, and rape are sometimes grown.

The Tama silt loam is very desirable farming land in that it is easy to cultivate, of a fine, even texture, free from stones, and favorable in topography. Most farmers follow systematic rotations, usually plow to a sufficient depth, and care for intertilled crops adequately. Fertilization is confined chiefly to the available stable manure. For the maintenance of its permanent fertility, this land requires fairly deep plowing and systematic rotations in which some legume has a prominent place.

Land of this type is considered about the most valuable in the county. Very little of it is changing hands and a large proportion is worked by owners. Hardly any of the type is valued as low as $150 an acre and most of it is held at $200 to $250 an acre.

Tama silt loam, light-colored phase.—The light-colored phase of Tama silt loam resembles the typical soil in most respects, except its lighter color, indicating a lower content of organic matter, and its more rolling topography. A typical boring usually shows a surface soil of about 12 inches of dark grayish brown or grayish-brown friable silt loam. This is underlain by a light grayish brown silt loam passing at 18 or 20 inches into a light-brown, compact, but friable silt loam which continues compact and becomes a little lighter colored with increase in depth.

This phase is inextensive and occupies small areas, chiefly along the Dubuque County line east of Petersburg, between Forestville and Edgewood, and in a few other places. It usually adjoins areas of the typical soil or constitutes transitional areas between it and the Clinton silt loam.

Probably 90 per cent of it is under cultivation though perhaps a larger proportion of it is used for pasture than of the main type. Farm practices as to cropping and handling the soil are otherwise the same as those followed on the typical Tama silt loam.

FAYETTE SILT LOAM

The Fayette silt loam has a surface soil, ordinarily 8 to 10 inches deep, of light-brown to light grayish brown, friable, smooth silt loam, though sometimes a little gritty with very fine sand. This grades into a light-brown, compact, friable silt loam and at 18 to 20 inches into a noticeably lighter colored, compact, but friable silt loam. The surface soil on the steeper slopes and on sharp divides is somewhat lighter colored and shallower than on the smoother slopes. On some of the flatter locations or slight depressions the subsoil below about 24 inches is slightly mottled in places with light gray, yellow, or brown. Neither soil nor subsoil is calcareous.

This type is mapped in a few places, chiefly on low ridge positions southeast of Ryan, north of Delhi, and west of Edgewood. The surface is somewhat rolling or sloping; in many places is steep enough to allow some surface washing in cultivated fields. The drainage generally is well established.

Originally the type had more or less of forest growth, about the same as that found on the Clinton silt loam. Nearly all is now cleared and probably 85 to 90 per cent is improved. Practically all the staple crops grown in the region give excellent returns, though as a whole the land is hardly as desirable as the Tama silt loam or the better areas of the heavier textured Carrington soils.

Owing to its greater degree of compactness, due principally to the small supply of organic matter, the soil is somewhat more difficult to work, is little more subject to surface washing, and there is more danger of impairing the soil structure if handled when too wet. The chief need of the soil is the increase and maintenance of the supply of organic matter.

DODGEVILLE SANDY LOAM

The Dodgeville sandy loam is a sandy loam of shallow depth which rests upon beds of limestone at less than 36 inches. The surface soil usually consists of 8 to 10 inches of dark-brown friable sandy loam, which passes into a subsoil of light-brown or yellowish-brown, moderately friable, gritty loam, which may rest on the limestone at any depth from 18 to 36 inches. In places just above the limestone there is a brown or reddish-brown gritty clay, usually containing small fragments of cherty limestone rock. Where the soil is more shallow, fragments of limestone of various sizes are found on or near the surface and in places rock outcrops are common.

This type is rather widely distributed in small tracts through a belt crossing the county in a northwest-southeast direction. Many areas are associated with the Carrington sandy loam and some occur within Carrington loam areas. It is developed on slopes, in draws, and along drainage depressions.

Where the surface is sufficiently smooth and the soil mantle not too shallow, this type is cultivated apparently with fair success. Perhaps 25 to 30 per cent of it is in cultivation, the remainder being used for pasture or timber land. Corn, oats, hay, and minor crops are grown. The value of the type as a whole is much lower than that of the Carrington sandy loam or other agricultural types.

The table below shows the results of mechanical analyses of samples of the soil and subsoil of the Dodgeville sandy loam:

Mechanical analyses of Dodgeville 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*
335227	Soil, 0 to 9 inches	2.0	18.2	15.8	30.0	4.7	18.5	10.8
335228	Subsoil, 9 to 36 inches	1.8	26.8	12.4	19.4	3.2	19.3	17.2

DODGEVILLE SILT LOAM

The Dodgeville silt loam includes areas of soil of rather variable character but all of shallow depth overlying limestone. A characteristic soil section consists of about 6 inches of dark-brown silt loam or silty loam, grading into a compact dark-brown or dull-brown heavy silt loam to silty clay loam which at about 18 inches rests on beds of limestone. In places the soil section is a little deeper; in other places rock outcrops occur or the rock is covered with only a few inches of soil. A few patches of sandy loam are included.

This type occurs mainly in small widely scattered tracts within Carrington and Tama soil areas. Several of the larger areas lie east of Petersburg Station and between Oneida and Almoral.

Most of this type is reserved for pasture, as its shallow depth makes it difficult to cultivate and also makes it droughty. A few of the better areas are cultivated, apparently with fair success.

GASCONADE LOAM

The Gasconade loam includes areas in which the soil is very shallow and marked by limestone outcrops. Ordinarily the surface has a few inches of dark-brown to grayish-brown gritty loam which rests on the bedrock. The soil usually contains limestone fragments of various sizes, either embedded or strewn on the surface.

This type has a small total area. It occurs mainly in the eastern part of the county, along slopes leading to larger streams and in isolated elevated areas.

Practically none of the type is cultivated. It is kept for pasture land, and some is in forest which is mostly rather scrubby oak. In many places the limestone rock has been quarried either for building purposes or for burning for lime.

THURSTON SANDY LOAM

The surface soil of the Thurston sandy loam is a brown to dark-brown loam or gritty loam, about 10 inches deep. This is underlain by lighter colored material of about the same texture, which at varying depths of 14 to 18 inches passes into yellowish-brown sand and fine gravel, usually stratified or cross-bedded. The materials are derived from Kansan deposits.

The Thurston sandy loam occurs in isolated areas varying in size from 4 or 5 acres upward to 40 acres. It is widely distributed,

mainly within areas of Carrington soils, though occasionally within the margins of loessial soil areas. The type is developed on knolls and on rounded more or less elongated elevations or knobs. These may occur singly or in closely connected groups.

Owing to the loose subsoil and substratum, these areas are droughty and only small parts are cultivated. Crop yields are low, but in wet seasons the better variations often give satisfactory results. As agricultural land it has low value. The sand and gravel of the subsoil are used to some extent in road building.

In the table below are given the results of mechanical analyses of samples of the soil and subsoil of the Thurston sandy loam:

Mechanical analyses of Thurston 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*
335229	Soil, 0 to 12 inches	6.0	16.8	5.4	8.8	14.9	31.4	16.7
335230	Subsoil, 12 to 36 inches	40.2	28.6	4.4	4.6	4.2	10.6	7.4

O'NEILL SANDY LOAM

The O'Neill sandy loam has a surface soil of dark-brown or grayish-brown sandy loam containing a moderate supply of organic matter. The subsoil is a brown, somewhat more compact sandy loam which passes at depths varying from about 20 to 28 inches into loose yellowish-brown sand or gravel, or both, and in many cases plainly stratified. In places the lower subsoil is less porous, consisting of medium-textured sandy loam or loamy sand, but nevertheless is loose enough to be more or less leachy. Such variations represent an approach to the Buckner soils. In a few places the surface soil is a fine sandy loam of about the color of the typical sandy loam. A few very small tracts of O'Neill loam are included. These variations are of small extent and widely scattered and can not be shown separately on the map.

The O'Neill sandy loam is distributed along the larger streams of the county. Most of it is on terraces of low to medium height but all above normal overflow. Elevations usually range from about 10 to 30 feet above the flood plains, though a few areas reach a height of 40 or 50 feet. The largest single area is located at Manchester and other important ones are at Dundee, at Hopkinton, south of Almoral Station, and in a number of scattered locations. The type is usually developed within prominent bends of streams and along the streamward parts of the terraces.

The surface is ordinarily nearly level, but is varied somewhat by slight swells and depressions. Wind appears to have modified the surface to some extent in places.

Probably about 75 per cent of the O'Neill sandy loam has been brought under cultivation. Some of it has a sparse growth of timber, mostly oak. Originally parts of it are said to have had very little timber.

Where the soil is not too sandy and leachy, most crops produce fairly well, especially in seasons of abundant rainfall. Corn and

oats are the principal crops. Hay crops do not give very satisfactory yields. Corn yields from about 30 to 50 bushels and oats from 20 to 40 bushels per acre. Rye is often grown and gives low to moderate yields. Melons and truck crops are sometimes grown with good success.

On account of the smooth topography and light texture, this soil is easy to work and can be handled when heavier textured soils are too wet.

O'NEILL LOAM

The surface soil of the O'Neill loam consists of about 12 to 16 inches of dark-brown to nearly black friable loam, usually gritty with medium and coarse sand. This passes through a gradual transition into a brown, compact, gritty loam, which at about 24 to 28 inches gives way to a light-brown mixture of sand and small gravel. In places the gravelly horizon is reached at 10 to 12 inches; in other places it may lie at depths of 36 inches or more. Open cuts usually show stratification of the subsoil and substratum material. As a rule the lower subsoil layer is open and porous, though in places it appears somewhat loamy.

In a few places the surface material is a silt loam of darker color than the typical loam. Such an area lies just west of Robinson.

The largest single development is south of Manchester, extending toward Golden. Other areas extend up Honey Creek north of Manchester, along Buck Creek in Hazel Green Township, and in various smaller tracts. The type occupies positions similar to those of the O'Neill sandy loam, though when occurring with the sandy type it occupies the part of the terrace adjacent to the uplands. It is more extensive than the sandy loam.

The drainage is thorough and the soil is more or less droughty. In places minor drainage from the uplands spreads over the surface but soon runs off or seeps into the subsoil.

Probably 80 or 85 per cent of the O'Neill loam is under cultivation. Some of it has a forest growth and a few less desirable tracts are kept in permanent pasture. Corn easily leads as the principal crop and in seasons of ample rainfall yields from 35 to 50 bushels per acre; it may yield considerably less in dry seasons. Oats yield 30 to 40 bushels and hay 1 to 1½ tons per acre. Clover ordinarily makes a fair to good stand.

Farming methods compare favorably with those practiced on the better upland soils and farms on this type indicate a reasonable degree of prosperity. Dairying and hog raising are leading industries, and considerable pasturage is usually available on near-by first-bottom soils. The land value ranges from about $125 to $200 an acre, varying with the location and the condition of improvements.

WAUKESHA SILT LOAM

The surface soil of the Waukesha silt loam consists of 12 to 14 inches or more of dark-brown to black friable silt loam, rich in organic matter. The subsoil is a lighter brown compact silt loam, which grades into a light-brown or slightly yellowish brown, moder-

ately compact, friable silt loam at about 28 to 30 inches. In places the lower subsoil is a little heavier, approximating a silty clay. In some of the slight depressions the lower part of the subsoil is faintly mottled with gray and yellowish brown and is a little less friable. The typical soil section resembles that of the Tama silt loam in general appearance.

This type has a small total area. The most typical developments are about 3 miles southeast of Delhi and along the river toward Hopkinton. There are a very few other isolated areas. Practically all of the type has good natural drainage and resists drought well.

The prevailingly flat, smooth surface renders it all good farming land, and fully 90 per cent of it is under cultivation. It is excellent corn land and well adapted to the usual line of farm crops. Yields of corn are said to exceed those obtained on the Tama silt loam or other soils. The land is handled about the same as the Tama silt loam.

BREMER SILT LOAM

The surface soil of the Bremer silt loam consists of 12 to 16 inches of nearly black fairly friable silt loam. This passes into a dark-brown or dull-brown compact silty clay loam which becomes a little plastic at about 20 inches and usually slightly mottled with yellow and yellowish brown. With increase in depth the texture becomes heavier and the structure more plastic, and at 28 to 30 inches the material generally is a yellowish-brown plastic clay loam or silty clay mottled with bluish gray, yellow, and brown. On some of the higher lying situations the subsoil is more friable and the mottling less noticeable. The soil and subsoil are noncalcareous.

This type is confined to a few small tracts, mostly within the Tama silt loam region. The principal areas are along Bear Creek southeast of Petersburg.

The surface is flat and slightly sloping toward the first bottoms bordering stream courses. Most of the areas are low lying with no distinct line of demarcation at the border of the first bottom. The drainage is fair, though in depressions and along minor drainage ways leading from the uplands it is rather deficient.

Probably 75 per cent of the type is in regular cultivation, and the remainder is reserved for pasture, though practically all of it is arable. All the general crops give satisfactory results, and hay often yields better than on many of the upland soils. The land is generally well farmed and in a good state of cultivation.

The results of mechanical analyses of samples of the soil and subsoil of the Bremer silt loam are given in the following table:

Mechanical analyses of Bremer silt 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*
335239	Soil 0 to 12 inches	0.2	0.2	0.1	4.6	10.0	57.2	27.7
335240	Subsoil 12 to 36 inches	.8	.8	.4	9.6	12.0	55.5	21.1

JUDSON LOAMY SAND

The surface soil of the Judson loamy sand consists of about 12 inches of slightly coherent brown to grayish-brown loamy sand or light sandy loam. This grades into a brown to light-brown loose loamy sand which continues below 40 inches. The subsoil at about 30 inches in a few of the minor depressions is somewhat more loamy.

The Judson loamy sand is of small extent, being confined to two small areas south of Rockville along the Dubuque County line. It occupies a terrace position 10 to 15 feet above the adjacent stream bottoms. The surface is slightly undulating or in places billowy. High winds may have aided in modifying the surface configuration. The drainage is thorough and the soil is somewhat droughty.

At least 98 per cent of the type is under cultivation. Some of it is pastured. Corn is the leading crop. Small grains, oats, and rye are also grown and give moderate yields.

WABASH LOAM

The surface soil of the Wabash loam consists ordinarily of a dark-brown to nearly black friable loam, often more or less gritty with the finer grades of sand. At depths of 14 to 18 inches the material grades into a compact dull-black or slightly bluish black loamy clay, which becomes less friable with increase in depth. At and below 24 to 28 inches it contains mottlings of brown and rusty brown or gray and some brown concretionary deposits.

In places the lower subsoil is rather sandy and resembles the subsoil of the Cass loam. Adjacent to the stream channels the material is variable, being gravelly, sandy, and sometimes stony. Many patches of Cass loam which are too small to separate on the map are included. Along Elk Creek in the northern part of the county the soil is rather light colored and more or less variable, especially where the bottoms are narrow.

The Wabash loam has a small development along Robinson, Plum, and Elk Creeks, and in a few other locations. Most of the areas comprise rather narrow bottoms, where the channels are more or less meandering and overflows are frequent. It is fairly well drained when not overflowed. The surface is fairly smooth, being slightly uneven in places, owing to the presence of abandoned channels.

The type is nearly all used for pasturage, for which it is well adapted. Perhaps 1 or 2 per cent is used for cultivated crops, mostly corn.

WABASH SILT LOAM

The surface soil of the Wabash silt loam is a black friable silt loam, somewhat compact in untilled fields but quite mellow and friable when cultivated. At 14 to 18 inches the subsoil is a little more compact and slightly plastic, the plasticity usually becoming more pronounced with increase in depth, the lower part of the 3-foot section being usually a silty clay loam or silty clay, which has a dark color with a dull-bluish cast. Below 20 to 24 inches it contains more or less pronounced mottlings of brown and brownish yellow and some rusty-brown concretions.

Where the adjoining uplands are of light color, the surface soil of the bottoms is generally grayish brown, underlain at varying depths by compact silt loam of dark color, indicating a deposition of the lighter colored material within comparatively recent years.

The Wabash silt loam is the predominating first-bottom soil within most of the Tama silt loam region, and to a less extent within the region of Carrington soils. It is extensive along Bear Creek and upper Plum and Buck Creeks.

The surface is flat, with a slight slope toward the stream, though in a few places it is a little lower at the upland margin. Aside from a slight unevenness caused by abandoned channels, the surface is smooth. Numerous meandering channels interfere with its use for cultivated crops. The drainage is somewhat deficient, and overflows tend to discourage regular cultivation. In places the land has been improved by deepening and straightening channels and opening ditches.

This type originally was forested mainly with elm, walnut, cottonwood, ash, and willow. Except for fringes along stream channels and scattering groves, it is cleared and used largely for pasture. Perhaps 10 or 15 per cent of it is in cultivation and cropped principally to corn. Yields of 50 to 60 bushels of corn are common and in favorable seasons as high as 80 or 90 bushels are sometimes obtained. Small grains give satisfactory yields, but the growth of straw is rank and tends to lodge. Hay produces well, and redtop and timothy or mixed grasses often yield 2 to 2½ tons per acre. Corn, however, is frequently grown continuously for a number of years. No special fertilization is practiced. The excellent grazing and availability of water make the type especially valuable for pasturing dairy cattle and other livestock. The selling value is about the same as that of the adjoining upland soils.

CASS LOAM

The Cass loam in its typical development has a surface soil of about 10 inches of dark-brown friable fine loam. The subsoil is a dull-brown, compact, friable loam, which with depth gradually becomes light brown in color, and grades at an average depth of about 24 inches into a light-brown, fairly loose mixture of loamy sand and fine gravel. In most places the loose lower subsoil consists of sandy loam and in others of gravelly loam.

In places the surface soil is rather sandy, especially in narrow strips bordering the stream channels. Where these are sufficiently wide and the soil of brownish color, they are mapped as Genesee fine sandy loam. In some of the depressions and in small areas sheltered from the swifter overflow currents the soil is a silt loam.

The Cass loam is the first-bottom soil along many of the larger streams of the county. It occupies the bottoms of Prairie Creek and that of lower Honey Creek. It is prevalent along the Maquoketa River; in many places along this stream the soil adjacent to the channel is the Genesee fine sandy loam.

The surface generally is smooth and nearly level, though in places a little uneven. It is subject to overflow, but between overflows the drainage is adequate. The land was originally forested with about the same species common to the Wabash soils.

The Cass loam has a limited use for crops, and the greater part is in pasture. The cultivated part, perhaps 20 per cent of the total area, is nearly all devoted to corn, with an occasional field of oats or other small grain. Sorgo, millet, Sudan grass, and other forage crops are sometimes grown. In seasons when the rainfall is adequate and no destructive overflows occur corn yields from 45 to 60 bushels and oats somewhat less. Bluegrass affords very good pasturage, and the availability of water makes this soil desirable for pasture land.

As a rule no definite rotation is followed on cropped areas. Corn is often grown a number of years in succession without noticeable decrease in yield. Fertilizers are not used, except occasional applications of stable manure.

GENESEE FINE SANDY LOAM

The Genesee fine sandy loam includes materials that are variable in texture and color both in the soil and subsoil. In general, the type may be said to consist of about 10 inches of brown to dark-brown fine sandy loam, underlain by a light-brown or yellowish-brown loamy fine sand or fine sandy loam. The lower part of the 3-foot section is generally sandy, but in some places it contains compact layers. Near the stream the soil is usually light brown, the texture is coarser, and the soil profile less constant, and the material is quite like Riverwash.

This type is mapped principally along the Maquoketa River. On the narrower bottoms it occupies the entire overflow area, but where the bottom widens the part bordering the upland is usually the Cass loam.

The surface is more or less uneven, owing to the action of shifting currents. The porous nature of much of the material insures good drainage between overflows.

This type is more or less forested with elm, birch, willow, ash, walnut, and other species. Very little of it is cultivated. The principal use is for pasture, for which it is best suited.

PEAT

Peat consists of dark-brown to black, partly decomposed organic matter derived from an accumulation of remains of water-loving plants and grasses. Most of it is in a distinctly fibrous condition, though the immediate surface portion may be somewhat decomposed. In most of the areas the Peat has a depth of 3 to 4 feet, but in places it rests on a substratum of dense silty clay, grayish or dark gray in color. This subsoil material in some cases is calcareous.

The Peat is confined to a very few small tracts, notably just east of Almoral Station and about 3½ miles northeast of Masonville. It is usually associated with the Clyde silt loam and occurs in similar positions. The Peat is utilized for pasture or for cutting a rather coarse wild hay.

SUMMARY

Delaware County is situated in northeastern Iowa. It has an area of 571 square miles. The topography varies from undulating or

rolling in the southwestern and central parts to sharply rolling or somewhat broken in the northeastern part.

As a whole the regional drainage is well established. Most of the county is drained by the Maquoketa River and its tributaries. The trend of the drainage is toward the southeast.

In 1920 the county had a population of 18,183, of which 3,111 is classed as urban. Manchester is the county seat and largest town. The county is well supplied with railroads and good highways.

The climate is favorable to grain production and stock raising. The average growing season is about 155 days. The mean annual precipitation is 30.9 inches, and the mean annual temperature is about 45° F.

The livestock industry, chiefly hog raising and dairying, constitutes the principal source of farm income. Corn is the leading grain crop, followed by oats, timothy, and clover. Farming is established on a permanent basis and as a whole the business is prosperous.

Fertilization is confined mostly to the application of stable manure, though some commercial fertilizer and lime are used.

Over 95 per cent of the area of the county is in farms, and about 80 per cent of the farm land is improved. The average size of farms is 152.3 acres. Nearly 60 per cent of the farms are operated by owners. The selling price of the better lands ranges from $200 to $250 an acre.

Most of the soils are of dark color and are derived from glacial drift and loessial deposits. Soils from the drift are classified in the Carrington, Shelby, Lindley, Thurston, and Clyde series; those from native rock, in the Dodgeville and Gasconade series; and those from loessial material in the Clinton, Fayette, and Tama series. The second bottoms along the streams are included in the O'Neill, Waukesha, Bremer, and Judson series, and recent-alluvial materials are classed with the Wabash, Cass, and Genesee series.

The Carrington loam and Carrington silt loam are among the most extensive types in the county. They are well suited for general farming, especially for corn, oats, and hay crops.

The Carrington sandy loam and the fine sandy loam are usually a little less desirable soils than the heavier Carrington soils, but are successfully used in general farming.

The Clyde silt loam in its natural condition has poor drainage, but when properly drained is an excellent soil for corn and hay crops. A few small areas of Peat are associated with this type.

The Shelby sandy loam and Lindley sandy loam are rather loose-structured soils, but give fairly good yields of corn and general crops.

The Thurston sandy loam is used largely for pasture.

The Clinton very fine sandy loam and the Clinton silt loam with its steep phase are light-colored soils. They are fairly good general farming soils. The rougher parts are better suited for pasture.

The Tama silt loam and its light-colored phase are dark-colored soils and are admirably adapted to corn and a wide variety of other crops.

The Fayette silt loam has a small area, but generally is productive.

The Dodgeville and Gasconade soils are shallow and have little value except for pasturage.

The O'Neill soils of the second bottoms are more or less droughty but give good results in general farming.

The Waukesha silt loam and Bremer silt loam are good corn and general farming soils.

The Judson loamy sand is a light-textured soil that produces fairly good yields of corn and miscellaneous crops.

The Wabash soils are productive first-bottom soils, the better drained areas being well adapted to corn. Excellent pasturage is afforded.

The Cass loam, also a first-bottom soil, is used to some extent for corn, but largely for pasture. The Genesee fine sandy loam is used almost entirely for pasture.

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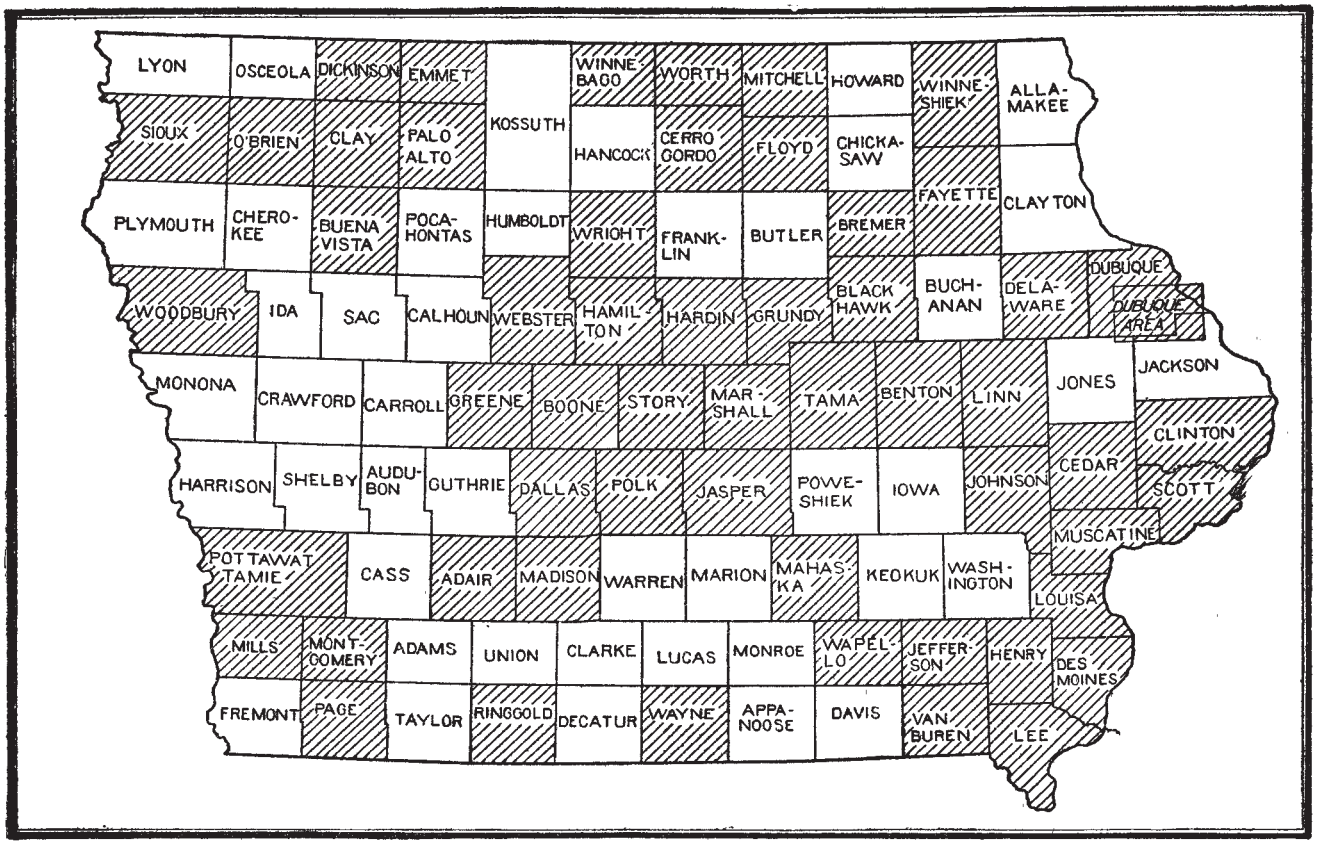

Areas surveyed in Iowa, shown by shading

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