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

SOIL SURVEY OF BENTON COUNTY, IOWA.

BY

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

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[PUBLIC RESOLUTION—No. 9.]

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

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

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

Approved, March 14, 1904.

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

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MAP.

Soil map, Benton County sheet, Iowa.

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DESCRIPTION OF THE AREA.

Benton County is situated in east-central Iowa, in the fourth tier of counties west of the Mississippi River. It is about 30 miles long from north to south and about 24 miles wide and comprises an area of 712 square miles, or 455,680 acres.

Benton County is part of a drift-covered prairie plain overlying rocks of Devonian age in practically a horizontal position. No very great difference of altitude exists between the wide stretches of plain and the intervening valleys. The continuity of the plain is interrupted by the shallow valley of the Cedar River, which flows through the northeastern part, and by a part of the valley of the Iowa River, which intersects the extreme southwestern part. Erosion has been active on some of the valley slopes, especially south of the Cedar River in Benton Township, where the surface is rather broken and dissected.

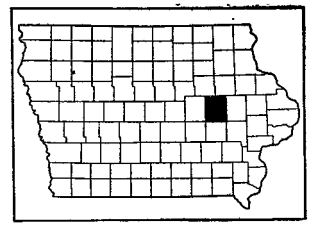

FIG. 40.—Sketch map showing location of the Benton County area, Iowa.

The greater part of the county has an undulating to gently rolling surface with slopes of moderate gradient leading from the divides to stream courses, ordinarily well suited for farming land. There is a succession of swells and moderate depressions, marking a country little affected by active erosion.

The principal drainage divide crosses the southwest-central part of the county, generally parallel to the course of Cedar River, extending from Monroe Township across parts of Homer, Big Grove, Union, Eldorado, and Fremont Townships. A variation in the surface of this plain consists in a series of chainlike hills one-half mile to 1½ miles wide, beginning with the forest-clad elevations in Monroe and Big Grove Townships and extending in a southeasterly direction south of Newhall to the northeastern corner of Florence Township. These elevations, termed "pahas" by geologists,[1] are most strikingly developed south and southeast from Newhall, where they rise in elongated or lenticular forms from 60 to 80 feet above the general plain. The only depressions are in the creek valleys in Bruce, Union, Eldorado, and Eden Townships, where the streams flow through partly filled valleys of pre-Iowan glaciation.

In the southwestern part, comprising an area of about 40 square miles and including the southern half of Iowa Township, the southern part of Leroy Township, and a small part of southern St. Clair

[1]Annual Report, 1904, Iowa Geological Survey, Geology of Benton County, Iowa, by T. E. Savage.

Township, the topography in general is broken and rugged. The valleys and ravines are deeply cut and have a more or less intricate system of branches extending into the uplands, leaving no large undissected areas. This part of the county comprises a part of the Kansan glaciation and has been subjected to a longer period of erosion than the Iowan, a later glaciation that covered the rest of the county. Included in this region are two isolated elongated areas. One of these occupies about 3 square miles in northeastern Big Grove Township and has a northwest-southeast trend. This area is deeply dissected and the tops of the hills stand 60 to 70 feet above the surrounding plain. The other area, covering about 500 acres in east-central Monroe Township, has about the same topography.

North of the Cedar River, in a belt of upland from 2 to 4 miles in width and generally parallel to the river, the surface evidently has been determined by wind action, as indicated by the loose, sandy nature of the soil and topographic forms. There appears to be little regularity in the arrangement of the surface features, though some of the ridges extend in a general east-and-west direction. North and east of this belt the plain, modified by one or two stream valleys, extends to the county limits.

Practically all the streams have bands of alluvium along their courses, usually of a width in proportion to the volume of water carried. These bottoms seldom exceed 1 mile in width and the wider bottoms consist in part of terraces lying above any present overflows and representing former levels of the overflow plains.

The surface of most of the county has a general southeasterly slope, but in the southern part it is more easterly. The highest elevations evidently are in the western part of Monroe Township, near Dysart. Just over the line in Tama County the altitude is 968 feet above sea level;[2] farther southeast, at Keystone, the altitude is 875 feet; at Van Horn, 943 feet; at Atkins, 833 feet; at Norway, near the bottoms of Prairie Creek, 792 feet; and at Vinton, 810 feet. The elevation of the flood plain of the Cedar River at the eastern boundary of the county (as indicated on the Shellsburg topographic sheet prepared by the U. S. Geological Survey) is 760 feet, while on the tops of the hills in that part of the county it is 960 feet. It is probable that the extreme range of elevation within the county is not much over 200 feet.

The drainage of Benton County is controlled by the Cedar and Iowa Rivers. The Cedar River receives most of the drainage waters, the Iowa draining only a small area in the southwestern part. The northeastern and southwestern parts of the county have well-developed stream courses and fairly thorough surface drainage. A considerable proportion of the intervening country has imperfectly developed drainage. It is marked by the smooth, flat surface of the divides and by shallow basins which originally were marshes or shallow lakes. Most of the marshy areas have been reclaimed by tile drains and now are valuable farm land.

The Cedar River enters the county near the northwest corner of Harrison Township, flows in a general southerly direction to Vinton, where it takes an easterly course, leaving the county through section 13 of Benton Township. North of Vinton the stream has developed

[2] Elevations from Gannett's Dictionary of Altitudes.

a fairly wide bottom, but east of this place it appears to have carved a new channel since glacial times, and most of this part of its course lies in a more gorgelike valley.

The Iowa River barely cuts through the southwestern corner of the county, but receives drainage from about 75 square miles of the southwestern part. One prong of Stein Creek rises in Monroe and Homer Townships and passes westerly into Tama County. Farther south Pine Creek rises in Kane Township, flows southeast, and enters Iowa River in Iowa County.

A bountiful supply of wholesome water for farm use is obtained from wells ranging in depth from 25 to 75 feet over practically the whole county. The various tributaries of the larger streams flow perennially and provide abundant water for pastured stock.

Benton County was organized March 1, 1846. The first settlers arrived in 1839, but permanent settlement dates from several years later. The early settlers came mainly from the more eastern and northern States, with a few from the Southern States. More recent arrivals have included Germans, Scandinavians, Irish, and Bohemians. The south-central part of the county has many residents of German extraction; the comparatively few Bohemians live chiefly in the western part.

The total population of the county in 1920 was 24,080, of which 69.8 per cent are classed as rural. The rural population is fairly evenly distributed, and averages 23.6 persons to the square mile.

Vinton, with a population of 3,381, is the county seat and an important canning center. Belle Plaine has a population of 3,887. Other towns of local importance are Garrison, Mount Auburn, Urbana, Shellsburg, Keystone, Van Horn, Newhall, Atkins, Blairstown, and Norway. These and a few smaller places are trading and shipping points. Bricks and drain tile are manufactured at Belle Plaine, Garrison, Shellsburg, Norway, and Vinton.

Excellent transportation facilities are provided for all parts of the county. The main lines of the Chicago & North Western and the Chicago, Milwaukee & St. Paul Railways pass through the southern and south-central parts, respectively. The main line of the Chicago, Rock Island & Pacific Railway crosses the northeastern part, and a branch extends westward from Vinton. An electric interurban railway, extending from Cedar Falls through Waterloo and Cedar Rapids to Iowa City, passes through the extreme northeastern part.

Except in a few of the rougher regions and along some of the larger streams, the public roads follow section or other land lines. Most of the roads are well graded and kept in repair by dragging. The transcontinental Lincoln Highway crosses the county near the southern boundary, passing through Belle Plaine. A few miles of road leading out of Vinton and Belle Plaine, which were paved this summer (1921), are part of a permanent improved road system.

Rural mail delivery and telephone service reach all parts of the county. Rural schools and churches are conveniently located, and consolidated schools have been established in some townships. In some localities electric transmission lines furnish current for light and power.

Cedar Rapids and Chicago are the principal outside markets for farm products. Most of the corn and oats and some of the hogs are marketed in Cedar Rapids.

CLIMATE.

The climate of Benton County as a whole is very favorable for the production of the general farm crops, and practically no serious crop failures occur. Occasionally some difficulty is experienced during wet seasons, and during the growing season droughts sometimes reduce the yields, but when the land has been properly prepared and the crop well planted and cultivated, satisfactory yields are usually obtained.

According to the records of the Weather Bureau station at Belle Plaine the total precipitation for the driest year of which there is any record (1910) is 18.77 inches, and that for the wettest year (1902), 57.48 inches. The mean annual precipitation is 33.89 inches, which is sufficiently well distributed to meet the needs of all crops. The precipitation during the fall months is relatively low and favorable for the gathering of the corn crop and other farm work. Occasionally windstorms and hail cause some damage to corn and grains.

There is quite a wide range in temperature, the extreme range being from −31° F. to 104° F. The winter mean is 20.7° F. and the summer mean 71.2° F. Extreme temperatures are comparatively rare, and during the growing season fairly uniform temperature prevails.

The average date of the last killing frost in the spring is May 2 and that of the first in the fall October 5. Killing frosts have occurred as late in the spring as May 31 and as early in the fall as September 11. The normal growing season is about 156 days.

The table below gives the principal climatic data as recorded by the Weather Bureau station at Belle Plaine:

Normal monthly, seasonal, and annual temperature and precipitation at Belle Plaine.

(Elevation, 886 feet.)

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1902).
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	23.9	62	−21	1.43	0.07	2.40
January	17.5	58	−31	1.65	2.45	1.07
February	20.8	65	−24	1.62	.80	2.39
Winter	20.7	65	−31	4.70	3.32	5.86
March	33.3	86	−13	2.33	.46	3.45
April	48.9	90	17	3.27	1.69	2.57
May	60.4	93	25	4.63	3.02	7.13
Spring	47.5	93	−13	10.23	5.17	13.15
June	69.0	99	38	4.05	1.68	7.12
July	73.4	104	42	3.98	.86	6.20
August	71.3	102	40	3.50	3.26	13.53
Summer	71.2	104	38	11.53	5.80	26.85
September	63.2	100	25	3.14	3.47	5.64
October	51.0	90	14	2.56	.34	2.85
November	35.4	78	−3	1.73	.67	3.13
Fall	49.9	100	−3	7.43	4.48	11.62
Year	47.4	104	−31	33.89	18.77	57.48

AGRICULTURE.

From the first settlement in 1839 grain and livestock farming have been the leading types of agriculture. The first efforts at farming were necessarily somewhat primitive. For a number of years grain crops were grown largely for subsistence and cattle were herded on the open range, where the luxuriant prairie grasses easily supported livestock a large part of the year. Wheat was an important crop in the early agriculture, but in later years declined because of attacks of insect pests and inadequate profits. Corn also was grown early and gradually increased in importance, owing to the large areas of soil adapted to it and to its value as feed for livestock. Oats, rye, and barley ranked next in importance.

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

Acreage and production of principal 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	127,752	5,871,574	24,420	892,835	56,928	669,550	754	13,098	8,829	186,618
1889	113,543	5,007,949	71,037	3,023,835	5,432	65,493	396	6,632	7,811	236,906
1899	136,804	5,629,460	79,147	3,113,510	4,752	73,000	887	10,900	17,560	543,000
1909	133,225	5,742,496	73,987	2,570,382	757	12,491	996	15,049	12,972	261,183
1919	128,485	5,587,492	90,292	3,595,475	5,341	92,692	1,333	17,271	4,706	116,293

Corn is grown primarily as a subsistence crop, but some of it, probably between 20 and 40 per cent, is marketed, especially by tenant farmers. The principal variety is Reid Yellow Dent. Many farmers produce some corn for silage. According to the Iowa Yearbook, there were 552 silos in the county in 1919, containing 46,003 tons of silage. In the vicinity of Vinton, Shellsburg, and Garrison, where canning factories are located, the production of sweet corn is of some importance. The Iowa Yearbook gives the acreage in sweet corn in 1919 as 2,892 acres and the yield as 6,407 tons.

Oats rank next to corn in acreage. During the last four decades the acreage and production have increased. The oat crop is considered of value in the crop rotation and is grown as a subsistence crop and for market. About half of the crop is sold, mostly at Cedar Rapids. The principal varieties are Albion (Iowa No. 103), Richland (Iowa No. 105), Silvermine, and Kherson.

Wheat at present is a crop of minor importance. Both winter and spring wheat are grown, winter wheat giving somewhat better yields. In 1919 there were 2,099 acres sown to winter wheat, yielding 48,277 bushels, and 2,623 acres of spring wheat, yielding 39,345 bushels.

Rye is a minor crop, grown mostly on sandy types of soil. Barley is relatively unimportant. Buckwheat and flax are sometimes grown in a small way.

Timothy and clover rank first as hay and forage crops. These crops are more often grown together. They are commonly grown separately when intended mainly for seed. The census reports an area of 31,655 acres in timothy and clover mixed in 1919, producing 58,375 tons of hay; 6,401 acres in timothy alone, producing 8,573 tons; and 4,223 acres in clover, producing 8,047 tons. For the same

year the Iowa Yearbook shows a production of 11,715 bushels of timothy seed from 2,346 acres, and 1,133 bushels of clover seed from 947 acres. There was a small acreage of alfalfa and millet. Coarse forage was cut from 4,387 acres and produced 12,117 tons.

Potatoes have always been a minor crop, being grown primarily to supply the home. In 1919, 46,499 bushels of potatoes were grown on 1,154 acres. While the potatoes and other vegetables grown ordinarily supply the rural demand, considerable quantities of these products are shipped into the county for consumption in the towns. On some of the sandy soils watermelons and cantaloupes are produced as a surplus crop. Sorgo is grown to some extent for sirup, of which 6,149 gallons were produced in 1919.

Tree and bush fruits are produced on practically every farm, but not commercially. As a rule little attention is given to pruning, spraying, and fertilization. Apples are the principal tree fruit, followed by cherries, plums, pears, and peaches. In 1919 there were 31,042 apple trees, producing 15,072 bushels. Grapes and berries are grown to supply the home.

The livestock industry is the most important source of farm income. Hog raising leads. On July 1, 1919, according to the Iowa Yearbook of Agriculture, there were 124,954 hogs in the county, or an average of about 48 per farm. Poland-China is the leading breed, followed by the Duroc-Jersey, Chester White, and Hampshire. There is much interest in the hog industry, and many herds consist of purebred animals.

Cattle are principally of the beef type, the Hereford, Aberdeen Angus, and Shorthorn breeds predominating. Cattle are bred within the county and some feeders are shipped in from the western ranches, but slow markets and high freight rates in the last few years have greatly discouraged this industry. The 1920 census reports 54,292 beef cattle in the county. As a rule herds are not purebred, but most breeders use purebred sires.

Dairying is carried on in a small way. Most farmers milk a few cows, mainly of the beef type, though there are some of the dairy type, chiefly Holstein, Guernsey, and Jersey. Cream is separated at home and sold to creameries or to local buyers. At present (1921) there are two creameries in the county, one at Vinton and one at Belle Plaine. The latter receives some whole milk. A few dairies in the vicinity of the larger towns deliver milk to patrons in these towns. The census reports the value of dairy products in 1919, excluding home use, as $589,069.

Sheep are kept on some farms, especially on the rougher lands. The Shropshire is the leading breed. The 1920 census gives the number of sheep in the county as 10,672, the wool produced as 59,788 pounds, and the value of wool produced as $29,751.

Practically every farm produces some poultry and eggs, and many have ducks, geese, and turkeys. The census reports the value of poultry and eggs produced in 1919 as $764,522.

Horses and mules of good draft types are used in farm work. Percheron and Belgian are the prevailing breeds, and many farms raise one or more colts each year. Horses are preferred as work stock. The Federal census for 1920 reports 18,799 horses and 706 mules in the county.

The general adaptations of soils to crops are usually recognized by the farmer. The dark-colored silty and loamy prairie soils are especially adapted to the production of corn and general farm products; in addition they have a smooth surface and are easy to cultivate, and therefore they are well developed. The lighter-colored soils, such as the types of the Clinton series, in the more rolling sections are recognized as desirable farm land on the smoother areas, but the more rugged land is generally used as pasture or for forest. The loose sandy lands north of the Cedar River are not considered desirable soils. The first-bottom lands are potentially strong soils, but are not fully utilized for crops because of the frequency of overflow; they make valuable pasture lands, providing good grazing and abundant water for stock.

Reasonably modern practices are followed in conducting farm operations. Seed corn is usually selected with care and stored to conserve the germinating power, and some seed is tested before planting. In harvesting corn the ears are snapped from the standing stalks and hauled to storage cribs. Corn for silage or for fodder is cut by machine. Small grains are practically all threshed in the field from the shock; only rarely is grain stacked before threshing. Hay is stored largely in barns, though some is stacked in fields or near feeding lots. Soybeans are sometimes planted with corn to provide early winter forage and to increase soil fertility.

Most of the farms have well-built houses, barns, and other outbuildings. An increasing number of houses have modern improvements, such as running water, bath, and electric or other modern lighting systems. Barns are usually of sufficient size to house the livestock and provide storage for their feed during the winter months. Silos are in rather common use, and their number is increasing. Tractors are in use on most of the up-to-date farms, and many auto trucks are used in hauling produce and supplies. In the preparation of the land and in cultivating and harvesting crops modern machinery and implements are employed. These include manure spreaders, seeding and gang plows, disk and smoothing harrows, check-row planters, riding cultivators, corn harvesters, grain drills, grain binders, and haying machinery of all kinds.

The fences are mostly of barbed wire, though woven-wire bases are used around sheep and hog pastures. Three, four, or five-horse teams are used in plowing or other heavy cultural operations. On the average 160-acre farm there are about 30 head of cattle, 5 being milk cows, about 50 hogs of all kinds, 6 horses and colts, and about 100 chickens. According to the 1920 census, 80.1 per cent of the value of all farm property per farm is in land, 10.2 per cent in buildings, 3.3 per cent in implements, and 6.4 per cent in domestic animals. The decrease in the proportionate value of domestic animals, as compared with preceding decades, is explained by the extraordinary advance in land prices as a result of the war and by the decline in cattle raising.

In preparing the land for corn, about three-fourths of it is plowed in the fall. Plowing of grain stubble begins very soon after the grain is threshed, or may be done at any time before the ground freezes. When corn follows corn the land is plowed in the spring. The land is disked and harrowed in the spring. Planting is done with check-row planters, but fodder or silage corn is commonly drilled in. Corn is usually planted the first week in May. The first cultivating is

done with a light smoothing harrow, and later, as the crop is developing, three to four cultivations are made with cultivators. Corn picking begins after the first frosts have deadened the stalks and may continue well into December. "Hogging off" the crop is sometimes practiced.

Land for oats and barley is ordinarily disked but rarely turned with the plow. Seeding is done, if possible, during the first week in April either with a drill or broadcast seeder. Wheat and rye are sown in September, ordinarily following oats in the rotation. Some spring wheat is grown, and although yields are lower, this crop frequently fits in well with the cropping scheme. Fall-sown wheat is harvested the latter part of June or the first part of July, and oats and barley a little later in July. Threshing follows closely upon the grain harvest.

Crop rotations, as a rule, are not well systemized. Corn may be grown several years in succession, or oats may be alternated with corn as may be found convenient, and occasionally oats are seeded with grass. Some of the better farms, especially those operated by the owners, are using successfully a rotation consisting of corn two years, oats one year, clover one year, or timothy and clover one to two years, or one year pasture.

Stable and barnyard manure are the principal fertilizers used. Some commercial fertilizer and lime are applied, mostly in an experimental way. The census reports show that 44 farms used commercial fertilizer in 1919, with a total expenditure of $5,240.

The supply of farm labor has been deficient, but at present is usually adequate. Most of the farm laborers are native whites. Competent single men are paid from $40 to $50 a month and board, and married men about $50 in cash. In addition, the latter are usually supplied with milk, a house, and a garden plot. Day labor during the harvesting season receives from $2.50 to $3. Corn pickers last season (1920) received from 3 to 4 cents a bushel; 3 cents where an elevator was used and 4 cents where the corn was shoveled. In 1919, on the 1,942 farms reporting, an average of $619.48 was paid for labor.

In 1920, according to the census, there were in the county 2,562 farms, comprising 94.7 per cent of the total area. The average size was 168.4 acres. Farms of much smaller acreage are not as economically managed. In some of the rougher parts of the county the farms are larger, and more land is used for pasture or left in forest.

During the last four decades there has been a gradual increase in the number of farms operated by tenant farmers, the percentages increasing from 39.7 per cent in 1880 to 46.3 per cent in 1920. It is estimated that at present (1921) about 60 per cent of the leased farm land is rented on a cash basis, the rent ranging from $6 to $11 an acre. During the latter part of the World War much higher rentals prevailed. About 30 per cent of the land is rented on the basis of the owner and renter each bearing half of the expense and receiving half of the crops. About 10 per cent is worked under leases varying in their provisions.

Prices of land are high, and during the latter part of the war period reached the maximum. Very little land is changing hands at present (1921) but well-improved land convenient to towns or

good markets, such as the Tama silt loam and Carrington silt loam, is held at about $300 an acre. Less desirable lands, such as the rougher areas of Clinton soils and bottom lands subject to overflow, bring lower prices, though little, even of the inferior land, can be bought for less than $100 to $150 an acre. The average assessed value in 1920 is given by the census as $235.86 an acre.

SOILS.[3]

Benton County lies in the prairie region of the West, where the climate and surface features have favored a luxuriant growth of grasses and, to a less extent, forest growth. The smoother parts evidently have always been prairie, and doubtless the rougher and more broken lands were also prairie until the forest gradually became established following the drainage and aeration of the land.

A grass vegetation under favorable climatic conditions has permitted the accumulation of organic matter which gives to the soil its dark-brown to black color. Where the surface has a little more pronounced relief and is better drained the soil has a dark-brown color, and where the surface is low and flat and the drainage sluggish the black color is found.

The typical profile of the upland prairie soils of the area, and one which may be regarded as mature for the prevailing climatic conditions, has a dark-brown surface layer with a fine granular structure. This varies in depth from 10 to 16 inches and is underlain by a heavier material which changes with depth from dark brown to brown. This passes into a brown or yellowish-brown material, heavier than the surface soil, usually a silty clay loam. The carbonates, including lime carbonate, have been largely removed to depths of more than 3 feet. The Tama and the Carrington series belong to this group of well-drained and well-aerated soils. With this group may also be placed the Waukesha and the Judson series of the well-drained terraces. The O'Neill and the Buckner series have been developed under the same conditions, but they have porous, coarse subsoils owing to the character of the parent material.

Another group of dark-colored soils includes those that have been developed under conditions of imperfect drainage. They have a surface layer of black color and normally of granular structure and are underlain by gray, or mottled gray, yellow, and brown subsoils heavier in texture than the surface soils and in some cases compact. The details of the profiles of these soils vary considerably, depending on the depth to which drainage and oxidation have extended. In some cases both surface soil and subsoil have developed under a cover of water or at least under a continually wet condition. In other cases the soil has been rather well drained, but the subsoil has been frequently wet. This group of poorly drained soils includes the

[3] Benton County, Iowa, adjoins Black Hawk County on the north and Linn County on the east. In some places the soil maps of these counties do not agree along the boundaries. This is due to the fact that several types found in these adjoining counties, on account of their very small area, have not been extended into Benton County. Usually the difference is only a slight change in texture. The Buckner silt loam of Linn County has been included with the Waukesha silt loam in Benton County, and types of the Carrington, Buckner, and Sarpy series have been included with other types of the same series in Benton County. The silty clay loams of the Clyde and Bremer series in Black Hawk County have been included with the silt loams of the same series in Benton County.

Grundy series of the flatter areas of the upland, the Bremer soils of the terraces, and the heavier types of the Wabash on the low flood plains.

In the rougher and more broken areas which lie along most of the larger streams and to some extent elsewhere the topography has facilitated run-off of surface waters as well as favored further erosion. This better drainage has resulted in a deeper aeration of the soil material, and this, with the more rugged topography, has been more favorable to a forest vegetation. Owing to the absence of grass vegetation these forest areas and areas formerly in forest have soils of light color. The areas of light-colored soils are, therefore, almost coextensive with the areas covered by forests when the white man first settled the country, and the soils owe their characteristics very largely to the influence of the forest growth.

These soils have profiles consisting of a surface layer of 6 to 8 inches or more of grayish-brown or light-brown silty or floury material, more or less granular in the heavier soils and looser and more open in the sandier members. This is underlain by subsoil material essentially like that found in the darker colored soil areas in color and lime content, but differing in places by being less friable and granular at a depth of 30 to 36 inches. Two series of soils in the area may be placed in this broad group, the Clinton series, derived from the loess, and the Lindley series, derived largely from glacial drift.

The Cass and the Sarpy series are developed on material of comparatively recent deposition. Their subsoils are composed of loose, porous material, and leaching, as well as the character of the material itself, has prevented the formation of a distinct profile.

All the soils of the county to a depth of 3 feet or more are more or less acid or sour, and lacking in lime, at least to the extent that they do not effervesce with hydrochloric acid. It is probable, however, that originally the soil material was distinctly calcareous and that the absence of this constituent to depths of more than 3 feet is due to leaching through long periods of time. The material of the substratum commonly contains lime carbonate at greater or less depth.

While it is now believed that such factors as organic matter, moisture content, and weathering have had a predominating influence in soil-forming processes, the characteristics of the soils are also influenced by the nature of the parent material. This is especially true with respect to the texture upon which the separation of the soils into types is based.

The mineral constituents of the soil consist of transported materials, deposited by glaciers, and of more recent deposits of silty material, known as loess. Most of the county is covered by the Iowan drift; in a small area along the southern border the Kansan drift appears. With the advance of the glaciers masses of rock and earth were ground up into fragments of various sizes grading from huge bowlders through gravel and sand to clay. The rocks supplying the materials are largely granite, gneiss, and diabase. From the records of well borings the thickness of the drift has been found to vary from 75 feet to 300 feet. The soils derived wholly or in large part from the drift are those of the Carrington and the Lindley series, the former a dark and the latter a light colored soil.

Subsequent to or contemporaneous with the retreat of the glaciers, a deposit of wind-blown material—loess—was superimposed upon the drift. This deposit varies in thickness, but is an important source of material in most of the surface soils south of the Cedar River. North of the river there is less evidence of the loess, and most of the soils appear to be composed largely of the glacial materials. Here, however, many of the sandy soils bear evidence of the influence of wind action in their formation. The dark-colored loessial soils have been classed with the Tama and the Grundy series and the light-colored with the Clinton series.

The soils are classified into soil series on the basis of similarity in color, structure, drainage, and mode of accumulation of the parent material. Each soil series is divided into soil types, which differ from one another in the texture of the surface soils.

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

The surface soils of the types grouped in the Grundy series are dark brown to black. The upper subsoil is heavy, rather plastic when wet and hard when dry and mottled with dark drab and yellowish brown. The lower subsoil is of lighter color, likewise mottled, and contains rusty-brown iron concretions. The series occurs on the tops of divides, the topography is flat to gently undulating, and the natural drainage is poor. The Grundy series is represented by one type, the silt loam.

The types of the Clinton series are characterized by gray or dark-gray surface soils and a light-brown or yellowish-brown compact subsoil. The topography is rolling to broken and the drainage is well established. This series is derived from the weathering of loessial materials. Two types, the silt loam and the fine sandy loam, are mapped.

The types of the Lindley series have prevailingly yellowish-brown soils, but they may range in color from gray on the one hand to brown on the other. The subsoil is yellow to yellowish brown and in rare cases reddish brown. It is usually heavier than the surface soil, though containing in most places a considerable proportion of sand and gravel. The topography is ordinarily rather rough. This series is derived by weathering mainly from the Kansan drift. Two types, the silt loam and the fine sandy loam, are developed in the county.

The surface soils of the types in the Carrington series are dark brown and the subsoil is yellow to light brown. These soils are derived through the weathering of glacial till, but the heavier types are modified to some extent by loess. The topography is gently undulating to rolling. Neither soil nor subsoil is highly calcareous. Five types, the silt loam, loam, fine sandy loam, sandy loam, and sand are shown on the map.

The Clyde series includes types with dark-brown to black surface soils and a light-gray subsoil mottled with yellow and rusty brown. These soils have been developed from glacial drift under conditions

of poor drainage and require artificial drainage before they can be farmed. They are essentially noncalcareous and in most areas show a strong acid reaction to litmus. One type, the silt loam, is mapped.

The Judson series comprises types of alluvial and colluvial origin. The surface soils are dark brown to almost black in color, and the subsoil is lighter brown. Neither soil nor subsoil is highly calcareous. The type occurs on terraces above overflow and on colluvial slopes along the foot of bluffs. The soil material is mainly wash from loess or silty drift soils. A small acreage of the silt loam is mapped.

The types included in the Waukesha series are characterized by dark-brown to black surface soils, underlain by a brown to yellowish-brown subsoil. The subsoil is heavier in texture than the soils, but is not compact and impervious. Types of this series are derived from water assorted glacial debris deposited on broad filled-in valleys or as outwash plains and terraces. The topography is mainly flat to undulating. The drainage is good. The Waukesha silt loam is mapped.

The types of the O'Neill series are characterized by dark-brown to black surface soils and differ from other terrace soils in having a light-colored sandy to gravelly subsoil. They occupy terraces and second bottoms along stream courses. The surface is level, but the drainage is thorough, owing to the porous subsoil. The surface of the sandy type is sometimes modified by wind-blown material. The loam and sandy loam are developed in this county.

The types of the Chariton series have surface soils ranging in color from dark gray to dark brown or black. The upper subsoil is typically an ashy-gray silt loam or silty clay loam. The lower subsoil is a mottled brown and ashy gray, compact silty clay loam or clay. These types occur on old terraces above present overflow. Typically the surface drainage is good, but it is deficient in Benton County. Only the silt loam is mapped in this area.

The Buckner series consists of dark-brown to almost black surface soils over a lighter colored friable subsoil which does not differ greatly in texture from the soil. Neither soil nor subsoil is highly calcareous. The series is composed principally of reworked loessial material, modified in places by sediments from glacial or residual soils. The surface is level, but the drainage is good, and the soils by their position on terraces are protected from overflow. One type, the sandy loam, is mapped.

The types of the Bremer series differ from those of the Waukesha series mainly in having a heavy, tenacious, mottled subsoil, indicative of poor drainage. The surface soils are dark brown to black, and the subsoil, which contains enough fine material to be plastic, is dark brown in color in the upper part and mottled with yellow, brown and gray in the lower part. The topography is flat to undulating. Two types, the silty clay loam and the silt loam, are mapped here.

The Wabash series includes types with dark-brown to black surface soils, high in organic matter, and a dark-drab to gray heavy subsoil. Both soil and subsoil are low in lime. The series is typically developed in the first bottoms of the Central Prairie States, the material being derived principally from the loessial and silty glacial soils of the region. These soils are subject to overflow, but

natural drainage is well established in some areas. Three types, the silty clay loam, silt loam, and loam, are found in Benton County.

The surface soils of types correlated in the Cass series are dark brown to black. The subsoil is lighter in color, and in texture it resembles the subsoil of the O'Neill series. The soils are alluvial and are most extensively developed in the bottoms of the Mississippi and Missouri Rivers and their tributaries. They occur in association with the Sarpy soils, and are subject to overflow. Between the high stages of the stream the drainage is good. Two types, the loam and sandy loam, are mapped.

The Sarpy series includes types with brown soils, underlain by a subsoil of lighter texture, frequently passing within the 3-foot depth into loose sand and gravel. This series occupies first bottoms subject to overflow. It differs from the Cass series mainly in the lighter color of the surface soils. It is represented in this county by the Sarpy sand.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Tama silt loam	216,968	48.4	Lindley fine sandy loam	1,920	0.4
Shallow phase	3,192		Grundy silt loam	1,856	.4
Carrington silt loam	53,696	11.8	Carrington fine sandy loam	1,536	.3
Wabash silt loam	37,952	8.3	Buckner sandy loam	1,472	.3
Clinton silt loam	32,576	7.1	Wabash silty clay loam	1,088	.2
Carrington sandy loam	23,680	5.2	Cass sandy loam	1,024	.2
Carrington loam	19,840	4.4	O'Neill loam	768	.2
Waukesha silt loam	13,056	2.9	O'Neill sandy loam	768	.2
Clyde silt loam	12,736	2.8	Chariton silt loam	576	.1
Bremer silt loam	10,048	2.2	Meadow	448	.1
Wabash loam	5,120	1.1	Bremer silty clay loam	384	.1
Clinton fine sandy loam	4,096	.9	Peat	128	.1
Lindley silt loam	3,392	.7	Judson silt loam	128	.1
Cass loam	3,008	.6			
Sarpy sand	2,240	.5	Total	455,680	
Carrington sand	1,984	.4			

TAMA SILT LOAM.

The Tama silt loam has a surface soil 12 to 16 or 18 inches deep, consisting of a dark-brown friable silt loam, nearly black when moist and a dark grayish brown when dry. It is of uniformly fine texture, and has a soft floury feel when rubbed between the fingers. Below a transition layer of 3 or 4 inches the subsoil consists of a light-brown, compact, but friable, silt loam or silty clay loam. In the lower part of the 3-foot section the material becomes somewhat lighter in color and slightly less friable. As a rule no mottlings occur in the subsoil, but in depressions where the conditions approach those of the Wabash or Clyde soils the lower subsoil contains some mottlings of brown and yellow and is somewhat dense and plastic. Both soil and subsoil practically always give acid reactions.

The Tama silt loam predominates on the uplands of the county south of the Cedar River, particularly in the middle and western parts. The areas are interrupted by areas of the Wabash and other alluvial soils along stream courses and by areas of the upland soils of the Carrington and Clinton series.

Most of the type has an undulating to gently rolling surface, and few areas have sufficient slope to cause injurious erosion or to interfere with the use of modern farm machinery. South and southeast of Newhall some lenticular low hills and parts of the adjoining lands have a moderately hilly to rolling surface, but it is smooth. Natural drainage is good in both soil and subsoil.

Practically all the area of this soil is improved and under cultivation. A few of the more rolling areas, especially narrow strips along the streams, are retained with these bottoms in permanent pasture. General farming prevails upon this type, with corn as the leading crop. Other crops include oats, some wheat, barley, and clover and timothy. Of the animal industries, hog raising easily leads, with cattle secondary in importance.

The yield of corn ordinarily ranges from 40 to 50 bushels, but reaches a maximum of 80 or 90 bushels per acre in favorable seasons. There is about the same range in the yield of oats. Hay yields from 1 to 2 tons.

Preparation and cultivation of this soil usually are adequate. Most of the grain stubble and sod land is plowed in the fall, and corn stubble is turned under in the spring. As a rule, no systematic crop rotations are followed. Oats usually follow corn. However, corn is sometimes grown on the same field for several seasons. Although the soil is more or less acid, red clover seeding is usually successful. Fertilizers are practically confined to stable and barnyard manures. Commercial fertilizers and lime are sometimes used in small amounts in an experimental way.

Land values vary considerably and are somewhat less than they were two or three years ago during the war-boom prices. Present (1921) values range from $250 to $300 an acre, varying with the location and condition of improvements. War prices of this land ran as high as $450 or $500 an acre.

In improving the soil and maintaining its fertility, better results would be obtained by adopting a rotation in which the land would be seeded to grass oftener. Moderate applications of lime, and probably phosphate fertilizers, every few years would doubtless prove beneficial.

Tama silt loam, shallow phase.—The Tama silt loam, shallow phase, in its surface appearance resembles closely the typical Tama silt loam. It differs in the presence of limestone bedrock at varying depths within the 3-foot section. A representative boring consists of about 10 to 12 inches of dark-brown mellow silt loam, underlain by a lighter brown somewhat more compact silt loam, which at about 22 inches changes to a coarse loamy sand containing fine gravel. At about 28 to 30 inches this rests on limestone, somewhat soft and crumbly at the point of contact.

Areas of this phase occur in the northern part of the county, notably in sections 7, 8, and 18, Cedar Township. A few small areas, mostly narrow strips marking bluffs and rock outcrops, occur north of the Cedar River. The surface varies from rolling in the larger areas to steep and broken in the smaller ones.

Comparatively little of this land is cultivated, most of it being reserved for pasture and woodlots. Some quarries have been worked for building stone and lime.

GRUNDY SILT LOAM.

The Grundy silt loam has a surface soil of about 10 inches of dark-brown to nearly black fairly friable silt loam. This changes below, through an intermediate zone of 3 to 4 inches, into a bluish-black or dark grayish black compact silt loam or silty clay loam, which at about 20 inches becomes a bluish-gray, stiff, rather plastic silty clay, mottled with yellowish brown and rusty brown. The material becomes lighter in color with increase in depth, and at 30 inches is a yellowish-brown, dense, plastic silty clay, mottled with rusty brown and containing small, mealy, dark concretions.

Practically all of this soil is found in the western tier of townships in a number of small areas, none exceeding 1 square mile in extent. It has a generally level to gently undulating surface and occupies flat areas on drainage divides in the Tama silt loam region. Natural surface drainage is fair, except in many of the more level positions, where the run-off is slow. The dense, tenacious subsoil hinders free subsoil drainage. Some of the poorly drained areas have been tiled with good results.

The Grundy silt loam is used for production of general crops of the same kind and gives about the same yields as the associated Tama silt loam.

CLINTON FINE SANDY LOAM.

The Clinton fine sandy loam consists of rather variable material as compared with the similar Lindley fine sandy loam and the darker colored Carrington fine sandy loam. In general the type consists of about 18 to 20 inches of light-brown loamy fine sand, which below becomes more loamy, until at about 28 inches the subsoil is a lighter brown, compact, rather heavy fine sandy loam. The virgin soil as found in woods and permanent pastures typically has a surface layer of 2 or 3 inches of dark-colored material, the color being due to a relatively high content of organic matter. Some cleared and exposed high-lying areas consist of light-brown loamy fine sand to a depth of 3 feet or more, probably the result of wind action. In depressions the soil is much darker than typical, and the subsoil generally is much heavier and more loamy. On the lee side of elevations the soil is often more sandy than on the windward side.

Practically all the type is developed in a belt along both sides of the Cedar River and within 1 to 2 miles of the river. The most notable area is on the north side of the river east of Vinton. The type is closely associated with areas of Clinton silt loam. In many places it is difficult to draw satisfactory boundaries between the Clinton fine sandy loam and the Lindley and Carrington fine sandy loams. The topography ranges from rolling to somewhat hilly. Natural drainage is well established.

Because of the comparatively small total area of this soil, its more or less sandy character, and its low content of organic matter, it is of minor importance. All of it originally was in forest and parts of it now support a forest growth of the same character as found on the Clinton silt loam. The cleared land is utilized in producing the usual farm crops, with yields somewhat lower than on the heavier textured soils. The soil is easy to cultivate and warms up early in the spring.

In seasons of ample rainfall satisfactory yields are obtained, but in periods of dry weather crop growth is retarded, and the yields fall below the average for the county.

This soil needs additional fertilization, especially with the view of increasing the supply of organic matter. This is best supplied with stable manures or green-manure crops, especially legumes. Exposed locations should be kept in cover crops to reduce to a minimum the drifting of surface sand by the wind.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Clinton fine sandy loam:

Mechanical analyses of Clinton 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.*
334509	Soil, 0 to 18 inches	0.2	14.3	20.7	42.1	3.6	14.2	4.8
334510	Subsoil, 18 to 36 inches	.2	7.2	11.6	31.9	6.8	31.7	10.7

CLINTON SILT LOAM.

The Clinton silt loam has a surface soil consisting of a light grayish brown or dull-gray, slightly compact, but moderately friable silt loam, 8 to 10 inches deep. Below this the material gradually becomes lighter in color, more compact, and commonly somewhat less friable. At about 18 to 20 inches the color is light brown to buff, and at about 30 inches the texture approximates a silty loam, often rather plastic. In the better drained locations little or no mottling or staining is noticed, but in the flatter positions the lower subsoil in many places has mottlings of yellow and brown and mealy concretionary matter of black and rusty-brown color. No stones or gravel are present in soil or subsoil. Owing to the comparatively low content of organic matter the soil is not as easily tilled as the Tama and Carrington soils of the same texture, and there is also a tendency for the soil to run together when wet and to bake when dry.

Where this type is associated with the Clinton fine sandy loam, notably in Harrison and Taylor Townships, there are some sandy variations, usually approximating a very fine sandy loam at the surface and containing also a larger proportion of fine and very fine sand in the subsoil than is found in typical areas.

The largest typical area lies north of Shellsburg, in the triangle bounded by the Rock Island Railway, Cedar River, and the Linn County line. Smaller areas occur in southern Leroy, southeastern Iowa, and southwestern St. Clair Townships. Several small areas are found in other places and are usually designated as "groves" with local names.

The surface as a whole is rather hilly and in places broken with rugged ravines. In practically all cases the type lies noticeably higher than the adjoining or surrounding Tama silt loam or Carrington types. Drainage is well established, except for occasional small swales or seepy spots.

A large proportion, probably two-thirds of the type, is in cultivation for the production of general farm crops. Other parts, especially the rougher areas, are used as pasture or reserved as forest land. The soil was originally forested with various hardwoods, including white, red, and bur oak, hickory, some elm, walnut, red haw, and hazel brush.

Corn is the leading crop. Oats, wheat, and barley, timothy and clover, and various other crops also are grown. Hog and cattle raising are important industries. Crop yields usually average somewhat less than those obtained on the darker colored silt loams, but the products are of good quality and some farmers think superior to those produced on the heavier yielding soils. Pastures are good and bluegrass thrives. Good stands of clover are obtained, although the soil naturally has an acid reaction.

Well-improved land sells from $200 to $300 an acre, while the rougher areas with less improvement are considered worth around $100 an acre.

The principal deficiencies of this type are its low content of organic matter and tendency to erode severely on the steeper slopes. The methods of improving the soil would include the use of stable manure, plowing under green-manure crops, and conducting tillage operations so as to control erosion as far as practicable.

LINDLEY FINE SANDY LOAM.

The Lindley fine sandy loam has a surface soil of light-brown normally mellow, fine sandy loam, 10 to 16 inches deep, averaging about 12 inches. The subsoil may be a compact light-brown fine sandy clay loam, with yellowish-brown slightly sticky loamy fine sand below 28 to 30 inches, or it may consist throughout of a compact and rather sticky fine sandy loam of light-brown to yellowish color. In places coarser sand and angular or rounded pebbles may be present in the soil section. There is more variation in the subsoil than in the surface soil.

The Lindley fine sandy loam is of small extent, and nearly all of it lies south of the Cedar River in Benton Township and in small areas in northern Canton Township. It occupies rolling to rather hilly country, though in places it is confined to ridges and slopes. Good natural drainage prevails.

This soil type is of minor importance because of its small extent and unfavorable topography. The less rolling parts are used for general farm crops, but a considerable proportion is kept in pasture and in forest. Originally all the type was forested. Fairly good results are obtained in farming this type. The soil needs careful management, including the application of manure and fertilizers, especially those that will aid in maintaining a supply of organic matter.

LINDLEY SILT LOAM.

The surface soil of the Lindley silt loam is a light-brown rather compact silt loam, 6 to 8 inches deep. The subsoil is a yellowish-brown or light-brown, compact, and somewhat plastic silty clay loam or clay loam which assumes a lighter color and becomes more dense and plastic with increase in depth. At 18 to 20 inches it is

usually a gritty, sticky, dense, dull-yellowish clay, which with increase in depth becomes mottled with brown and rusty brown and contains black concretions. The subsoil usually contains some sand, rounded cherty gravel, and larger granitic, cherty, and sandstone rock fragments.

This type is practically all in the southern part of the county in Iowa and Leroy Townships. One small tract lies in sections 4 and 9 of Harrison Township. It occurs on slopes and along sides of draws and ravines, with areas of Clinton silt loam in many places occupying the tops of the hills and dividing ridges. The surface is usually sloping and in places rather rough and broken. The surface drainage is good.

The smoother and better land, comprising about half of the total area of the type, is in cultivation; the rest is in pasture and forest. Oaks predominate in the forest growth. The rugged topography, low content of organic matter, and tenacious character of the subsoil make this type less desirable than the darker colored and more friable soils. Many farmers, however, are getting good results, especially where farms include stream-bottom or other dark-colored types.

CARRINGTON SAND.

The surface soil of the Carrington sand consists of 10 to 14 inches or more of grayish-brown or dark grayish brown, loamy, medium-textured sand. Its slightly coherent character is due to a noticeable content of silt, clay, and organic matter. The subsoil in practically all cases is a light-brown or yellowish-brown, incoherent, medium-textured sand. No stones or gravel are ordinarily found on the surface or in the soil section.

Where not protected by forest or other vegetation, the soil is particularly subject to drifting, frequently to the injury of planted crops, and in the more wind-swept positions blow pits are sometimes found.

This type is usually associated with the Carrington sandy loam north of the Cedar River. Other areas occur in the vicinity of Benton City and along the Black Hawk County line north of Mount Auburn. It occupies ridges and higher lying positions, elevated above the sandy loam type, and in places it has a dunelike appearance. The drainage is excessive and most of the land is droughty. Some scattering trees, mainly small oaks, grow on it.

The Carrington sand is an inferior agricultural soil, but low yields of all crops can be obtained. In seasons of abundant rainfall corn gives a fair yield, but in dry seasons this crop may fail. Oats and rye are grown to some extent. Grass and clover seldom make satisfactory stands. The soil is used with some success for growing watermelons, cantaloupes, and early truck crops. Most of the areas in the more exposed positions are uncultivated, but are used as pastures, though their value for grazing is low.

CARRINGTON SANDY LOAM.

The surface soil of the Carrington sandy loam consists of 18 to 20 inches of dark-brown or dull-brown sandy loam or heavy sandy loam. In places the soil really approximates a loam, but it contains enough of the coarser sand to give it a sandy loam character. This

upper layer grades below into a layer of lighter brown compact sandy loam, which usually passes at about 24 to 30 inches into the lower subsoil, consisting of light-brown, loamy medium sand or light sandy loam. The material of the substratum is the glacial till of yellowish stony sand and clay commonly found underlying the Carrington soils.

There is considerable range in the soil conditions, varying from the darker color and somewhat heavier texture found in lower lying and less exposed positions to the browner or lighter colored and looser textured variations, approaching the Carrington sand in higher lying and more exposed locations.

Nearly all of the Carrington sandy loam lies north of the Cedar River, where it is one of the principal soils. It predominates on the drainage slopes on the east side of Bear Creek and in Polk Township. A smaller area occurs along the river northeast of Mount Auburn, and others in a belt southeast from Benton City. The type is well drained but is not droughty, though less retentive of moisture than the heavier Carrington soils. It has a generally rolling surface, and most of it is smooth enough for easy farming operations.

The Carrington sandy loam is used for producing the ordinary farm crops, and satisfactory returns are usually obtained. Yields vary somewhat, depending on whether the soil is more loamy and more fertile or more sandy and less fertile. When exposed to winds, the drifting of sand may cause injury to young corn and to some extent to grain crops. Corn, oats, barley, wheat, rye, and clover and timothy are the principal crops. Watermelons, cantaloupes, and other truck crops are also grown.

The principal needs appear to be the control of wind erosion, moisture conservation, and generally an increased supply of organic matter. Deep plowing should be advantageous on the heavier textured variations. Early planting, which the porous condition of the soil permits, is an advantage, especially with corn, as it gets the crop sufficiently advanced to withstand hot, dry periods of summer. The soil is acid and needs liming to get the best results with clover or other legumes. Phosphate fertilizers also would doubtless be beneficial and profitable.

CARRINGTON FINE SANDY LOAM.

The surface soil of the Carrington fine sandy loam consists of 10 to 16 inches of dark grayish brown or dark-brown, loose, friable fine sandy loam. This grades through 6 to 8 inches of lighter brown fine sandy loam into a yellowish-brown or light-brown, compact, friable fine sandy loam, which at 28 to 30 inches usually becomes lighter both in color and texture, approximating a yellowish-brown loamy fine sand. The substratum, as observed in cuts, usually is a yellowish, stony glacial till.

This type is of small extent and occurs in a number of scattered areas. Most of it is north of the Cedar River, associated with the Carrington sandy loam and Carrington loam. In places it occupies ridges and positions more elevated than adjacent heavier soils. It undoubtedly has been modified more or less by wind action, and in places the lighter colored variations are difficult to separate from the Clinton fine sandy loam. The drainage is thorough and often excessive.

Some forested areas support a growth of oak, hickory, and several other species of deciduous trees and shrubs. Most of the type is improved and successfully used for producing the usual farm crops, with satisfactory and profitable results. Farms containing this soil practically always also contain Carrington loam, Clyde silt loam, or other soils.

CARRINGTON LOAM.

To a depth of 12 to 16 inches the Carrington loam consists of a dark-brown to nearly black friable loam, containing noticeable amounts of medium and fine sand and a good supply of organic matter. With increase in depth the subsoil becomes a somewhat lighter brown heavy loam and at 22 to 24 inches approximates a light-brown sticky fine sandy loam or sandy clay loam. Normally below 36 inches the material is a yellowish-brown sticky sandy loam. Occasional granitic bowlders are found on the surface. This type is usually associated with the Carrington silt loam; in places these types grade into each other, and the lines of separation on the map are rather arbitrary.

The Carrington loam is most typically developed north of Cedar River, notably in a belt 1 to 2 miles wide on each side of Prairie Creek and extending southeasterly through Urbana. Other areas occur in this part of the county. In the northwestern part it is found on the western side of Pratt Creek and in several smaller scattered areas.

The surface varies from gently rolling to rolling, and practically all is sufficiently smooth for effective working. On the slopes of a few draws repeated cultivations have induced more or less erosion, so that the lighter colored subsoil material is exposed in spots.

The drainage in general is good. In a few of the flatter places the subsoil is not well drained and needs tiling. As a whole the soil is fairly retentive of moisture and warms up readily in the spring, facilitating early preparation of the land.

The Carrington loam is well developed, and most of it is cultivated regularly. All staple crops are successfully produced, especially corn, oats, and hay. Wheat, barley, and minor crops are also grown. Average crop yields are easily obtained, and excellent results are had with intensive methods. The soil is responsive to manuring, but aside from stable manure little fertilizer is applied.

This type constitutes very desirable land and is considered worth around $300 an acre.

CARRINGTON SILT LOAM.

The Carrington silt loam to an average depth of about 10 inches consists of a dark grayish brown or dark-brown mellow silt loam, rich in organic matter. This grades downward through a few inches of dull-brown silt loam into a light-brown or dull yellowish brown compact silt loam, which at depths varying between 18 to 30 inches passes into a light-brown to yellowish-brown, compact, and moderately friable, but ordinarily somewhat sticky, gritty, silty clay loam or clay loam. The lower subsoil in places contains some gray and brown mottling and some granitic and cherty pebbles and gravel. On the surface are found occasional granitic bowlders varying in size from

a few inches to 1 or 2 feet in diameter, but most of these have been removed from the fields.

The principal development of the Carrington silt loam is in the southeastern part of the county, where it occupies most of the uplands between Shellsburg and the Iowa County line. To the west it grades into Tama silt loam, which it closely resembles, so that in many places the line of separation between these two types is arbitrary. A few smaller areas are mapped, notably one of 3 to 4 square miles in the center of the county and two smaller ones north of the Cedar River between Vinton and Urbana.

The surface varies from gently rolling to rolling, and all the land is smooth enough for efficient use of farm machinery. The drainage is prevailingly good.

The Carrington silt loam is practically all under cultivation, and as farming land it ranks fully as high as the Tama silt loam. It is easy to cultivate, responds well to good treatment, and is easily maintained in good tilth. All the usual farm crops of the region are extensively grown, corn being the chief grain crop. Yields run about the same as on the Tama silt loam. The farm practices and land values also are about the same. Hog raising and the production of beef cattle are important industries.

CLYDE SILT LOAM.

The surface soil of the Clyde silt loam generally consists of 8 to 12 inches of black silt loam, having some gritty or fine sandy material, and a noticeable content of more or less decomposed organic matter, which gives the soil a somewhat mucky consistency. The subsoil is a rather sticky silty clay loam nearly black in color, which passes at 20 to 24 inches into a dark-gray, plastic sandy clay and becomes more sandy and often stony near the 36-inch depth. Usually the lower subsoil is more or less mottled and stained with rusty brown, yellowish brown, and light gray.

The type as mapped includes several variations. Where closely associated with sandy soils, small areas may have a more or less dark, mucky, sandy surface soil and a subsoil of clean, grayish, sticky sand or sandy clay. Where found adjacent to loam or silt loam types, the surface soil may be a silty clay loam and the subsoil more uniformly heavy, resembling the soil profiles of the Wabash and Bremer soils. In a few small patches the surface soil approaches a silty clay in texture.

The Clyde silt loam is associated with the Carrington soils and to some extent with the Tama silt loam. It occurs in narrow strips, mostly along sluggish drainage courses extending well up the slopes, and in depressed poorly drained positions. Rarely is a quarter section found in a compact area. In places along some of the small drainage ways and heads of small streams it resembles the Wabash or the Bremer silt loam. These draws are frequently strewn with granite bowlders. The type always lies lower than adjoining soil. In its natural condition it has rather poor drainage, and except in dry seasons of the year, seepage water often is held for considerable periods. In many places tile drains have been installed, and areas so improved have become valuable farming land. In many places the surface is boggy and somewhat hummocky. After removal of

the excess water the soil becomes more friable and oxidized and crops are able to attain their best development.

Improved areas produce excellent yields of corn, but are not so well adapted to small grains. Good yields of hay are made, and most of the unimproved tracts are used principally for wild hay and for pasture. Good stands of bluegrass are maintained.

JUDSON SILT LOAM.

The surface soil of the Judson silt loam consists of 10 to 12 inches of friable dark-brown silt loam; this grades down through a few inches into a light-brown moderately compact, friable silt loam or silty clay loam, which becomes lighter in color with increase in depth and at 28 to 30 inches assumes a yellowish-brown color. Commonly at about 36 inches there are some yellow and brownish mottlings.

The Judson silt loam is mapped in several small areas along the Linn County line southeast of Urbana. It is derived in part from colluvial material or surface wash from the adjacent uplands. The surface is flat and smooth and slopes toward the first bottoms, and the drainage is good. The Judson silt loam is admirably adapted to a wide range of crops. Corn, small grains, hay, and other crops do about as well as on the Waukesha silt loam, which this type closely resembles.

WAUKESHA SILT LOAM.

The surface soil of the Waukesha silt loam is a friable dark-brown silt loam, 12 to 18 inches deep. The material is browner when dry and nearly black when moist. This grades into a subsoil of light-brown, compact, but friable and crumbly silt loam or silty clay loam, which may continue to 30 inches or more, but in many places at 28 or 30 inches the subsoil is looser and may consist of gritty loam or silt and loamy fine sand. The sandier subsoil is more commonly encountered near the stream courses.

A few small areas of Waukesha loam along the Cedar River are included. These generally consist of about 12 to 16 inches of dark-brown or dark grayish brown loam or gritty loam, underlain by a compact but friable light-brown silty loam or gritty loam, the sand content increasing in the lower subsoil.

The Waukesha silt loam occurs in widely separated parts of the county. It occupies terraces or benchlike positions of low to moderate elevation along the large and the more important of the smaller streams. In most places there is a distinct drop in elevation to the first-bottom levels, but occasionally the slope toward the streams is gradual. Some of the larger areas are at Belle Plaine, south of Vinton, and in Cedar and Jackson Townships.

The surface is nearly level or very slightly undulating and very favorable for farming. In places drainage courses leading from the upland have dissected the surface somewhat and local drainage ways make the surface a little uneven in some areas. As a rule, the drainage is good and the soil is well aerated. Owing to its high content of organic matter, the soil withstands droughts well.

The Waukesha silt loam is admirably adapted to the production of corn and other general crops, and most of it is in well-improved farms. The yield of corn ranges ordinarily around 50 to 60 bushels per acre, and where the best cultural methods are followed much higher yields

are obtained. The small grains and timothy and clover practically always give profitable yields. The farm practice is about the same as on the Tama and Carrington soils, with which the type is usually associated.

O'NEILL SANDY LOAM.

The O'Neill sandy loam has a surface soil of 12 to 16 inches of brown to dark-brown sandy loam possessing considerable body. The subsoil grades with depth into a lighter color and less loamy texture and at about 24 to 28 inches becomes a yellowish-brown, loose, incoherent sand of medium texture, mixed in places with waterworn gravel.

Areas along Big Creek and near Shellsburg have a fine sandy loam surface soil, but because of their small extent they have been mapped with the sandy loam.

The typical areas occur on low second bottoms along the Cedar River. The surface is generally smooth or slightly sloping, but becomes undulating in places. Drainage is for the most part excessive, and in seasons of low or unevenly distributed rainfall crops do not attain their best development.

Corn is the leading crop. Minor crops include oats, rye, and sorgo and other forage crops. Some truck crops, principally melons, are grown near Vinton. The better variations yield fair pasturage.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the O'Neill sandy loam:

Mechanical analyses of O'Neill 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.*
334537	Soil, 0 to 15 inches	1.8	40.0	22.9	21.2	2.1	7.1	5.0
334538	Subsoil, 15 to 36 inches	3.7	38.0	27.6	22.2	.9	3.8	3.9

O'NEILL LOAM.

The surface soil of the O'Neill loam is a dark-brown friable loam or gritty silty loam with an average depth of about 12 inches. This grades quickly into a brown or light-brown compact loam. Below 24 inches the texture becomes lighter, and at about 30 inches the material normally consists of a mixture of light-brown sand and gravel, often rather loose and incoherent. Similar material forms the substratum. Adjacent to the first bottoms or streams the gravelly subsoil is commonly more open and loose than in areas near the uplands.

Nearly all this type lies north of the Cedar River in areas seldom more than one-fourth square mile in extent. One is at Vinton south of the river and another lies along Big Creek. It usually occupies narrow strips on terraces lying 10 to 20 feet above the first bottoms.

Aside from some minor unevenness the surface is nearly level. Drainage is well established, and the loose porous subsoil often produces droughty conditions.

Nearly all the O'Neill loam is improved land and is used for cultivated crops and for pasturage. When the rainfall is ample and

well distributed good results are obtained with corn, small grains, and forage crops, but in seasons of deficient rainfall the yields are reduced. Bluegrass thrives and good pastures are usually maintained.

CHARITON SILT LOAM.

The Chariton silt loam has a surface soil of about 6 inches of dark-brown or grayish-brown moderately friable silt loam. The subsoil is a grayish or ashy-gray, rather mealy silt loam, stained or slightly mottled with yellow and yellowish brown, passing at about 24 to 28 inches into a whitish or grayish-brown, compact, rather plastic silty clay loam or silty clay, mottled with yellowish brown. Small iron concretions appear in the lower subsoil.

This type occupies a few small scattered areas. The more important lie in section 16 of Bruce Township, about 3 miles northwest of Mount Auburn, and just west of Vinton. It is commonly associated with the Waukesha or Bremer soils, which occupy a slightly higher position. The topography is nearly level. The drainage is adequate in places, but is deficient in a number of depressions and swales, and water may stand on the surface or saturate the subsoil for considerable periods after heavy rains. Tile drains have improved some of these places.

Some of the better drained parts of the type are used for corn and other crops, but most of it is reserved for pasture. A scattering forest growth, mainly oak, occurs in some pastured tracts. Good bluegrass pastures are maintained, but where the land is not artificially drained the yields of cultivated crops are somewhat uncertain. The soil needs tile drainage and lime to correct acidity and improve the tilth.

BUCKNER SANDY LOAM.

The surface soil of the Buckner sandy loam is a dark-brown, loose sandy loam, with an average depth of 12 to 14 inches. There is a gradual change downward into a lighter colored or brown, loose sandy loam, which at about 30 inches becomes a light yellowish brown, slightly loamy sand.

This type occurs in a few small scattered areas along the Cedar River, on low second bottoms, most of which are above overflow. The surface is smooth and nearly level. Drainage is thorough and in places excessive, and in seasons of light rainfall crops often suffer.

Practically all the type is under cultivation. Corn, the principal crop, gives good average yields with sufficient rainfall. Rye is grown to some extent, but small grains do not give very satisfactory yields.

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

Mechanical analyses of Buckner sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
334541	Soil, 0 to 12 inches	2.9	23.4	12.6	41.7	3.7	8.7	7.1
334542	Subsoil, 12 to 36 inches	5.5	45.4	15.7	22.3	1.7	5.1	4.3

BREMER SILT LOAM.

The surface soil of the Bremer silt loam is a dark-brown to nearly black mellow silt loam, high in organic matter, and from 10 to 14 inches deep. This grades through several inches into a dull grayish brown or grayish-black, compact, plastic silty clay, and between 24 and 30 inches into a lighter colored or dull yellowish gray, dense silty clay, mottled with rusty brown, and in places containing iron concretions and brownish concretionary matter.

The Bremer silt loam is found in small detached areas widely scattered over the county in about the same topographic position as the Waukesha silt loam. It occurs mostly on low second bottoms along the principal streams, excepting the Iowa River. Some of the lower lying areas are only slightly above the adjoining tracts of Wabash silt loam. An important area, containing about 1 square mile, is located about 1½ miles southwest of Mount Auburn.

The surface is nearly level or slightly sloping and favorable for farm operations. The drainage is inadequate, because the run-off is slow and the impervious subsoil hinders underdrainage. In places surface ditches and tile drains have brought improvement.

The Bremer silt loam is a highly productive soil, and the better drained parts give excellent yields of practically all farm crops. It is well adapted to corn and is extensively used for this crop. Small grains also do well, though they have a tendency to lodge. Yields ordinarily run about the same as those obtained on similar areas of Waukesha silt loam. The type makes good pasture. The soil is later in the spring than the lighter textured and more rolling soils, and more care is necessary to maintain good tilth, particularly in working the land, which must be handled only when moisture conditions are right.

Areas of this soil form parts of farms consisting mainly of upland soils, generally the Tama silt loam or Carrington silt loam, and the value of this type depends more or less on the condition and value of the rest of the farm.

BREMER SILTY CLAY LOAM.

The surface soil of the Bremer silty clay loam is composed of about 8 inches of black friable silty clay loam. The subsoil is a nearly black, compact, and somewhat plastic silty clay loam or clay loam, which gradually assumes a very dark gray color faintly mottled in most areas with brown or rusty brown. At 24 to 28 inches the subsoil becomes a dark-gray plastic silty clay mottled with light brown, gray, or bluish gray. Small concretions and spots of concretionary matter are common.

This type is confined principally to three areas, the most important one lying along the south side of Prairie Creek at the Linn County line. It occurs on moderately low second bottoms similar to those of the Bremer silt loam. It has a nearly level surface relieved here and there by a few depressions. The drainage is fair to poor, as the flat surface retards the run-off and the dense character of the subsoil hinders the underdrainage.

Corn is the principal crop. Some land is devoted to the production of small grains and to pasturage. Except the slightly greater difficulty in cultivation because of the heavier and denser nature of the soil, its agricultural value is about the same as that of the Bremer silt loam.

WABASH LOAM.

The Wabash loam has a surface soil of 12 to 14 inches of dark-brown or black, compact, but friable loam, usually containing relatively large proportions of fine and very fine sand. The subsoil grades downward into a dark-brown to bluish-black, compact, and moderately sticky or plastic, heavy loam or loamy clay. Brownish or yellowish-brown mottlings and brownish stains are present in places in the lower subsoil. A fine sandy loam variation found in a few places, notably about 1½ miles southeast of Shellsburg, consists of a brown to dark-brown friable fine sandy loam, underlain by a light-brown compact fine sandy loam containing here and there streaks and pockets of fine or medium sand and generally becoming lighter in color with increase in depth.

The Wabash loam has a smaller extent and is less widely distributed than the Wabash silt loam. It is developed along streams with currents of a little more than average swiftness and in localities where the drainage issues from loam or sandy upland soils. It occurs chiefly along Stein, lower Wild Cat, and Big Creeks and along most of the streams north of Cedar River.

The surface is nearly level and smooth, with the exception of slight irregularities due to occasional abandoned channels and minor depressions. The drainage between overflows is usually fair to good, but the shallow depressions usually hold water for considerable periods after overflows and heavy rains.

The Wabash loam is used mainly for pasturage, to which it is admirably adapted because of the good stands of bluegrass and the available water for livestock. The better drained areas are successfully used for corn and to a less extent for small grains and other crops. Some parts, especially along the stream channels, are forested, chiefly with willow, elm, sycamore, maple, and oak.

WABASH SILT LOAM.

The surface soil of the Wabash silt loam consists of 12 to 16 inches of a very dark brown or nearly black friable silt loam. This grades downward into a nearly black heavy silt loam or silty clay loam, and at an average depth of 30 inches into a light grayish brown, compact, and moderately plastic silty clay, faintly mottled with brown and rusty brown. The soil has an ample supply of organic matter, which keeps it friable and granular when dry, but when wet the soil tends to be sticky and stiff and puddles if worked in this condition. During wet seasons the subsoil often is saturated for considerable periods.

In places the lower subsoil has sandy variations, especially narrow strips of land near present or former stream courses, and some of these may approximate the Wabash loam. These areas are not mapped separately because of their small extent.

Wabash silt loam is the predominating first-bottom soil along the creeks or minor streams of the county, where the water currents have been of moderate swiftness. Very little of this type occurs along the Cedar River but some was mapped along the Iowa River. Along many of the smaller branches the soil in places approaches the character of the Clyde silt loam.

The surface is nearly level or slightly sloping, and aside from some minor unevenness is smooth. It is more or less subject to over-

flow, and on the flatter bottoms water does not drain off readily. In places tile drains and open ditches have been used to improve the drainage.

A large proportion of the Wabash silt loam is devoted to pasture. The soil supports excellent stands of bluegrass, with coarser native grasses in swaly spots, and abundant water for livestock is afforded. Fringes of trees, principally willow and elm, grow in places along the stream banks. Much of the land is undesirable for cultivation because of the tendency to overflow, the slow drainage, the occurrence in narrow bands along streams, and the irregularity of the channels in places.

Many of the larger areas are successfully used for growing corn and other crops. Corn ordinarily yields 50 to 60 bushels per acre, and frequently 80 or 90 bushels. Small grains give excellent yields, but are likely to lodge. Little attention is given to rotation and fertilization, though on cultivated fields corn is alternated to some extent with oats or other grains, and stable manure is sometimes applied.

WABASH SILTY CLAY LOAM.

The surface soil of the Wabash silty clay loam consists of about 12 inches of dark-brown or grayish-black moderately friable silty clay loam or clay loam. From this the subsoil grades into dark-brown more compact clay loam or loamy clay, which increases in compactness and plasticity with depth. The lower subsoil is mottled with yellow, yellowish brown, or gray in places. The surface tends to crack and check upon drying.

This type has a small total area and is developed mainly south of Belle Plaine and along a branch between Big and Rock Creeks. The surface is flat and nearly level, and where associated with other bottom types it is depressed. It occupies the beds of old sloughs and other depressions, where water has been impounded, and also many areas along the outer margins of the first bottoms. The type is subject to overflow, and in places water stands for considerable periods after rains or inundations. As a consequence the drainage is poor and swaly conditions are common.

The Wabash silty clay loam is used largely for pasture, but a few areas are cultivated. It is naturally a strong soil, but is not well suited for cultivation because of the unfavorable drainage conditions.

CASS SANDY LOAM.

The surface soil of the Cass sandy loam consists of 14 to 16 inches of brown to dark-brown sandy loam, containing more or less coarse sand and gravel. This passes into a lighter colored subsoil of sandy loam, which at 24 to 30 inches changes to a yellowish-brown incoherent sand or slightly loamy sand. There is some variation in the texture of the surface soil, which in a few spots is a fine sandy loam, and in the depth to the loose porous subsoil.

This type is associated with the Cass loam and other types of the Cedar River bottoms. Two of the principal areas are located about 2½ miles northwest of Vinton on the north side of the river and 3 to 4 miles northeast of Mount Auburn.

Most of the Cass sandy loam is in pastures, but some of it is used for growing corn, rye, and other crops.

CASS LOAM.

The surface soil of the Cass loam consists usually of 12 to 16 inches of dark-brown loam or silty loam, which is mellow and friable when cultivated but somewhat compact in its virgin condition. The surface soil grades through 4 to 6 inches into a subsoil of loamy fine sand or fine sandy loam, which becomes lighter in color and below 28 to 30 inches is a light-brown loamy fine sand.

The soil shows considerable variation. The loamy surface soil may be only a few inches deep on some of the low ridges. In depressions or abandoned channels the surface material may extend nearly or quite to 36 inches, in which case the type approximates the Wabash loam or silt loam. As a rule, however, sandy loose material is encountered within a depth of 40 to 45 inches. In places swift overflow waters have deposited sandy materials on the surface.

The Cass loam occurs on the first bottoms of Cedar River. More commonly it lies toward the outer margins of the bottoms, but locally it has developed adjacent to the stream, in places where the land is protected from swifter overflow currents.

Drainage is fairly good between overflows and favorable for crop production. Frequently the land is flooded during the cropping season, and this discourages any extensive development. This soil is used almost entirely for pasture, for which it is admirably suited. It supports some timber growth, including bur and white oak, elm, birch, haw, and willow. Bluegrass does well on the better drained locations and prairie and other coarse wild grasses thrive in swales.

SARPY SAND.

The surface soil of the Sarpy sand typically is composed of 6 to 7 inches of grayish-brown or light grayish brown sand or loamy sand, which passes more or less abruptly into a subsoil of whitish or yellowish-white, loose, incoherent sand continuing downward below 36 inches. A large percentage of the sand in the soil and subsoil is of medium and coarse texture, and there is some fine gravel. The type varies in being more loose and sandy near the river and on more elevated spots and more loamy and somewhat darker in color in depressions. In some of the sharper bends of the river there are deposits of Riverwash sand.

The Sarpy sand is found only along the Cedar River and occupies positions bordering the channel where the swiftest overflow waters have deposited the sandy material. The surface is usually somewhat uneven owing to the action of shifting water currents. The drainage is excessive. The type has comparatively little agricultural value except for pasture.

MEADOW.

The soil material classed as Meadow comprises alluvial soils so variable in texture, structure, color, and drainage that separation into types was impracticable. The principal soils in these areas are of the Wabash and Cass series, mainly loams and sands.

Meadow was mapped along the Black Hawk County line on the bottoms of Big and Spring Creeks and the Cedar River. It is used almost entirely for pasture and supports some timber growth, such as is found on the identified Wabash and Cass soils.

PEAT.

The material mapped as Peat consists of brown to dark-brown, partly decomposed but fibrous, vegetable matter, mixed with which are small quantities of mineral matter. In places the Peat layer may extend to depths of 3 feet or more. Shallower deposits are underlain at 10 inches or below by bluish-gray or dull-yellow, sticky, plastic clay, more or less mottled with brown and rusty brown. In places the organic material is fairly well decomposed and has a mucky consistency.

Peat is confined to a very few small tracts. The most important area is situated about three-fourths mile southwest of Mount Auburn. A few areas of less than 1 acre could not be shown on the map. The shallower and more mucky variations resemble the Clyde soils.

The Peat is found in depressions where aquatic vegetation has accumulated in ponds, or on slopes where seepage water has kept the surface saturated. The natural drainage is poor, and water often stands on the surface during wet periods.

Peat is used mainly for pasture, though a few small areas have been drained sufficiently to be profitably cultivated. The native vegetation consists mostly of wiry, coarse grasses and various aquatic plants. Most of the Peat can be reclaimed by drainage, and when so improved the areas having the more decomposed material should have value in growing certain truck crops, such as onions. cabbage, and celery.

SUMMARY.

Benton County is situated in east-central Iowa and has an area of 712 square miles.

The county lies within the glaciated part of the State, and the topographic features are those of a relatively smooth prairie plain, which is eroded and somewhat rugged and forested in some parts along the larger streams.

The county is drained largely by the Cedar River and its tributaries and to a small extent by the Iowa River in the southwestern part. Drainage is fairly well established. In some localities of gentle relief the natural drainage is deficient, but has been largely corrected by artificial means.

The population consists of white persons, mostly native born. According to the 1920 census the population was 24,080, of which about 70 per cent are urban. Vinton is the county seat. A number of other towns provide good trading and shipping points. Excellent railroad facilities are available to all sections.

The mean annual precipitation is 33.89 inches, and the mean annual temperature is 47.4° F. There is an average growing season of about 156 days.

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

Hog raising leads in the animal industries, followed by beef cattle and sheep raising.

Comparatively little attention has been paid to systematic crop rotations, but more interest is being manifested.

In 1920, 94.7 per cent of the county was included in 2,562 farms, with an average size of 168.4 acres. Desirable farm land has an average selling value of about $300 an acre.

The soils are for the most part dark-colored prairie soils, with a small extent of light-colored forest soils. All are derived from weathered glacial till and loessial deposits. Besides Peat and Meadow, there are 26 soil types in Benton County, representing 15 soil series.

The Tama silt loam is the predominating upland soil south of the Cedar River. It occupies gently rolling prairies and is well adapted to corn and general farm crops.

The Clinton silt loam and fine sandy loam are rolling, light-colored, forest soils, fairly well suited for general farming.

The Lindley silt loam and fine sandy loam are rolling forest soils of glacial origin, used to some extent for general farming but largely for pastures.

The Carrington loam and Carrington silt loam are dark-colored prairie soils, largely derived from glacial materials, and have about the same value as the Tama silt loam.

The Carrington sandy loam and fine sandy loam generally make good farming land and are easy to till, but have some tendency to be droughty. The Carrington sand is a loose droughty soil of low agricultural value.

The Clyde silt loam is a dark-colored soil, with a high content of organic matter. It occupies upland sloughs bordering drainage ways and has poor drainage in its virgin condition. When drained the land is very productive.

The Judson silt loam is a dark-colored soil, in part of colluvial material, and is productive.

The Waukesha silt loam is a dark-colored second-bottom soil well adapted to corn and other crops.

The O'Neill loam and sandy loam are dark-colored terrace soils with a loose porous subsoil, which usually make good farming land.

The Chariton silt loam, of limited extent, has a dark-colored surface soil and a light-colored, poorly drained subsoil.

The Buckner sandy loam is a dark-colored second-bottom soil. It occurs along the Cedar River and is generally well improved.

The Bremer silt loam and silty clay loam are dark-colored to nearly black second-bottom soils. The subsoil is stiff and heavy and rather poorly drained. Under favorable conditions good yields of corn and other crops are obtained.

The Wabash loam and silt loam are dark-colored first-bottom soils extensively used for pastures. On areas reasonably free from overflows, excellent yields of corn are grown. The Wabash silty clay loam is a heavy, poorly drained soil used largely for pasture.

The Cass loam and sandy loam are underlain by a loose, porous subsoil. They are naturally fertile, but, being subject to overflow, they are used mostly for pasture.

The Sarpy sand occurs along the Cedar River and is used for pasture.

A few small areas of Peat are undeveloped but furnish some pasturage.

Meadow includes a variety of first-bottom soils in the northern part of the county, difficult to classify into types.

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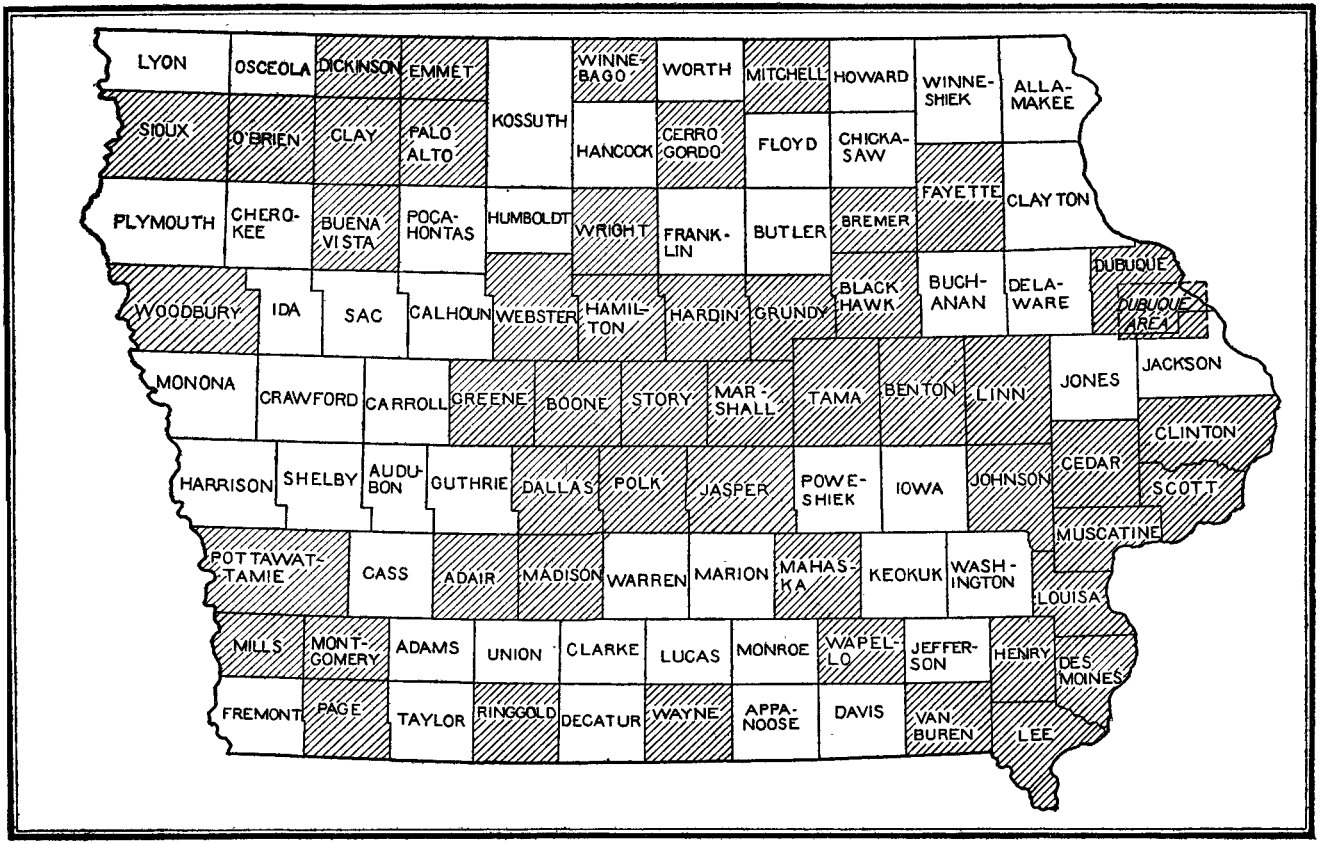

Areas surveyed in Iowa, shown by shading.

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Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).