U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE IOWA AGRICULTURAL EXPERIMENT STATION,
C. F. CURTISS, DIRECTOR; W. H. STEVENSON, IN CHARGE SOIL SURVEY;
P. E. BROWN, ASSOCIATE IN CHARGE.

SOIL SURVEY OF MADISON COUNTY, IOWA.

BY

T. H. BENTON, OF THE IOWA AGRICULTURAL EXPERIMENT STATION,
IN CHARGE, AND HUGH B. WOODROFFE, OF THE
U. S. DEPARTMENT OF AGRICULTURE.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1918.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1921.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., December 8, 1920.

SIR: Under the cooperative agreement with the Iowa Agricultural Experiment Station, C. F. Curtiss, Director, a soil survey of Madison County was carried to completion during the field season of 1918.

I have the honor to transmit herewith the manuscript and map covering this work and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1918, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. E. T. MEREDITH,
Secretary of Agriculture.

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SOIL SURVEY OF MADISON COUNTY, IOWA.

By T. H. BENTON, of the Iowa Agricultural Experiment Station, In Charge, and HUGH B. WOODROFFE, of the U. S. Department of Agriculture.—Area Inspected by THOMAS D. RICE.

DESCRIPTION OF THE AREA.

Madison County is situated in the south-central part of Iowa. It lies almost entirely on the east side of the great divide between the Missouri and Mississippi Rivers, the divide running through Adair, the first county west, and cutting across the southwest corner of Madison. It is in the third tier of counties north of the Missouri State line, and the northwestern corner of the county is approximately 10 miles southwest of Des Moines, the State capital. It is composed of 16 townships and has an area of 563 square miles or 360,320 acres.

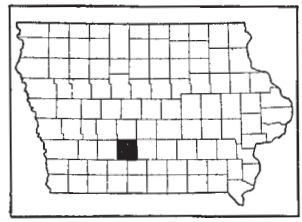

FIG. 1.—Sketch map showing location of the Madison County area, Iowa.

The surface of the county was originally that of a level loess-covered plain, sloping to the northeast at a rate of about 10 feet to the mile. The original features have been greatly modified through the erosional action of the streams, and two distinct types of topography, due to the difference in hardness of the underlying materials, have been developed.

In the northwestern quarter and south-central part of the county the surface is that of a gently undulating prairie, essentially flat, which has not been modified to a marked degree by erosion. The underlying rock has resisted the cutting of the smaller streams, so that the plain is preserved to almost the brink of the valleys. In this section the valleys of the main streams are V-shaped, deeply cut, the slopes rather steep, the bottom lands narrow, and the tributary streams short.

The region east of Clanton Creek from St. Charles south to South River presents a like topography, being underlain by the same strata of limestone.

The divide between Middle and Grand Rivers in the southwest part of the county is characterized by a very broken relief, the tributaries of these two streams having cut back into the upland until

their headwaters lie close together. The original surface deposits here have been largely carried away by stream action.

The eastern part of the county, except the plain east of Clanton Creek, has been so completely dissected that little of the original plain remains. The less resistant underlying materials here have allowed the development, along the main streams, of broad, flat valleys with gently sloping walls. The smaller streams have so cut the remaining upland areas that this portion of the county presents a rolling to hilly or even steeply hilly topography.

An intricate and extensive drainage system has been developed by many streams cutting deeply through the drift, and their tributaries cover practically every part of the upland divides. On the tops of the wider divides small flat areas occur, lying in narrow broken strips, which have no natural drainage. With the exception of these level areas, the natural drainage over the county is good, with excessive run-off leading to erosion on the steeper slopes. The general trend of the main streams is in an eastern direction. The channels of the larger streams have been cut from 100 to 250 feet below the upland plain. It is noticeable that the stream channels in general lie close to the south slopes, which have a rough and abrupt appearance, and generally support a forest belt. More gentle hills and slopes usually occur on the north side.

The alluvial lands in Madison County are well developed, and are most extensive in the eastern half of the county, along North and Middle Rivers and Clanton Creek. They may be divided into two natural classes, the second bottoms or terraces, which lie above the overflow of the streams, and the first bottoms, which are practically all subject to overflow.

Terraces are found along all the larger streams, and range in width from one-eighth to three-fourths mile. They occur in irregular bodies and discontinuous strips, are flat, benchlike, and show very little relief, except where cut by streams issuing from the uplands. They generally lie from 5 to 20 feet above the flood plains, but in a few places approach the lower bottom lands so gradually that there is no definite line of separation. Terraces are most extensively developed along Middle River and Clanton Creek.

The first bottoms occur along nearly all the streams of the county. They are generally level, except for the areas lying in the sharper bends of the stream channel where the materials are being continually shifted and reworked, and the surface made uneven. The elevation of the bottom land at Bevington is 849 feet above sea level, the lowest point in the county.

The recorded elevation of the upland ranges from 1,066 to 1,127 feet above sea level. Winterset, in the exact center of the county, lies at 1,127 feet and is the highest elevation recorded. In the north-

ern part of the county, Earlham lies 1,116 feet above sea level. St. Charles in the southeast is 1,066, and Truro, 1,078. East Peru, on the terrace of Clanton Creek, has an elevation of 948 feet; Middle River, at Patterson, 854 feet; Clanton Creek, north of Hanley, 878 feet; and Clanton Creek, west of Barney, 1,066 feet.

Madison County is situated within two large drainage basins, those of the Des Moines and Missouri Rivers. Middle and North Rivers and Clanton Creek, a tributary of Middle River, are the largest streams in the county. With their tributaries these streams drain about 91 per cent of the county, finally discharging their waters into the Des Moines River about 15 miles south of Des Moines. Their channels range from 50 to 125 feet in width and are not being deepened except in the western part of the county, where they have cut through the limestone. Their valleys are broad where they pass out of the county, narrowing gradually upstream for a distance of 12 to 15 miles, where the bottom lands immediately become narrower and the valleys V-shaped, with cliffs of limestone fringing the valley walls.

Grand River with its tributaries, in the southwest portion of the county, carries about 5 per cent of the total drainage waters. Its channel winds sharply back and forth near the center of its flood plain. This stream flows in a southeasterly direction diagonally through Grand River Township and eventually empties its waters into the Missouri.

South River, in the southeast part of Ohio Township, carries about 2 per cent of the drainage waters and empties into the Des Moines River. Its course is northeast through a well-developed flood plain. Badger Creek, which lies north of the North River drainage basin, sends its waters to Raccoon River and drains about 2 per cent of the total area.

All of the larger streams are meandering and sluggish and in general follow the south slopes of their valley walls. The bottom lands of all the streams originally supported scattered belts of hickory, walnut, elm, cottonwood, haw, ash, and other hardwood trees.

The first white settlers came to Madison County from Missouri in 1846, and later the county was settled by pioneers from the adjoining States, east and southeast. The town of Winterset, which is now the county seat, was first settled in 1849. Madison County was organized in 1850.

The population of the county was reported by the 1920 Census as 15,020, of which 12,114, or 80.2 per cent is rural. The rural population averages 21.5 persons to the square mile, and is uniformly distributed.

Winterset, the largest town and the county seat, is located in the geographical center of the county. It had a population in 1920 of

2,906. It is situated at the end of the Indianaola and Winterset Division of the Chicago, Rock Island & Pacific Railroad, is an important distributing center, and the chief shipping point for the live-stock and agricultural products of the county. A tile and brick plant, fender factory, and grain elevator are located here. Earlham, in the northwest part of the county, is the second town of importance. Other locally important towns are Bevington, East Peru, Patterson, St. Charles, Truro, Macksburg, Peru, Hanley, and Webster. East and south of Earlham are situated two stone quarries, which have a large output of high-grade stone. An important quarry and limestone-crushing plant is located at East Peru.

The county is fairly well supplied with transportation facilities, no point being more than 12 miles from a railroad. The Chicago & Great Western Railroad traverses the southeast portion of the county, passing through Hanley, East Peru, and Barney, giving direct connection with Kansas City and Des Moines. The Des Moines & Carlinville branch of the Chicago, Burlington & Quincy Railroad runs through the extreme southeastern part of the county along the level divide east of Clanton Creek, passing through St. Charles and Truro. The main line of the Chicago, Rock Island & Pacific Railroad crosses the northwest quarter of the county, giving a direct connection with the Chicago and Omaha markets. It passes through Earlham and affords an outlet for the quarries south and east of the town. The Winterset Branch of the Chicago, Rock Island & Pacific enters the central-eastern part of the county, providing transportation facilities for Bevington, Patterson, and Winterset.

The more important highways in the county are well graded and kept in good condition. Little attention is paid to the less important roads. All the roads are of earth. In general, they follow the section lines, except in the hillier portions, where they traverse the tops and slopes of the divides.

The county is well supplied with rural mail delivery routes and efficient telephone service. There is an excellent system of rural schools, which are well kept.

Kansas City, St. Joseph, Des Moines, Omaha, Chicago, and St. Paul are the principal markets for live-stock and agricultural products.

CLIMATE.

The climate of Madison County is characterized by wide ranges in temperatures during the year, but is favorable for the growing of the staple crops of the corn belt.

The mean annual precipitation as recorded at Winterset is 34.16 inches, over two-thirds of which falls during the growing season. The heaviest rainfall occurs during the months of May, June, and

July, and is 41 per cent of the total precipitation. The rainfall is lightest in December, January, and February. Droughts of short duration occur, but cause little damage to the crops, complete crop failures being unknown. The total rainfall for the driest year on record (1910) is reported as 19.71 inches. The greatest precipitation for one year was 50.14 inches in 1902.

The mean annual temperature is recorded as 49.3° F., with a maximum temperature of 111° and a minimum of —34° F. The average mean temperature for the summer months is 73.2° F., and for the winter months 23.4° F.

The average date of the last killing frost in the spring is April 26, and that of the first killing frost in the fall, October 6. This gives an average growing season of 163 days. However, killing frost has occurred in the spring as late as May 12, and as early in the fall as September 18. Crops are seldom damaged by frost.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation as recorded at the Weather Bureau station at Winterset:

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

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	26.1	62	—23	1.30	0.20	2.09
January	20.9	60	—34	0.96	1.72	1.20
February	23.1	65	—23	1.03	0.40	0.47
Winter	23.4	65	—34	3.29	2.32	3.76
March	35.4	82	—12	1.80	T.	1.05
April	50.7	93	18	3.60	0.79	1.15
May	62.3	96	25	4.64	4.68	5.19
Spring	49.4	96	—12	10.04	5.47	7.39
June	70.2	101	39	5.03	1.33	6.90
July	75.8	108	41	4.67	0.72	11.08
August	73.5	111	37	3.82	3.24	8.35
Summer	73.2	111	37	13.52	5.29	26.33
September	64.8	100	27	3.34	5.33	5.83
October	52.3	86	13	2.48	1.04	4.57
November	36.6	78	0	1.49	0.26	2.26
Fall	51.2	100	0	7.31	6.63	12.66
Year	49.3	111	—34	34.16	19.71	50.14

AGRICULTURE.

The first white settlers in Madison County came from Missouri in 1846. This region was then abundantly supplied with wild game, fish, berries, and nuts. The gently rolling prairies and the bottom lands supported a heavy growth of coarse grasses. Narrow belts of hardwood trees occupied the slopes adjacent to the water courses. The first houses were built near the streams and small fields were established along the edges of the timber, the sod here being easier to break and cultivate than on the heavier prairie lands. The crops raised at first were principally used for the sustenance of the families. Corn, wheat, oats, flax, and barley were the first field crops. Flax was grown on the freshly broken sod, generally for two years. Wheat was the principal source of income. The open prairies were used chiefly as stock ranges. Fire swept the prairies annually and caused much damage. Roads were not well established and markets were difficult to reach; consequently the prices of farm products were low and the farmers were not very prosperous.

With the building of railroads the influx of settlers became more rapid and better farm machinery was introduced, permitting the efficient handling of larger soil areas. The rich prairie lands were broken, fields fenced, and farm buildings erected. The size of the cultivated fields increased rapidly, and farms were much improved in general. Wheat became the leading cash crop. Oats were practically all fed to stock, supplementing the forage crops. Considerable corn was sold, but the larger part was used in fattening beef cattle and hogs, which early became an important industry. With the extensive growing of wheat and continuous cropping on the same land, the yields began to decrease, and new cropping systems, including legumes and grasses and providing for the production of more hay, were introduced.

As early as 1879 corn occupied nearly twice the acreage of all other cereal crops; there were 95,217 acres grown, with an average yield of 40 bushels per acre. Wheat was second in importance, with an acreage of 42,145, and hay was grown on 27,390 acres. Oats occupied 11,725 acres, and potatoes 1,132 acres. Forest products were important, being valued at $75,054, and orchard products at $24,745.

During the next 10-year period the acreage in oats increased to 29,988 acres and hay crops to 53,957 acres, while the acreage of corn decreased to 79,916 acres and wheat dropped to 2,575 acres. These extreme changes in acreages of crops were due to changes in prices and the lowering of crop yields through continuous cropping.

From 1889 to 1899 the acreage of corn increased nearly 25 per cent. Oats increased to 30,473 acres, wheat to 9,693 acres, while the hay

crop suffered a decrease. There was an area of 1,376 acres in barley in the latter year.

In 1909 the records show a sharp decline in acreages of all staple crops except hay. Corn was reported on 87,739 acres, oats 20,285 acres, and wheat 2,891 acres. Barley increased to 5,671 acres.

The agriculture of Madison County at present consists mainly of a combined system of grain and live-stock farming, which is uniform over the county. Corn is the principal crop and is practically all used in the feeding and fattening of hogs and beef cattle. Dairying is carried on to a small extent on the farms in conjunction with the raising of other stock. Oats, wheat, timothy and clover mixed, and timothy alone are the other important field crops, while barley, rye, potatoes, millet, clover, and alfalfa are supplementary crops of considerable importance.

Corn is produced over the entire county on practically all of the soil types. The 1920 census report shows an acreage of 73,866, with a production of 2,709,800 bushels, or an average of 36.7 bushels per acre. The present acreage shows a slight decrease from that in 1909.

Reid's Yellow Dent is the most extensively grown variety. Other popular varieties are Boone County White, Pride of the North, Leaming, and Little Calico. The crop is practically all check rowed, and is cultivated from three to five times, depending on the season. Most farmers are making a practice of selecting their own seed, and the testing of the seed before planting has proved profitable. Rape or cowpeas are often sown after the last cultivation. A large part of the corn is cut, shocked, and fed whole or shredded, or used for ensilage. Hogging down corn is extensively practiced in handling the crop, and where fed in the field hogs follow the cattle. The greater part of the crop produced in normal seasons is fed on the farms.

Oats have been the principal cash crop since 1890. The acreage has increased more than 50 per cent since 1910. The 1920 census reports the total crop as 970,988 bushels, with an average yield of 35.2 bushels per acre. Green Russian and Albion (Iowa 103) are the principal varieties, with Kherson (Fourth of July) and early champion of less importance. A small proportion of the seed oats planted is of a mixed variety. The crop usually follows corn in the rotation. The fields are disked and the seed drilled in. The crop is ready for harvest the latter part of July. Most of it is thrashed from the shock in the field. The crop is used principally as feed for work stock, but a considerable quantity is sold. Most of the surplus is shipped to Chicago and Kansas City.

Wheat has been of minor importance for the last 25 years, until the recent call for increased production. Not nearly enough was

produced for local consumption. In 1910 only 2,891 acres of wheat were grown in the county; in 1917, the area was increased to 4,267 acres; in 1918 an estimate compiled by the local farm bureau, based on reports obtained from farmers, placed the acreage for that year at about 22,000 acres. The 1920 census reports 36,728 acres in wheat in 1919 with a production of 729,364 bushels. Winter wheat is grown almost exclusively, as it lightens the farm work in the spring. Spring wheat in 1917 showed an average yield of 23.8 bushels per acre compared to an average of 18.1 bushels for winter wheat. The year 1917 was exceptionally favorable for spring wheat. The ten-year (1908–1917) average yield of spring wheat in the State was 16.4 bushels per acre; of winter wheat, 20.9 bushels per acre. In no year in this period except 1917 did spring wheat outyield winter wheat. The crop usually follows oats or corn, oats stubble being fall plowed, and the seed drilled in about October 1. It is generally thrashed from the shock, but some is stacked and thrashed later. Turkey is the principal variety grown, with occasional fields of Iowa 404, another hard red wheat, and of Fultz, a soft red wheat. Bluestem and Marquis are the principal spring varieties. The Hessian fly causes little or no trouble, according to local information. Practically all the crop is shipped, there being no flour mills in the county.

Barley is reported on 3,165 acres in 1919 and rye on 734. Other grain crops grown to a limited extent are buckwheat, kafir, sweet corn, and pop corn.

The chief hay crops of the county are timothy and clover mixed, and timothy alone. Where grown together the yield is slightly increased. The census reports 3,815 acres of timothy and clover mixed, averaging 1.2 tons per acre in 1919, and 10,725 acres of timothy alone. In 1917, 7,512 bushels of timothy seed were harvested, yielding an average of 5 bushels per acre. Oats are commonly used as a nurse crop for timothy and clover. The acreage of wild hay is confined almost wholly to the bottom lands, principally along North River.

Clover alone was grown on 3,260 acres in 1919, with an average yield of 1.4 tons per acre. Small patches of millet and sorghum are planted. Sudan grass is being grown successfully, principally in the northern part of the county, but in a small way. Bluegrass is used extensively for pasture, and does well on the areas of rougher land.

Alfalfa is being tried on a number of farms in small patches, and some very excellent stands have been obtained. Some farms, however, report a complete failure. In 1919, 426 acres were reported in the crop. On account of the higher average yield as compared with the other hay crops now grown, the acreage could be profitably extended.

Other legumes grown are soy beans, vetch, red clover, peas, beans, and peanuts. Sweet clover makes a luxuriant growth along the roadsides, especially in cuts where the calcareous subsoil of the Shelby loam is exposed.

Potatoes are grown to a considerable extent, but not in sufficient quanties to supply the home markets, several carloads being shipped in each year. The production for 1919 is reported as 15,907 bushels on 391 acres, averaging 40.7 bushels per acre. Early Rose, Early Ohio, Snowflake, and Rural New Yorker are the principal varieties.

Trucking is only sufficiently extensive to supply local markets. The aggregate vegetable crop in 1919 had a value of $158,167.

Fruit growing has been neglected. At present there is a tendency to replant farm orchards, which have suffered greatly through lack of care, the trees dying out in many cases. Of the few commercial orchards in the county only two contain as much as 25 acres. The Duchess, Red June, Yellow Transparent, Ben Davis, Jonathan, Grimes, Wealthy, Winesap, and Delicious are the principal varieties grown. Plums, cherries, grapes, strawberries, and blackberries, and raspberries are grown in quantities insufficient to supply the local markets.

Cattle raising and feeding is the most important live-stock industry in Madison County. The 1920 census reports 40,596 cattle of all ages. The beef cattle raised are mostly grade Shorthorns and Aberdeen Angus. The latter breed is found largely in the vicinity of Earlham. Not much attention is given to raising purebred stock. However, in the northeast and eastern parts of the county there are several purebred herds of considerable size, principally Angus, Hereford, and Shorthorn. From 115 to 120 carloads of feeders are shipped in annually from St. Paul, Omaha, and Kansas City stockyards, the bulk coming from St. Paul. On a few farms as many as one to three carloads are fed, and on nearly every farm a few head are fattened and sold. The feeders are shipped in during the late fall, kept on pasture as late as possible, then finished on silage and corn, with fodder for roughage, and some clover hay and cottonseed meal. More cottonseed meal is used during a short crop season. They are marketed late in December and January being shipped to Chicago, St. Joseph, Kansas City and Ottumwa.

Hog raising is next in importance to the production of cattle, 71,953 head being reported in 1920. The breeds raised are Poland-China, Duroc-Jersey, Hampshire, and Chester White, the first two named predominating. The Duroc-Jersey and Hampshire are the favorite breeds in the southeast quarter of the county. Enough hogs are butchered on every farm to supply meat for home consumption. From 2,500 to 4,000 stock hogs formerly were shipped annually to

a large feeding plant at Peru and fattened, but the plant has been temporarily discontinued. Probably one-half of the hogs shipped from the county are delivered to Winterset and sent to the larger markets at Chicago, St. Joseph, and Kansas City.

Sheep raising is of minor importance compared with the raising of cattle and hogs, but is gradually increasing. There were 22,803 sheep in the county in 1920. The rougher lands, represented chiefly by the Lindley and Shelby soil types, are particularly adapted to sheep raising, the slopes affording excellent bluegrass pasture. A few carloads of grade westerners are shipped in and fed, principally in the southern part of the county. Shropshire, Merino, and Delaine are the principal breeds. A few herds of goats are found in the extremely rough areas. In the 1920 census the value of wool and mohair is given as $70,819.

Dairying is poorly developed. In general only enough cows are kept on each farm to supply the household. Near the larger towns a few fair-sized dairy herds are kept. The products are nearly all used locally, although a small amount of cream is shipped. There are no creameries in the county. Holstein and Jersey animals predominate in the commercial dairy herds. Little attention has been paid to the selection of dairy cows on the general farms, most of the animals being grade Shorthorns.

Horses of all ages reported in 1920 census numbered 14,021, with 991 mules. The average number on each farm is from 10 to 12, mostly light drafters and farm chunks. A few colts are raised each year to keep up the supply of work stock.

Poultry is raised on every farm, and quantities of poultry products are sold on the markets. The flocks are practically all mixed, little attention being paid to purebred fowls. The census shows 281,488 fowls in the county in 1920, and gives eggs produced as 1,300,461 dozens.

The adaptation of different crops to certain soil types is recognized to a considerable extent in the county. The more level, well-drained upland country is recognized as best adapted to corn and general crops. The soils here belong in the Tama and Grundy series. The more rolling and lighter soil of the Clinton series is better adapted to small fruits, vegetables, tree fruits, wheat, hay, and pasture. The rougher areas represented by the Shelby and Lindley series, because of their erosional tendencies, are largely used for pasture lands and hay production. The Waukesha, Bremer, and Wabash types are excellent corn soils. In general the silt loams on both upland and bottoms are considered the best for corn and staple crops.

The value of a definite system of rotation is realized by the farmers, but not generally practiced. The lowering of crop yields through continuous cropping has shown this definitely. The most common

practice is to grow corn two years, oats one, and clover and timothy one to two more. Wheat, when grown, is usually placed after oats in the rotation.

Much of the land is fall plowed. Tractors are used on many of the larger farms in the more level areas, particularly in the northwest one-fourth of the county. Seed beds usually are carefully prepared and the crops given thorough cultivation. On the heavier types the surface is thoroughly stirred after heavy rains, to prevent drying out and cracking. The soils over the entire county can be handled by ordinary farm machinery and general farm methods.

Plowing is usually 4 to 6 inches deep, the four-horse hitch being most commonly used.

Clover is plowed under as a green manure on some farms to increase the supply of organic matter. Barnyard manure is applied, generally on sod, but is produced in insufficient quantities. Practically no commercial fertilizer is used.

Farm buildings in general are substantial, well kept, and give an appearance of prosperity. There are many large modern houses. Farms are well fenced and cross fenced, mainly with barbed wire, though much woven wire has been used the last few years.

The farm implements in general use are gang plows, sulky plows, walking plows, disk harrows, spike-tooth harrows, corn planters, drills, cultivators, hay rakes, hay loaders, hay stackers, mowing machines, manure spreaders, and binders. About 50 threshing machines in the county insure the prompt handling of the small grain after harvest. Motor trucks are being used on many farms and are becoming indispensable.

Efficient farm help is difficult to obtain. Where employed by the year, the average wage is about $40 a month, with board and washing. Many farmers find it more satisfactory to hire men with families. The hand is furnished with house, milk cows, chickens, and garden space. Most of the work on the farm is done by the farmer and his family. During the harvest season extra hands command a wage of $3 to $4 a day. The laborers are all white and nearly all of American birth.

The average size of farms in Madison County is 157.9 acres, the tendency being toward an increase in size. The total number of farms is 2,125, ranging in size from 20 to 1,000 acres or more. In 1920, according to the census, 63.3 per cent of the farms were operated by owners, 35.5 per cent by tenants, and 1.2 per cent by managers. There has been a decrease of 14.3 per cent since 1880 in the farms operated by owners. Cash-rent and crop-share systems and the combination cash and share system of renting are followed. Generally under the share system all implements and work stock are furnished by the tenant, one-half of the crop going to the owner.

In the combination system the pasture land is rented for cash and grain and hay land on shares. In either case the grain is delivered at the elevator. Cash rents have a wide range. The more level upland farms rent for $7 to $12 an acre, and in a few cases, where especially well located and productive, at $15 an acre. The rough and more broken drift soils and the bottom lands bring a cash rental of from $4 to $5 an acre for use as pasture.

The price of land in the county varies greatly, depending upon location, topography, soil type, roads, distance from markets, and improvements. The selling price ranges from $70 to $325 an acre. Small tracts composed wholly of steep, eroded drift soils, occurring in the timbered sections, can be bought for as little as $40 an acre. The average assessed value in 1920 is given as $178.76 an acre.

SOILS.

Madison County, Iowa, lies in the prairie region of the United States where the topography and the rather high moisture supply have favored a heavy grass vegetation over the greater part of the area. The original constructional surface of the region, with its poorly drained areas unfavorable to tree growth, and its heavy grass vegetation which spread fires, prevented the encroachment of timber on the area. As topographic changes have developed greater relief and better drainage, bringing about the complete surface and subsoil drainage of the soil over large continuous areas, timber growth has spread over them; but has not invaded the unchanged areas. Thus the native vegetation under which the soils of this county have developed has been grass over the relatively smooth uplands and timber along the deeper stream valleys.

The soils of the area were developed under the influence of a total precipitation amounting to 34.16 inches uniform for the whole area and well distributed throughout the year. The soils of the whole county are leached of their carbonates to a depth as great as soil making processes have extended, ranging from 3 feet, as a rule, to greater depths.

Differentiation of the soils of the county may be made on the basis of their most widely distributed and broadest characteristic into light-colored and dark-colored soils. The area of light-colored soils is coextensive with the area covered with timber when the white man first came to the area, or, to be more accurate, it includes those soils which were developed under a native vegetation consisting of trees. The soil profile has a surface horizon, ranging in depth from 3 to 8 inches, of gray, pale-gray, very pale yellow, or very light brown color and a silty, floury structure. This is underlain by material of a coarsely granular or "nut" structure extending to

depths ranging from 2 to 3 feet. Below this layer the texture is lighter and the structure less compact. The soils which belong to this light-colored group are the Clinton and Lindley series on the uplands and the Jackson and Calhoun series on the terraces. The Genesee soils could be included, though on account of their occurrence as alluvial material, their soil profiles are not differentiated into horizons.

The area of dark-colored soils is coextensive with the area of prairie on the upland and includes also areas of dark-colored alluvial soils. The dark-colored soils fall into two subclasses or groups whose differentiation is based on drainage conditions of soil or subsoil, or both, during their development.

The soils of one of these groups, of which the Carrington series is representative, were developed under conditions of good soil and subsoil drainage. The typical profile has a surface horizon of dark-brown to black color and granular structure, ranging from 5 to 15 inches in thickness. This is underlain by a strong brown horizon lighter in color than the surface with a somewhat granular structure, ranging in thickness from a thin layer up to 12 inches. Underlying this horizon the subsoil is brown to yellowish brown and perceptibly heavier in texture than the two upper horizons. It is friable and coarsely granular in structure. It extends to depths ranging from 2 to 4 feet and is underlain by a slightly looser horizon of the parent material not greatly differing from the fresh parent rock, which in this area is either glacial drift or loess. The carbonates have, as a rule, been removed to a depth of several feet.

This group includes the various members of the Carrington, Shelby, Tama, Waukesha, and some of the Wabash types. The Wabash owes its dark color to its recent formation by alluvial deposition of dark-colored material from the other dark-colored soils.

The members of the other group of dark-colored soils mentioned above, those developed under conditions of poor drainage, have a surface horizon of black color and usually well-defined granular structure. This is underlain by a gray or mottled gray and yellow and brown subsoil somewhat heavier as a rule in the surface. The details of the profiles of these soils vary considerably, depending on the depth to which good drainage and oxidation has extended. In some cases both surface and subsoil have developed under a cover of water, or at least in the presence of sufficient water to keep the material in a permanently wet condition. In other cases the soil has been rather well drained but the subsoil frequently wet, while in still others only the deeper part of the subsoil has been subjected to such conditions.

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This group includes the Grundy and Bremer series and the heavier types of the Wabash. These soils are confined to flat areas on the uplands and terraces and to low places in the alluvial plains.

The soils of each of the groups mentioned above are differentiated into series on the basis of difference in structure and minor details of the soil profile and on the basis of the source, character, and processes of accumulation of the material from which the soils have been developed. For instance, the Clinton soils are differentiated from the Lindley soils because the former are supposed to be developed from loess, a silty material accumulated by sedimentation of dust from the air, while the latter have been developed from material accumulated by deposition from glacial ice.

In the following pages the soils of the county are discussed with respect to the origin of the materials from which they have been derived.

The loess consists of a very uniform mixture of silt and clay particles, the silt predominating, with no coarse material in its composition. Originally this material contained more or less calcareous matter, but this has in this area been largely removed by weathering and leaching. A characteristic of the loess is its columnar structure, which causes the banks of drainage channels to remain practically perpendicular. Constant seepage action has carried the finer particles of the surface soil into the lower sections, leaving the surface more loose and open and giving the subsoil a heavier more tenacious structure. The Grundy, Clinton, and Tama series are derived from this material.

The Kansan drift, which underlies the loess, originally consisted of a bluish-gray heterogeneous mixture of clay, silt, sand, and gravel, with numerous bowlders of greenstone, granite, gneiss, limestone, and quartzite. This drift is one of the oldest of the glacial tills and many of the bowlders are in an advanced stage of decay. The material of which it is formed has been transported from long distances, very few of the bowlders found in it being of rock found in this locality. Where exposed to weathering the color of the drift, owing to oxidation, has been changed to a yellowish to reddish-brown color, the depth of this weathered layer varying from a few inches to 3 or 4 feet. The surface soil is generally lacking in calcareous material, owing to leaching, while in the lower section, at depths from 5 to 7 feet, nodules of lime and streaks of soft calcareous deposits are present. In many places the surface soil has incorporated with it considerable quantities of organic matter and is friable and easily worked. The subsoil is generally of a silty clay to clay texture, very tenacious and plastic in nature. Both the surface soil and subsoil contain fairly large admixtures of coarse sand and

gravel with bowlders of small size occurring here and there. This glacial material has been the parent material of the Shelby and Lindley series.

The rocks underlying the drift material consist of limestone, shales, sandstones, and thin coal seams of the carboniferous period. These materials belong to two stages,[1] the Des Moines, and the Missourian.

The Des Moines stage, which underlies the eastern part of the county, is made up mainly of argillaceous and arenaceous shales, soft sandstones, and thin coal seams, with very little limestone. The Missourian stage in the western part consists principally of limestone with occasional thin layers of shale. These stages are exposed along all the larger streams. Small areas of residual soil are found adjacent to and below outcroppings of limestone along some of the larger streams of the county. This material forms talus slopes below the limestone and is derived from the weathering of the fragments broken from the cliff above.

The bottom land along the streams consists of a mixture of reworked loessial and drift material. A greater part of this area is subject to overflow annually, while the rest is flooded only at infrequent intervals. Fine sediments carried by the water are deposited at these times of overflow. The finer textured soils predominate. The alluvial soils have been correlated with the Wabash series.

Terraces or second-bottom lands occur along all of the larger streams. They consist of alluvial material deposited on the flood plains when the streams were flowing at a higher level than at present. Reworked silt from the upland loess and finer particles of the glacial till make up the soils of these areas. The Waukesha, Bremer, Jackson, and Calhoun series are found on these terraces.

The soils over the county in general are naturally productive, but are practically all acid. Applications of lime or crushed limestone would be highly beneficial in securing the maximum availability of the incorporated plant food and in improving the texture and structure. Results will be visibly apparent in the field planted to leguminous crops. The first year after applying crushed limestone, corn and grain crops as a rule do not show an increased production until the second year, due to the slow rate of solubility of the limestone.

The soils have been grouped into series, on a basis of similarity of color, subsoil, topography and drainage, and origin. A further separation into types in each series is made, on the basis of texture. There are on this basis 12 series, including 15 types, in the county.

[1] Iowa Geol. Survey, Vol. VII, pp. 489–539, J. L. Tilton and H. F. Bain.

The surface soils of the types included in Tama series are dark brown and the subsoils yellow to yellowish brown. The structure is loose and friable. There is not sufficient lime in soil or subsoil to effervesce with acid. The topography varies from gently to sharply rolling. The series is derived from loess in regions where a large part of the lime has been leached from the surface material to a depth of 3 feet.

The types in the Clinton series are characterized by lighter colored surface soils than those in the Tama series, the range being from light brown to grayish brown. The subsoil, which is heavier than the soil, is yellowish brown to brown. In the lower sections of the subsoil the material is a plastic, silty clay to clay loam, and the color is mottled with gray. The type occupies the more rolling upland between the Tama soils and the drift soils along the larger valleys. Because of its topography and silty character it erodes badly. This soil was originally forested.

The surface soils of the types included in the Grundy series are dark brown to black. The subsoil is a plastic, tenacious brown silty clay to clay loam, highly mottled with yellow or yellowish brown in the lower depths, and containing rusty-brown iron concretions. A very light gray pulverulent silty layer sometimes occurs between the soil and subsoil. It occurs on the tops of divides, and the topography is flat to gently undulating, causing the natural drainage to be poor.

The Shelby series includes types with brown to dark-brown soils underlain by light-brown to yellowish-brown gritty silty clay to sandy clay subsoils mottled with yellow. Coarse sand, gravel, and small stones are found throughout the soil section. The lower subsoil frequently contains lime nodules. This series occurs on the gently sloping to steep sides of the valleys and ravines, and is subject to erosion. Part of its area is forested.

The soils of the Lindley series are usually yellowish-brown, but may range in color from gray on the one hand to brown on the other. The subsoils are yellow to yellow brown and in rare cases reddish brown. The topography is usually rolling. The land was originally covered with oak and hazel brush. This series differs from the Shelby only in the lighter color of the surface soils.

The soils of the Sogn series are gray to almost black. The subsoils consist of gray, yellowish-gray or olive-gray tough heavy calcareous clay. Both soil and subsoil contain fragments of limestone, chert, and shale. The subsoil is wholly residual from limestone. The soil is mainly from the same source but may contain some glacial drift.

The Hagerstown series is characterized by the brown color of its soils and the light-brown to reddish-brown color of its subsoils. This series is derived by weathering from limestone. Fragments of limestone and limestone exposure are of common occurrence. The soils usually have an undulating to rolling topography, but in Madison County they occur on steep hillsides. Only the silt loam has been mapped in this area.

The alluvial soils include first bottom and second bottom or terrace types. The Waukesha, Bremer, Jackson, and Calhoun series have been mapped on the terraces. The Wabash is the only series developed on the first bottoms.

The types in the Waukesha series have brown to dark-brown surface soils, and friable subsoils becoming heavier with depth. A heavy dark-brown silty clay loam layer is sometimes present between the soil and subsoil. The series occupies level to gently undulating areas and is well drained.

The Bremer soils differ from the Waukesha in having heavy tenacious mottled subsoils indicative of a poorly drained condition. The surface soils are dark brown to black and the subsoil is plastic and dark brown in color in the upper part, and mottled with yellowish brown and gray in the lower part. The topography is similar to that of the Waukesha, but the drainage is poor.

The Jackson soils occupy a higher terrace position than the Waukesha and the Bremer series and are much lighter in color. The surface soils are light brown to grayish brown and the subsoils are lighter in color than the soils. The subsoil becomes heavier and more compact with depth and in the lower part is a yellowish-brown compact silty clay, marked by numerous streaks of gray. The surface is flat with a gentle slope toward the stream channel.

The surface soils of the type included in the Calhoun series are light brown to light grayish brown. A thin layer of floury, light yellowish gray silt occurs between the soil and subsoil. The subsoil consists of yellowish-gray silty clay to clay. These are the highest terrace soils. They have little relief and are poorly drained.

The Wabash series, occupying the first bottoms, includes types with dark-brown to black surface soils, and brown to dark-brown or black subsoils, in places mottled with gray or lighter shades of brown. The soils of this series are high in organic matter and are subject to overflow. They are flat, and the heavier types have inadequate drainage.

In the following pages of this report the soils of Madison County are described in detail and their relation to agriculture discussed; the accompanying map shows their distribution in the county,

while the following table gives the name and actual and relative extent of each soil mapped:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Tama silt loam	181,184	50.3	Waukesha silt loam	3,584	1.0
Shelby loam	71,744	19.9	Wabash silty clay loam	3,200	0.9
Clinton silt loam	33,472	9.3	Bremer silt loam	2,688	0.7
Lindley loam	15,360	4.3	Jackson silt loam	1,152	0.3
Grundy silt loam	14,912	4.1	Hagerstown silt loam	640	0.2
Wabash silt loam	11,840	3.3	Calhoun silt loam	320	0.1
Sogn stony silt loam	10,368	2.9	Total	360,320	.....
Wabash fine sandy loam	5,248	1.4			
Wabash loam	4,608	1.3			

TAMA SILT LOAM.

The soil of the Tama silt loam is a dark-brown, mellow silt loam, 8 to 20 inches in depth, the average being about 14 inches. The subsoil is a yellowish-brown to brown, compact, friable, heavy silt loam to light silty clay loam that becomes heavier with depth. In the lower part it often has a grayish cast, and faint mottlings of yellowish brown may occur. Some reddish-brown iron stains appear. Where the loessial covering is thin, the surface soil has a grayish-brown appearance when dry.

There is little lime in the material to a depth of 36 inches, but cuts in the roadside and along the ditches show lime concretions at greater depths.[2]

The Tama silt loam is the most extensive soil in Madison County, occupying 50.3 per cent of the total area. It lies high on the upland plains and ridges between the water courses. In the northwestern part of the county and on the tops of the more level divides between the larger streams the surface is undulating to very gently rolling. In these regions the loess layer is very deep and the content of organic matter high. In the northeastern, and particularly in the southwestern part of the county, the surface is gently rolling. The type differs here somewhat in both surface soil and subsoil, the former being more shallow, from 8 to 14 inches deep, and lighter in color, and the latter being faintly mottled with yellow in the upper part and strongly so in the lower part. The lower part of the subsoil, while compact, is friable. Rusty-brown iron concretions are present.

[2] In the southwestern part of the county, between Webster and Macksburg, where the terrain is very rolling, the deeper cuts in roadways show large balls and streaks of soft lime in the substratum 4 to 7 feet below the surface.

Typical areas are developed on the high upland plain south and east around Truro and St. Charles.

The Grundy silt loam, which has a heavier subsoil than the Tama, is extensively developed within the bodies of the Tama silt loam, where the topography becomes level to flat. The boundaries between these two types are more or less arbitrary, the separation being based upon the heavier texture of the subsoil, and probably small areas of Tama silt loam have been included with the Grundy silt loam as mapped. On the north slopes adjacent to the smaller streams the descent is gentle and the glacial till is not often encountered within the 36-inch section.

The Tama silt loam is mellow and easy to handle, but has marked power of retaining moisture. Where seed beds are well prepared and crops given proper cultivation they seldom suffer from drought. Originally this type supported a luxuriant growth of native prairie grass, 2 to 8 feet high. There was very little timber. About 95 per cent of the type is now under cultivation and in tilled crops or cultivated grasses, there being practically no waste land.

Farms on this type as a rule are improved with excellent buildings and well equipped with machinery and work stock. The principal crops are corn, oats, wheat, and timothy and clover. Corn ranks first in importance; oats is next, and is grown mainly as a cash crop. In ordinary seasons most of the corn produced is used for feed, as the raising and fattening of beef cattle is a very important industry. Hogs rank next in importance in the live-stock industry. Some horses and sheep are raised, but dairying is poorly developed, only enough cows being kept to supply the home with milk and butter.

Corn yields on this type range from 35 to 70 bushels per acre, with an average of about 45 bushels. Wheat produces 20 to 30 bushels per acre, and is exclusively a cash crop. Winter wheat is grown almost entirely at present. The principal hay crop on this type is clover and timothy mixed, the yields ranging from 1 to 3 tons per acre. Most of the hay produced is fed to stock. The second crop of clover is sometimes cut for seed. Rye, barley, millet, sorghum, vetch, rape, and Sudan grass are grown to some extent. Fruits and vegetables are grown for home use. Potatoes yield well.

At present no definite crop rotation is generally practiced. The value of systematized rotation is gradually being recognized and adopted as a means of maintaining productiveness of the soil. Corn is usually grown for two years, oats and wheat one, and timothy and clover one to two. Where the land is farmed by a tenant corn is often grown in the same field for three to five years. Some difficulty has been experienced in getting a stand of alfalfa, owing probably to

the acidity of the soil, and only small acreages are in this crop at present.

This soil type is naturally very productive and very little commercial fertilizer is used. The supply of organic matter is maintained by applications of manure and the plowing under of clover and timothy sod.

Land values on the Tama silt loam have a wide variation, depending on improvements, location, distance from markets, and condition of the soil. In general the selling price ranges from $135 to $275 an acre (1918) and a few farms especially well improved and located have sold recently (1918) for $300 to $325 an acre. The land rents ordinarily for $7 to $11 an acre, but as much as $15 has been asked and received in the case of highly improved farms in exceptionally favorable situations.

While the Tama silt loam is naturally well supplied with organic matter, legumes should be used in definite rotation to maintain the supply. Deeper plowing would prove beneficial on many farms.

Laboratory tests show this soil to be somewhat acid. This condition should be corrected by applying lime, either in the form of burnt lime or crushed limestone. Limestone is found throughout the county, and its use could be made inexpensive. Alfalfa, when once well established, with its roots well down in the subsoil, is well suited to this soil. Liming and inoculation should make it possible to secure satisfactory stands.

CLINTON SILT LOAM.

The surface soil of the Clinton silt loam, to a depth of 7 to 12 inches, is a light grayish brown, smooth, floury, silt loam. This passes into a more compact, brown to yellowish-brown heavy silt loam, faintly mottled with gray, which gradually becomes heavier with depth and between 14 and 18 inches changes to very compact though a friable yellowish-brown silty clay, mottled with light gray and grayish brown. Iron concretions are sometimes present in the lower section. When wet the surface soil has a brownish appearance and the subsoil proper becomes very tenacious and plastic. The content of organic matter in the soil is low.

The Clinton silt loam occurs on the tops of the higher ridges adjacent to the larger streams. It is most extensively developed in the county along Middle and North Rivers and Clanton Creek, where it occurs in irregular strips one-eighth to 1 mile wide. Toward the source of the streams and along their tributaries the development is less extensive, and the type occurs in small patches, lying on the tops of the ridges at the junctions of the main streams with their tributaries. In the northwest and southwest sections of the county the type is of rare occurrence. The most extensive area lies on the

high divide between Clanton Creek and Middle River, where they flow out of the county.

The topography of the Clinton silt loam is gently rolling to hilly, and the surface drainage is adequate, and often excessive. Erosion is an important problem in the handling of this soil as it has a tendency to wash and ditches and gullies are quickly formed. Brush, straw, and manure are used in efforts to control the damage caused to fields where erosion is active.

Originally the soil was forested with white oak, black oak, elm, hickory, hazel, and other hardwood trees, but most of the land has been cleared and is now used for general farming.

The principal crops are corn, oats, wheat, clover, and timothy. Corn does best where sod or a green manure crop has been plowed under the preceding fall or applications of barnyard manure have been made, and yields range from 20 to 40 bushels per acre. Practically all the corn grown on this type is fed on the farm. Oats are grown extensively and yield from 25 to 40 bushels per acre, a large proportion of the crop being sold. Hay crops ordinarily yield 1 to 2 tons per acre. Small patches of alfalfa are being successfully grown and this crop is particularly important because of its root system, which holds the soil together and prevents washing. Small fruits and tree fruits do especially well on this soil, strawberries, blackberries, raspberries, cherries, apples and grapes being grown, but not in quantities sufficient to supply the local markets. Potatoes and garden vegetables are produced for home consumption. Cattle and hogs are raised, but not as extensively as on the black upland soils.

Owing to the dissection of the surface by drainage ways, and association with rough drift areas, the fields are small and irregular, making cultivation difficult, despite the friable nature of the surface soil.

No definite rotation is followed, but corn is grown not oftener than once in three or four years. Practically no commercial fertilizer is used. Barnyard manure is applied, but not enough is produced on the ordinary farm to keep the soil in the best state of productiveness.

The land values are influenced by location, improvements, and topography, and range from $70 to $140 an acre.

This soil, as indicated by its color, is low in organic matter. Additions of barnyard manure, the more extended use of green manure and leguminous crops and deeper plowing would greatly increase the productivity and lessen the tendency to erosion. Greater care should be taken to prevent erosion. Contour plowing should be practiced on the hills and the steeper slopes should be used only as pasture land, or planted to cover crops.

GRUNDY SILT LOAM.

The surface soil of the Grundy silt loam, as it occurs in Madison County, consists of a dark-brown to almost black, friable silt loam, 8 to 14 inches deep, with an average depth of 10 inches. The subsoil to a depth of 18 to 22 inches is a grayish-brown to dark-brown silty clay loam, containing faint yellowish brown mottlings in the lower depths. Below 22 inches there is an abrupt change, the material passing into a bluish-gray or grayish-brown silty clay highly mottled with yellow. In a few places a layer of gray silty material occurs in the subsurface layer between the depths of 8 and 12 inches. Rusty-brown to black, soft iron concretions are numerous. The color becomes lighter and the texture more plastic and tenacious with depth, and because of its dense impervious character, the lower subsoil is locally called hardpan. This type is very high in organic matter.

The Grundy silt loam is found quite generally over the county but in comparatively small areas. It occupies the highest parts of the upland, on the flat level divides, occurring in continuous strips from one-eighth to three-fourths mile wide and in isolated patches. The topography is level to very gently undulating. Very few streams enter this type; consequently the drainage is inadequate and tile drainage systems should be installed. The largest bodies are in the northwestern part of the county, west of Winterset, near the center of the county, and five miles southeast of Winterset on the summit of the divide between Middle River and Jones Creek.

The Grundy silt loam is not extensive in area, but is all under cultivation. When properly drained it is easily cultivated and very productive. It is recognized as one of the best corn soils in the county, and most of its area is devoted to this crop. It produces an average yield of about 55 bushels per acre, but with intensive cultivation and favorable seasonable conditions as much as 85 bushels has been obtained. Wheat, oats, rye, and clover and timothy also give excellent returns, but wheat and oats are inclined to lodge in wet seasons. Oats yield from 30 to 80 bushels per acre, and wheat 20 to 40 bushels. Hay crops range from 1 to 2½ tons per acre.

No definite rotation is followed on this type. The more general practice is corn, one to three years, oats or wheat one year, and timothy and clover one to two years. This type is devoted chiefly to the production of grain, which is largely fed to cattle and hogs. No commercial fertilizers are used, but liberal applications of barnyard manure are made.

The price of land of the Grundy silt loam type ranges from $225 to $300 an acre, depending upon the location and improvements. The average selling price is about $250.

Where properly drained and prepared this type of soil is well adapted to alfalfa, and this should prove a very profitable crop. Deeper plowing would be beneficial. Legumes should be placed in the rotation, at least once in every four or five years, and turned under to maintain the supply of organic matter. Only where corn is grown continuously in the same field for a number of years is there any apparent decline in productiveness.

SHELBY LOAM.

The Shelby loam consists of a brown to dark-brown mellow loam, 6 to 14 inches deep, passing abruptly into a subsoil of stiff, waxy yellowish-brown to light-brown gritty clay or sandy clay, mottled with yellow and drab. Below 30 inches the subsoil is frequently a light-colored coarse sand mixed with assorted gravel.

The surface soil varies widely, having a range in texture from fine sandy loam to a silt loam. Shallow layers composed of coarse sand, gravel, and small stones, consisting of quartz, quartzite, greenstone, sandstone, and granite in many places occur between the soil and subsoil, and this same coarse material is also found scattered throughout the soil section. Large lumps and streaks of lime are exposed in the ditches and road cuts in the horizon between 4 and 10 feet below the surface.

The depth of the surface covering depends considerably on the topography which ranges from gently rolling or rolling to hilly. The gentler slopes are covered 12 to 14 inches deep with a loam or silt loam layer, while on the steeper slopes this has been greatly reduced by wash, the yellowish-brown silty clay loam subsoil being exposed in many places. Along the intermittent streams, occur narrow strips of colluvial material that have not been differentiated. Small areas of silt loam are included in this type where the underlyng drift was not encountered until a depth of 18 to 22 inches. On the south slopes of the streams, which are inclined to be abrupt, pebbles, small stones, and gravel outcrop, and a few small bowlders are occasionally found. Ridges and knolls occurring on the hillsides consist of a fine sandy loam, containing pockets of coarse sand and gravel. These bodies were not mapped as a distinct type because of their small area, and the impracticability of separation. Two areas of typical Shelby fine sandy loam also are included with this type because of their limited extent. These lie on the slopes of streams in sections 4 and 5, Madison Township, and sections 35 and 36, Walnut Township.

The Shelby loam is generally distributed over the county, occupying the steeper slopes between the bottom lands and the break of the upland. It lies in narrow, continuous strips that extend back along the valley walls of the smaller tributary streams, on the hillsides adjacent to the Tama silt loam. Drainage is well established on this

type and the run-off is so rapid as to cause destructive erosion in many places. The Shelby loam warms up quickly in the spring, and is easily cultivated and kept in good tilth throughout the year. The same farm implements are used and the same general methods of handling the soil followed as on the Tama silt loam. About 75 per cent of the smoother variation of this type is under cultivation, the remainder being used as pasture.

Most of the typical Shelby loam is used as pasture or hay land. Originally a part of this type was timbered with oak, hickory, elm, and many other kinds of hardwoods, hazel, and underbrush. Some of the slopes still have the original forest growth. Some hogs and cattle, sheep, and goats are raised, the native bluegrass which covers the slopes affording excellent pasture. Where this type is farmed, corn, oats, and hay are the principal crops. Corn yields 20 to 40 bushels, oats 20 to 30 bushels and hay 1 to 1½ tons per acre. Sweet clover is not a cultivated crop, but grows luxuriantly on this type, particularly where the calcareous subsoil is exposed.

The Shelby loam is sold in farm units combined with other types, usually Tama silt loam. It ranges in value from $50 to $150 an acre, depending upon topography, location, and improvements.

Fields located on the rougher part of this type should be kept in grass and hay crops as much as possible. Cover crops should be grown to prevent wash from the early spring rains. Where washes and ditches have been formed, measures should be taken to prevent further erosion by filling with brush, straw, or manure.

LINDLEY LOAM.

The Lindley loam consists of a light grayish brown to brown loam, extending to a depth of 6 to 12 inches, underlain by a light-brown or yellowish-brown, tenacious, gritty, sandy clay loam to sandy clay in many places mottled with yellowish brown and grayish drab. Large proportions of gravel and coarse sand are common in the subsoil, and here and there some lime nodules may be present in the lower depths.

This type varies greatly in texture, as does the Shelby loam previously described. The surface soil ranges from a silt loam or silty clay loam to a fine or coarse sandy loam, but because of the small extent of these variations, separation was impracticable. One-fourth mile south of Hanley a long broken slope extending to the bottom land along Clanton Creek has a texture of a fine sandy loam to fine sand of light yellowish brown color. In the more heavily timbered areas where there has been a large admixture of decaying vegetable matter, the top soil is a mellow black silt loam, 2 to 5 inches deep. In many of the small depressed areas on the hillsides is a layer of silt

loam or silty clay loam several inches in depth for the immediate surface.

Erosion has been severe on the steeper slopes, washing off the surface soil and cutting channels in the subsoil. Fragments of limestone, sandstone, chert, granite, and quartzite are found on the surface and throughout the soil section, and bowlders of different sizes are distributed over parts of the type.

The Lindley loam occupies the slopes descending to the stream courses, and covers largely the area between the Clinton silt loam on the upland and the alluvial types in the valleys below. The slopes are steep and abrupt often in many places reaching an angle of 45°. It is dissected by many deep gullies and lateral streams rising in the upland plain. Surface drainage is excessive and underdrainage good. The larger part of this type is forested with white and black oak, hickory, ash, and other hardwood trees, with a smaller growth consisting of hazel, sumac, and red haw.

Owing to the broken topography, only a small area is under cultivation, most of the type being used for pasturing cattle, horses, and sheep. A native bluegrass sod affords excellent pasturage.

On most of the cultivated areas corn, oats, and hay are the leading crops. Small patches of alfalfa have been grown successfully, though it is somewhat difficult to get a stand because of surface wash. Corn yields 20 to 40 bushels, and oats 25 to 35 bushels per acre. Clover does well on this soil.

Only the more gentle slopes are used for cropping. The soil is handled similarly to the Clinton silt loam. Liberal applications of barnyard manure to maintain the supply of organic matter and to check the surface wash are made. Much of the cultivated farm land located on this type is devoted to hay crops and grasses.

Land values have a wide range, depending on the roughness of the area, ranging from as low as $40 an acre for the poorer, eroded, brush-covered slopes to $125 an acre for the better cultivated areas.

Control of erosion is the chief problem in the management of this type. It is, for the most part better adapted for permanent pasture than to tilled crops, and where used for grain crops the various means of preventing damage to the fields, such as contour plowing, deep plowing, addition of organic matter, and the use of winter cover crops, should be carefully employed.

SOGN STONY SILT LOAM.

The Sogn stony silt loam type consists of 6 to 8 inches of a black, loose, mellow silt loam, passing abruptly into a grayish-brown to olive-gray loam to clay, which is tough, plastic, and highly calcareous. It contains fragments of limestone, chert, and shale.

This type is residual, being derived by weathering from narrow exposures of limestone. It occupies the steep slopes and ravines below the limestone outcrops which in places form the upper parts of valley walls. The surface is rough and uneven and subject to excessive erosion.

The type is found in the central and central-western parts of the county along Middle River, in the northern part of the county along North River, North Branch and Cedar Creek, and in the southeastern part along Jones Creek and upper Clanton Creek, where these streams have cut their beds through the limestone.

The soil type is of little value for farming and can be used only for pasture. It supports a sparse growth of hardwood trees. None of it is under cultivation and it is always sold with other soil types.

HAGERSTOWN SILT LOAM.

The surface soil of the Hagerstown silt loam is a silt loam that varies in color from light red to reddish brown. In many places it has a purplish-red appearance on the surface. In small areas where much organic matter has been incorporated in the soil, the color is darkened and becomes a dark reddish brown. The depth of the soil ranges from a very thin layer to 12 inches, with an average of about 8 inches. The soil is underlain abruptly by a reddish-brown stiff heavy clay loam or clay.

This type occurs in several small areas in sufficient size to be mapped and in many others too small to indicate on a map of small scale. The largest areas lie along Clanton Creek northeast of East Peru, northeast of Winterset along Cedar Creek, and north of Winterset along North River.

The topography is sharply rolling and the type has little agricultural value, being about equal to the Sogn stony silt loam. It has been derived by weathering from narrow beds of limestone that usually outcrop along steep hillsides. The usual position of the Hagerstown silt loam is midway up the hillside with the Sogn stony silt loam below and the Clinton silt loam above it.

The type was originally covered by a sparse growth of hardwood trees. At the present time the land is used for pasture and woodlots.

This soil is of interest in that it is the only red soil so far mapped in the State of Iowa. It is not identical with the Hagerstown silt loam found in the eastern States, but resembles it more closely than it does any other established type.

WAUKESHA SILT LOAM.

The Waukesha silt loam is a brown to dark-brown, uniform, mellow, silt loam 12 to 20 inches deep, resting on a compact, friable, brown to grayish-brown heavy silt loam to a light silty clay loam.

The subsoil layer is marked with gray mottlings and becomes heavier in texture and lighter in color with depth. In the more level to flat areas there is a sharp line of demarcation between the soil and subsoil, a heavier intermediate dark-brown silty clay loam layer, 10 to 15 inches in depth, occurring in the upper subsoil, the lower subsoil being typical.

The type occupies narrow discontinuous benches, above the soils of the Wabash series, and represents very old alluvial deposits. In a few places the slope between the terrace and first bottom is gradual and the soil boundaries indefinite. Some small areas of the Waukesha silt loam may be overflowed at the high flood stage of the streams.

Scattered areas of Waukesha silt loam lie along Clanton Creek. More extensive areas occur below Winterset, extending eastward along the entire course of Middle River to the county line. Small areas also are developed on North River.

In topography the Waukesha silt loam is generally level or gently undulating, except where the streams from the uplands have cut winding courses through the terrace bed, and left the adjacent areas on either side somewhat ridgy and uneven. The soil is drought resistant and practically all under cultivation. A few of the smaller areas are used for pasture. This is the most extensive terrace type in the county. It originally supported a growth of prarie grasses, with scattered belts of forest along the water courses. The trees have nearly all been removed.

The same crops are grown as on the Tama silt loam on the upland. Corn is the most important and yields 35 to 70 bushels per acre. Oats, wheat, and clover and timothy also are grown on considerable acreages. Alfalfa occupies very small areas, returns 2 to 3 tons of hay per acre per season.

No definite rotation is used on this type. Ordinarily corn is grown from one to three years, and followed by oats, or wheat, and then by timothy and clover. Corn is sometimes grown continuously for a period of years.

Drainage is well established, and the land compares favorably in cropping value with any in the county. The soil is friable, well supplied with organic matter and can be cultivated under a wide range of moisture conditions. Barnyard manure is applied but no commercial fertilizer used.

This land is valued at from $145 to $200 an acre, depending on the location, improvements, and general condition of the farm.

This type is admirably adapted to alfalfa, which should be more generally grown. Heavy applications of manure should be used to maintain the supply of organic matter.

BREMER SILT LOAM.

The surface soil of the Bremer silt loam consists of 8 to 12 inches of dark-brown to black, compact, friable silt loam. The subsoil is a dark-brown to black heavy, stiff, silty clay loam which passes at 22 to 28 inches into a brown to dark-brown plastic clay loam, mottled faintly with yellowish brown and gray. In places the subsoil contains reddish-brown to black mealy iron concretions. The type is free from sand and grit.

The Bremer silt loam is a second bottom or terrace soil, lying generally from 5 to 20 feet above the first bottoms. It is most largely developed along Middle River between Patterson and Bevington. Less extensive areas are found scattered along the North Branch of North River, Clanton Creek, northeast of Barney, and small areas 2 miles south of Winterset along Middle River. The Bremer silt loam is closely associated with the Waukesha silt loam and the change in the subsoil is gradual between them, hence the soil boundaries separating the types are more or less arbitrary.

Included with the Bremer silt loam are several small areas of Bremer silty clay loam which differ principally in their heavier texture. These were not of sufficient importance to warrant separate mapping.

The topography is nearly level to gently sloping and uniform in all of the areas mapped. The surface drainage is generally good, but owing to the heavy character of the subsoil tiling is necessary to insure the prompt removal of water during wet seasons.

The type is high in organic matter, very productive, and practically all under cultivation. A small proportion of the land is used as pasture. The prevailing type of agriculture is general farming.

Corn, oats, wheat, and hay are the principal crops, corn and hay occupying the largest acreages. Corn yields 35 to 70 bushels, and hay 1½ to 2 tons per acre. Wheat and oats yield well.

The methods of handling this soil are similar to those used on the Grundy silt loam. No commercial fertilizer is used.

The price of farming lands of the Bremer silt loam type ranges from $125 to $225 an acre.

In many places artificial drainage would be beneficial, especially in improving the tilth of the soil and allowing earlier planting in the spring. Deeper plowing should be practiced and barnyard manure should be applied to maintain the supply of organic matter. The included areas lie along Middle River, 1 mile west of School No. 2 in Scott Township, and 1 mile southwest of Patterson in section 36, Union Township. It also occurs along Clanton Creek, one-fourth mile east of School No. 9 in South Township. The areas are low lying and the drainage poor.

JACKSON SILT LOAM.

The surface soil of the Jackson silt loam ranges from light-brown to grayish-brown, smooth, mealy, silt loam, and has a depth of 8 to 12 inches. The soil passes gradually into a light-brown to yellowish-brown silt loam subsoil becoming more compact with depth, and heavily streaked with gray, and below 30 inches the subsoil is very compact, brown heavy silty clay loam, having scattered gray mottlings.

The type is fairly uniform, but along the edges of the terrace, where it joins the upland, small layers and pockets of mixed sandy and silty material occur in the subsoil, and sandy material has in places accumulated on the surface, where it has been washed from the adjacent slopes.

This is a second-bottom soil occurring along the larger streams. It occupies comparatively small areas, the largest of which lie along Middle River southeast of Webster, and in the loop of Middle River one-half mile north of Webster. Isolated bodies are found along Clanton Creek, North Branch of North River, Grand River, and along North River northwest of Winterset. The areas stand 10 to 30 feet above the overflow lands. The terraces are nearly level to gently undulating, the surface having been modified but slightly by stream erosion. Drainage is generally good.

Corn, wheat, oats, and timothy and clover are the principal crops. Corn yields 30 to 50 bushels per acre, oats 30 to 40 bushels, wheat 15 to 30 bushels, and hay crops 1 to 2 tons. Small fruits and vegetables do well on this type, and apples are produced in small farm orchards. Hogs, cattle, and sheep are raised. Manure is liberally applied to the land, but practically no commercial fertilizer is used. This soil being friable is easily handled and kept in good tilth.

Land of the Jackson silt loam type varies in value from $100 to $150 an acre, the price depending largely upon improvements and distance from market or shipping points.

In the management of the soil especial attention should be paid to maintaining the organic matter supply. The growing of leguminous crops would accomplish this if occasional crops were plowed under in the green state.

CALHOUN SILT LOAM.

The Calhoun silt loam consists of light-brown to light brownish gray, floury silt loam 6 to 10 inches deep. This passes abruptly into a layer of light-gray to light yellowish gray silty loam or silt loam from 8 to 10 inches thick, below which there occurs a heavy compact and impervious yellowish-gray silty clay to clay loam, mottled with

yellowish brown in the lower depths and containing scattered rusty brown iron concretions.

This type occurs in bodies of small area along Middle River near Webster, along North River, and along the North Fork of Clanton Creek.

The Calhoun silt loam has a nearly flat to gently undulating surface favorable to cultivation, and the type is nearly all in crops. It is naturally low in organic matter, and owing to the impervious subsoil the drainage is rather poor. This type originally supported a sparse growth of oaks. It is cultivated and cropped in the same manner as the Jackson silt loam, except that the proportion of the land given to the production of hay is greater.

The selling value of land of this type ranges from $75 to $125 an acre.

WABASH FINE SANDY LOAM.

The Wabash fine sandy loam consists of a brown to dark-brown fine sandy loam 12 to 20 inches deep, underlain to 30 inches by a brown to light-brown fine sandy loam, which in places is faintly mottled with gray in the lower part. Below 30 inches the subsoil is commonly composed of a coarse light-brown sand. Both the soil and subsoil are of a loose open structure, and more or less grit and gravel is mixed with the material throughout the soil section.

The Wabash fine sandy loam occupies the first bottoms of the streams. It is developed along Clanton Creek, the tributaries of this stream in the southeastern part of the county; the West Branch of Grand River in the southwest corner of the county; and along Middle River, North River, and Jones Creek. The largest continuous area is that lying along Middle River south and west of Winterset.

This light-textured Wabash soil is developed along or near the stream channels and especially in the sharp bends and loops where most of it is subject to reworking annually. As a result of the loose open structure of the soil and subsoil the drainage is good. It is, however, the first soil to overflow with any material rise of the streams. The surface is generally flat, but marked by depressions where changes of the stream channels have occurred.

On account of the frequency of overflow, only a small part of this type is under cultivation. Corn is practically the only crop grown. Yields ordinarily range from 30 to 45 bushels per acre. The light texture of the soil makes the land undesirable for the small grains.

Land of this type is usually sold as part of adjacent terrace or upland farms. Areas large enough to form separate fields sell from $40 to $80 an acre.

Straightening the stream channels would improve overflow conditions on parts of this type. Its physical nature could be modified

advantageously by the incorporation of organic matter. This would make the soil more coherent and more retentive of moisture.

WABASH LOAM.

The Wabash loam usually consists of a grayish-brown to dark-brown mellow loam 8 to 12 inches deep, underlain by a light-brown to grayish-brown compact loam, which passes at about 24 inches into a lighter brown fine sandy loam. The texture varies considerably even in adjacent areas. The lower lying, more frequently overflowed parts contain more coarse sand and grit and the subsoil often includes layers of gritty clay material mixed with some gravel.

A small area of light-brown to brown loam, 15 to 20 inches deep, underlain by a yellowish-brown fine sandy loam, mottled with gray and coarse sandy materials in the lower depths, occurs along Middle River in sections 6 and 7, Scott Township, north of School No. 3. This soil belongs in the Genesee series, but because of its small extent has been included with the Wabash.

The Wabash loam is a type of comparatively small extent. It is developed chiefly along Grand Riveer, where it occurs in narrow, continuous strips that occupy all or nearly all of the first bottom. It is nearly flat, with a surface slightly lower than the Wabash silt loam, and is more or less subject to continual overflow during rainy seasons. It is also developed to some extent along Middle River, Clanton Creek, North River and its branches, and in some of the narrower bottom lands of the smaller streams. In general the open structure of the soil gives the type good drainage between overflows, but some poorly drained spots are found in the wider areas. The area along Grand River is somewhat lighter in texture than typical of this soil.

A negligible percentage of the area of this type is under cultivation, the land being used almost wholly as pasture. A sparse and open forest growth, consisting chiefly of cottonwood, willow, box elder, ash, and post oak, and a sod of native grasses covers the type. The value of this land ranges from $50 to $85 an acre.

WABASH SILT LOAM.

The surface soil of the Wabash silt loam consists of a dark-brown to very nearly black compact, friable, silt loam, 14 to 20 inches deep. This passes below into a dark-brown to black compact heavy silt loam extending to a depth of 24 to 28 inches, where there occurs a heavy tough dark-brown to grayish-brown silty clay to clay loam, mottled with gray or yellowish brown. As is likely to be the case with alluvial soils there is more or less variation from place to place. Thus along North River the surface soil is especially heavy and more shallow than typical, passing at from 8 to 14 inches into a tenacious and somewhat impervious, black silty clay to clay loam, mottled

with gray and increasing in heaviness with depth, and somewhat mottled with gray and faint iron stains in the lower depth. Along North River where the type is closely associated with the Wabash silty clay loam, the soil boundaries are more or less arbitrary.

The Wabash silt loam forms parts of the first bottom along all the more important streams. The largest areas, lying along North River and Clanton Creek, range from one-fourth to one-half mile in width. Well-developed areas are also mapped along South River in the southeast corner of the county, along the lower course of Jones Creek, along Badger Creek in the northeastern corner, and on Cedar Creek. Narrow and broken strips are mapped along the smaller streams generally over the county. Areas along Tom and Jim Creeks show a soil formed partly from colluvial material.

The surface of this type is generally level, or slopes almost imperceptibly toward the stream courses. The drainage is poor to fair, the former condition existing where the subsoil underlying the soil consists of the black impervious silty clay to clay loam. The surface is 4 to 12 feet above the normal water level of the streams and much of the land is subject to overflow. This type is characteristically slightly higher along the banks of the stream than it is 25 to 50 feet back from the channel. Bordering the upland the elevation is again higher and here the type rarely is flooded.

The larger areas along Clanton Creek and North River, in seasons of well distributed rainfall are not subject to overflow, and many strips adjacent to the uplands are never completely inundated. Sparsely scattered clumps and narrow belts of forest trees occur along the banks of the streams. The trees are principally oaks, hickory, ash, cottonwood, willow, and soft maple.

About 85 per cent of the Wabash silt loam is under cultivation. It is high in organic matter and very productive. Where well drained it is as easily handled as the upland types. Corn is the most extensive crop and is frequently grown on the same land for long periods. Oats, wheat, and hay are also important. No definite crop rotations are practiced. Corn yields from 40 to 60 bushels per acre with intensive cultivation, and under favorable seasonal conditions has produced 75 to 85 bushels per acre. Oats yield 30 to 60 bushels, and wheat 18 to 35 bushels per acre. Hay crops ordinarily yield 1 to 2 tons per acre. Cattle and hogs form most of the live stock raised on this type.

The silty and mellow structure of the Wabash silt loam and the level low-lying fields make it easy to plow and cultivate. Much of the land is plowed in the fall. No commercial fertilizer is used, but small quantities of barnyard manure are applied. The soil in the areas of heavier texture has a tendency to clod and bake if cultivated when too wet.

Land of the Wabash silt loam has a wide range in value, depending on the likelihood of overflow, on drainage conditions, tile drainage systems, and other improvements, the price ranging from $80 to $165 an acre.

Improvement of drainage will cause the greatest betterment in many parts of this type, where nothing has been done as yet, to get rid of excess water. On the higher lying areas surface ditches would supply sufficient drainage, but the lower areas need tiling. In the heavier phases, care should be taken to plow and cultivate under proper moisture conditions to prevent baking. Alfalfa should be profitable on the better drained bodies. In many areas the danger of overflow can be reduced by straightening the stream channels.

WABASH SILTY CLAY LOAM.

The surface soil of the Wabash silty clay loam to a depth of 8 to 10 inches is a black silty clay loam. Underlying this is a black tenacious clay loam which passes at 18 to 20 inches into a dark-brown to black, stiff, plastic clay loam, mottled with dull brown or gray. Yellowish-brown mottlings and reddish-brown iron stains occur in many places in the lower subsoil where the soil is better drained. No sand or gritty material is present, and because of its sticky, plastic character the type is locally called gumbo.

With the type is included small areas of mucky clay loam covered to a depth of 2 to 3 inches with a layer of decayed organic matter. These areas occur in depressions 5 to 100 feet in width, support a growth of reeds and coarse water grasses, and remain marshy during a considerable part of the summer. By far the greater part of the Wabash silty clay loam lies along North River. Small areas occur along Cedar Creek, and along Clanton Creek 2 miles north of St. Charles.

The surface of the Wabash silty clay loam is flat and practically level. Natural drainage is poor, owing to the impervious character of the subsoil. The run-off is slow and water stands in the depressions for long periods after heavy rains. While this type is low lying, it is subject to inundation only during long periods of excessive rainfall. Most of this type supports a heavy growth of coarse-fibered slough grass. In the small area cultivated, corn, oats, and hay are the principal crops. This is a strong soil, very high in organic matter, and where drainage is adequate corn yields 40 to 65 bushels per acre. Oats do fairly well but are likely to lodge. Cattle raising is important on this type, as the areas that have not been reclaimed can be utilized as pasture.

Where properly drained the soil is not difficult to handle. If plowed under proper moisture conditions a mellow seed bed is

formed, but the surface soil must be stirred soon after rains to prevent baking and cracking.

Owing to the natural high productiveness of the soil, little attention is paid to rotation and no fertilizers are used.

Land values range on this type from $60 to $150 an acre, depending upon the drainage condition.

The principal need of the Wabash silty clay loam is better drainage. The construction of more drainage ditches and the laying of tile drains would hasten the removal of water which now stands on the surface after heavy rains.

SUMMARY.

Madison County is situated in the south-central part of Iowa, in the third tier of counties north of the Missouri State line. It lies within the Glacial and Loessial province of the United States. The county has an area of 563 square miles, or 360,320 acres.

Its surface is that of a broad loessial plain sloping to the northeast, deeply dissected by many streams whose tributaries reach all parts of the county. The topography varies from flat or gently undulating to rolling and hilly.

The greater part of the area is drained by North and Middle Rivers and Clanton Creek, with their tributaries. The flow of the principal streams is in a general easterly direction.

The highest recorded elevation in the county, 1,127 feet above sea level, is at Winterset, the exact center of the county. The lowest recorded elevation, on the terrace of Middle River at Bevington, is 278 feet below the highest upland point, or 849 feet above sea level.

The first settlement was made in 1846 in the southern part of the county. The early settlers came from the neighboring States to the east and south. The population of the county in 1920 was 15,020. The rural settlement is uniformly distributed. Winterset, the county seat, and largest town in the county, has a population of 2,906 in 1920. The county has good railroad facilities, which furnish direct connection with the larger markets. The principal highways are well graded and kept in good condition. Rural mail delivery routes and telephone lines reach practically every part of the county. Rural school facilities are excellent.

The rainfall is well distributed and favorable for the growing of all staple field crops. The mean annual precipitation is 34.16 inches, and the mean annual temperature 49.3° F. The growing season covers a period of 163 days.

The agriculture of Madison County consists principally of grain farming combined with the raising and feeding of live stock. Corn, oats, wheat, barley, timothy and clover, and timothy alone, are the principal crops.

Cattle and hog raising are the important live-stock industries. Sheep raising is showing marked increase. From 115 to 120 carloads of cattle and several carloads of sheep are brought in annually for fattening.

Systematic rotations are followed to some extent. The staple farm crops are grown on practically all the soil types. Barnyard manure, clover, and timothy sod are used principally to maintain the supply of organic matter.

There are 2,125 farms in the county with an average size of 157.9 acres. The cash rent of farm land ranges from $7 to $12 an acre. Land values have a range from $70 to $325 an acre.

Fifteen soil types, grouped in 12 series, have been identified in Madison County. They are of loessial, glacial, alluvial, and residual origin.

The Tama silt loam, the predominating type, occupies the undulating to gently rolling uplands. It is well adapted to corn and the general farm crops.

The Clinton silt loam is developed on the uplands between the Tama and the drift soils along the deeper stream courses. It is light colored and was originally forested. It is used more extensively for oats, wheat, and hay crops than for corn.

The Grundy silt loam occupies the high flat areas within the Tama silt loam areas, and is farmed and cropped in the same way as the latter soil.

The Shelby loam, the most extensive drift type, is well suited to the staple field crops, but a large part of it is used for pasture land, because of its rough and steep topography.

The Lindley loam, also a drift soil, is developed on the steeper valley slopes, adjacent to the Clinton silt loam. This type is largely forested. The small areas under cultivation are used chiefly for the production of hay.

The Sogn stony silt loam and the Hagerstown silt loam are residual soils derived from limestone and shale. They are of little importance from an agricultural standpoint.

The Waukesha silt loam, an old alluvial soil, is the most extensive of the terrace types. It is a dark-colored soil with brown subsoil, and is an excellent corn soil.

The Bremer silt loam, occurring on second bottoms, has a heavy tenacious subsoil, but when drained produces good yields of corn, oats, and hay.

The Jackson silt loam, a higher lying terrace soil, is light brown to brown in color. It is not extensive, and occurs principally along Middle River. It is used for the production of general farm crops.

The Calhoun silt loam is a grayish soil occupying a high terrace position. This type is of small extent. It is best suited to the growing of oats and hay crops.

The Wabash soils are dark-colored types occupying first bottoms. The Wabash silt loam is comparatively extensive, and where well drained produces excellent crops of corn. Parts of this type rarely overflow. The Wabash silty clay loam is poorly drained, and used principally for pasture and hay. It will yield good crops of corn where properly tiled and drained. The Wabash loam and fine sandy loam are subject to frequent overflow, and are used entirely for the production of corn and for pasture.

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[PUBLIC RESOLUTION—No. 9.]

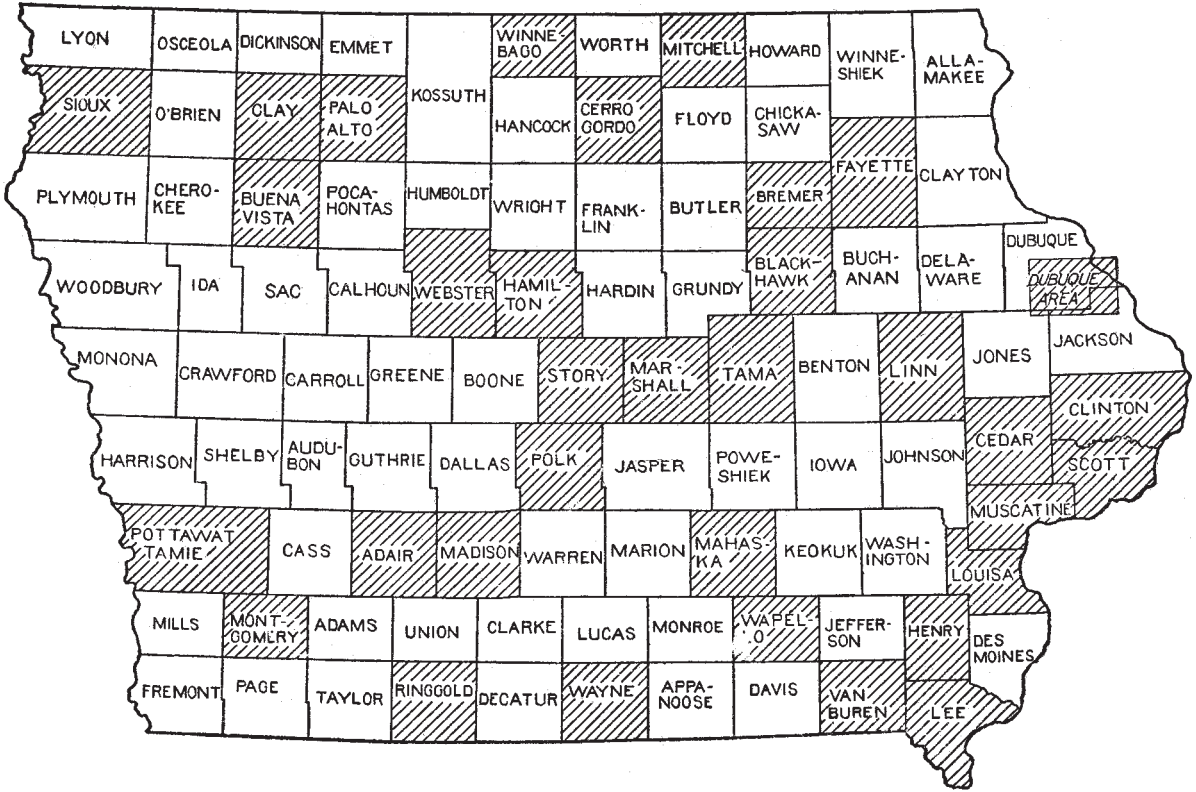
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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.


LYON
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O'BRIEN
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FAYETTE
CLAYTON
PLYMOUTH
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