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

SOIL SURVEY OF DUBUQUE COUNTY, IOWA.

BY

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

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1923.

[PUBLIC RESOLUTION—NO. 9.]

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

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

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

Approved, March 14, 1904.

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

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SOIL SURVEY OF DUBUQUE COUNTY, IOWA.

By J. O. VEATCH, of the U. S. Department of Agriculture, In Charge, and C. L. ORRBEN, of the Iowa Agricultural Experiment Station.

DESCRIPTION OF THE AREA.

Dubuque County is situated in northeastern Iowa. It is bordered by Jackson and Jones Counties on the south, Delaware County on the west, and Clayton County on the north. The Mississippi River forms the eastern and northeastern boundary, separating the county from Jo Daviess County, Ill., and Grant County, Wis. The total area of the county is 601 square miles, or 384,640 acres.

Physiographically the county is a high plain or plateau rendered rolling and broken by stream erosion. The topography of the eastern part of the county along the Mississippi River is strongly rolling to hilly and broken. The river occupies a valley or gorge walled in on both sides by rock bluffs which reach a height of 300 feet. The average width of the river flood plain is 1 to 2 miles, but in places it is little wider than the river itself. The tributary streams entering from the west have cut comparatively narrow valleys, 200 to 400 feet deep, which, along the lower courses of the streams, also are inclosed by precipitous rock bluffs. Streams are numerous in this part of the county; in fact a complete dendritic drainage system has been developed, so that practically no level stretches of land remain.

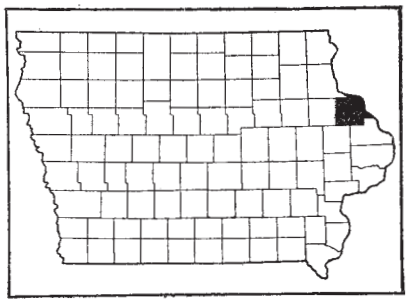

FIG. 11.—Sketch map showing location of the Dubuque County area, Iowa.

A conspicuous eastward and northward facing escarpment, lying from 1 to 10 miles back from the Mississippi River, extends across the county more or less parallel to the course of the river. This escarpment marks a rise in elevation of 200 to 300 feet within distances of one-half to 1 mile. The upper slopes are underlain by hard limestone and in places are steep and blufflike, while the lower slopes, underlain by comparatively soft shale, are rounded, smoother, and more gently sloping.

The escarpment does not present an unbroken front, but on the contrary the line representing the rim or upper margin is serrate, due to the incisions made by the eastward-flowing tributaries of the Mississippi. Salient ridges and reentrant or deep V-shaped valleys characterize the topography. Flat-topped hills or mounds have been formed by the stream cutting, and in instances have been left isolated in the general westward recession of the front. The escarpment is known as the "Niagara escarpment," from the fact that the Niagara limestone formation occupies the upper or steeper slopes and has been the main factor in its development.

In general, the western part of the county, or that part lying back of the rim of the Niagara escarpment, is less deeply dissected by streams and therefore less hilly as a whole than the eastern part. However, none of the land is quite level or flat, except negligible strips of bottom land; in fact, there are bluffs and hills in the extreme northwestern part and along some of the larger streams in the southwestern part of the county.

The lowest elevation above sea level, about 600 feet, is in the bottom land along the Mississippi River. The general elevation of the upland plain, or great erosional bench, lying east of the Niagara escarpment is 900 to 1,000 feet, and that of the higher plain from the rim of the escarpment westward is 1,000 to 1,200 feet.

The drainage of the county flows into the Mississippi River. In the eastern part all of the streams flow directly toward the river, but west of the rim of the Niagara escarpment streams flow southward or even westward before the waters ultimately reach the river through the counties to the south. Because of the elevation of the region and its proximity to the Mississippi, stream erosion has been accelerated. The main tributary streams have cut deep courses and have developed such a multitude of branches that very little of the county is without thorough natural drainage. The aggregate of land in need of artificial drainage for agricultural use probably is not more than 1 per cent of the total area of the county.

The county was for the most part forested at the time of the first settlement. The bluffs and steeper slopes along the Mississippi were densely covered with an association of mixed hardwoods in which white oak, bur oak, elm, walnut, hickory, basswood, hard maple, and aspen were the principal species, while tongues of the forest extended up the valleys back from the river. The greater part of the rougher and nonarable land still remains in forest. The upland also supported a tree growth of varying density, but was in part prairie. White oak, bur oak, red oak, and pin oak were the principal trees. A dense cover of hazel brush fringed the forest and was probably a forerunner of the invasion of trees on the prairie. Considerable bodies of grass-covered prairie were found by the early settlers in parts of New Wine, Dodge, Taylor, Vernon, Prairie Creek, and Washington Townships.

Dubuque County was one of the first parts of the State to be settled by white men. In 1788, Julien Dubuque, a Frenchman, made a settlement on the present site of the city of Dubuque, and was followed by a few other white men, chiefly miners. However, for a number of reasons, chiefly difficulties in the way of obtaining concessions and titles to land, white men did not settle in large numbers until 1832 and 1833. These later settlers were concerned with the agricultural development of the country as well as mining and began taking up the more desirable land. In the subsequent 20 to 30 years practically all of the prairie and most favorably situated forest land was occupied. For the last 50 to 60 years the new lands which have been cleared have comprised steep forested slopes which probably in some instances might better have been left in timber. Owing to the nearly complete occupation of the arable land, there has been little or no increase in the rural population during the last 40 years.

The farming population at present consists predominantly of native whites of Irish and German ancestry. The population of the

county, according to the United States census of 1920, is 58,262, of which 32.8 per cent is classed as rural. The urban population is centered in Dubuque, the county seat, which has a population of 39,141.

There are numerous manufacturing industries at Dubuque, and the value of their products exceeds that of the farm products. Agriculture, however, is relatively important, the value of the farm crops, not including animal products, reaching a total of $8,035,063 in 1919, as reported by the census.

Railway transportation facilities are excellent. Lines of the Illinois Central; Chicago Great Western; Chicago, Milwaukee & St. Paul; and Chicago, Burlington & Quincy systems traverse or enter the county. The Mississippi River also affords shipping facilities by boat.

The public highways are mostly common earth roads, but are maintained in fair condition by frequent grading and dragging. A macadamized highway traverses the central part of the county from Dubuque to the western boundary at Dyersville. Toll bridges across the Mississippi River at Dubuque connect with roads to cities in Illinois and Wisconsin.

Chicago is the principal market for hogs and cattle, although some stock is sold to a local packing plant at Dubuque. Dubuque is the principal center of trade for other farm products.

CLIMATE.

The mean annual precipitation is about 34 inches, according to records of the Weather Bureau station at Dubuque. About 58 per cent of the precipitation falls during the months of May to September, inclusive, and this is well distributed over the growing season. Droughts may occur during the summer, but have never been so severe as to cause complete crop failures, and it is only rarely that very serious reductions in crop yields result. Most of the precipitation is in the form of slow rains or showers, seldom heavy enough to cause any great damage to growing crops. The average annual snowfall amounts to 36.8 inches.

The mean annual temperature is 47.9° F. The mean for the summer is 72.1° F., and for the winter 21.4° F. The summers are rarely excessively hot, and the fall months are as a rule characterized by mild temperature and dry atmosphere. Severe temperatures are usually experienced in the winter, a minimum of −32° F. having been recorded. The average date of the last killing frost in the spring is April 30, and of the first in the fall October 13, making an average frostless period of 165 days. Frosts in late September and the early part of October, however, are not infrequent and result in more or less damage to corn.

The differences in altitude or in topography are not sufficient to cause any considerable difference in climate, although, judging from records at Delaware, in the county adjoining on the west, it is probable that the mean temperature is slightly lower and the frostless period a few days shorter on the upland of the western part of the county than at Dubuque, which is located in the valley of the Mississippi.

The following table of climatic data has been compiled from the records of the Weather Bureau station at Dubuque:

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

[Elevation, 639 feet.]

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
December	24.5	67	−24	1.72	0.35	0.52	7.8
January	18.3	63	−32	1.49	1.11	3.20	9.5
February	21.6	67	−31	1.38	1.22	1.53	9.0
Winter	21.4	67	−32	4.59	2.68	5.25	26.3
March	33.2	86	−12	2.21	3.06	4.00	7.0
April	48.9	88	14	2.92	2.27	3.63	1.3
May	60.8	94	26	4.32	1.75	5.96	T.
Spring	47.6	94	−12	9.45	7.08	13.59	8.3
June	69.6	99	39	4.55	2.25	7.88	.0
July	74.7	106	40	4.30	.02	8.15	.0
August	72.0	100	41	3.04	1.32	5.92	.0
Summer	72.1	106	39	11.89	3.59	21.95	.0
September	63.6	97	24	3.59	2.96	5.90	.0
October	52.0	89	15	2.68	1.51	1.10	.1
November	36.0	74	−12	1.81	1.53	2.49	2.1
Fall	50.5	97	−12	8.08	6.00	9.49	2.2
Year	47.9	106	−32	34.01	19.35	50.28	36.8

AGRICULTURE.

During the early period of settlement of the county, beginning about 1832, the farmers of necessity followed a mixed system of farming and supplied their individual food needs and other things required for domestic use to a greater extent than in subsequent years. Wheat soon became the principal source of farm income and continued to be the chief cash crop until about the year 1880, when, owing to changing economic conditions and generally decreased yields, it began to be replaced by corn as the major crop, and a system of live-stock farming and dairying soon became firmly established. At present practically all of the grain and forage crops are consumed on the farms where grown and the farm income is derived chiefly from the sale of hogs, beef cattle, and dairy products. Corn, oats, and timothy and clover hay are the staple crops grown on the majority of the farms.

The following table gives the acreage and production of the principal farm crops for the year 1919, as reported by the 1920 census:

Acreage and production of leading crops in 1919.

Crop.	Area.	Production.	Crop.	Area.	Production.
	Acres.	Bushels.		Acres.	Bushels.
Corn	64,267	2,736,780	Wheat	5,992	78,479
Oats	47,318	1,296,522	Potatoes	2,140	104,088
Barley	3,549	65,732			Tons.
			Hay (timothy and clover)	48,602	79,947

Corn is the principal crop in acreage and value. The average yield for the county as a whole during the last 20 years has ranged from 30 to 40 bushels per acre. At present probably an average of about 40 bushels per acre is obtained on 75 per cent of the total area devoted to corn. On well-cultivated land comprising the darkest colored and deepest soils of the upland, yields of 50 bushels or more are frequently obtained; on some of the bottom land yields of 60 to 70 bushels in a favorable year are not uncommon, although the average is perhaps little or no greater than on the upland. The lowest average yields are on the fine sandy loam and deep sand soils, which are lowest in natural fertility and on which some reduction in yield generally results from insufficient moisture at some time during the growing season. Corn is the most dependable crop grown, as there has never been a complete failure recorded.

Dent corn is grown almost exclusively, the most common variety apparently being Reid Yellow Dent or strains of this variety. Practically all of the crop is consumed on the farms where grown, chiefly as feed for hogs and beef and dairy cattle.

The acreage of oats is but little less than that of corn. It is generally grown both because it furnishes a needed feed for work stock and because it fits in best in a rotation system with the other major crops, corn and hay. The average yields for the county as a whole are 30 to 40 bushels per acre. There is apparently no great difference in yields on the various soil types. Medium late maturing varieties are preferred in order to avoid conflict in the harvesting of this and the hay crop. The varieties commonly grown are Albion (Iowa No. 103), Swedish Select, and Silvermine. Fields consisting of a mixture of oats and barley are occasionally seen.

The principal hay crop consists of a mixture of timothy and red clover. The average yield is about 1½ tons per acre. Usually only one cutting of hay per year is obtained, which may be followed by a second cutting of clover in the autumn for seed. Timothy and clover are grown separately to a small extent, chiefly for the seed as a sale crop. Little difficulty is experienced in obtaining good stands of clover, except on some of the more sandy soils and on the more eroded slopes in the hilly areas of Clinton silt loam. In these instances liming of the land and liberal manuring would probably be the most efficient remedy. Practically all of the hay is consumed on the farms where grown as winter feed for beef and dairy cattle and work stock. The surplus of individual farms is mostly sold locally, so that practically none is shipped from the county.

Barley normally occupies probably a slightly larger acreage than wheat. It is grown only on small fields. Formerly it constituted a cash crop of some importance, but at present it is largely consumed on the farms as feed for hogs and cattle. The fields appear to be a little more numerous in the eastern, more hilly part of the county than in the western part.

Wheat normally is grown only to a small extent, although owing to the stimulation arising from war conditions the acreage has been increased slightly during the last few years. Both winter and spring varieties are sown, but spring wheat occupies the greater acreage, and probably returns somewhat higher average yields. With favorable seasons and a minimum of damage from fungous diseases and

insects, yields of about 20 bushels per acre are obtained on the upland silt loam soils.

A number of other field crops also are grown, but are of minor importance in acreage and value. These include Irish potatoes, rye, rape, sorghum, millet, pop corn, soy beans, and alfalfa.

The growing of vegetables, melons, grapes, strawberries, and bush fruits is carried on both on small farms devoted principally to this business and also as an adjunct to general farming on some of the larger farms in the vicinity of Dubuque. Practically all of the products are sold locally. There are small bodies of sandy land along the Mississippi River directly north and south of the city which are adapted to vegetables and melons, while hillsides too steep for the profitable cultivation of the staple farm crops can be utilized successfully for the growing of bush fruits and grapes.

Orchard fruits, consisting of apples, cherries, and plums, are grown in a small way pretty generally over the county, but not on a very extensive commercial scale. Ordinarily there is a sufficient yield for home use and for the supply of local markets during the season.

Dairying is an important industry, being carried on to a greater or less extent on the majority of the farms. Creameries are located in Dubuque and all of the smaller towns and communities and hence are within easy access of the farms. A majority of the farmers sell the whole milk. Corn silage, timothy and clover hay, oat straw, and to a less extent the small grains, constitute the winter feed. During the summer and early autumn the dairy herds graze on the native pasture and in the hay fields after the cutting of the crop. In the more broken and hilly parts of the county, where a considerable part of the land is unsuitable for the profitable cultivation of the staple field crops, there are excellent pastures of bluegrass. Narrow strips of bottom land along the smaller creeks also afford good pasture. In these situations considerable white clover is mixed with the bluegrass.

The cattle kept are good grades of dual-purpose and beef breeds. Durham, Devon, and Angus breeds predominate. The feeding of beef cattle is an important industry. Corn is the principal grain used for fattening. On January 1, 1920, according to the census, there were 58,009 cattle in the county, of which 24,358 were classed as beef cattle and 33,691 as dairy cattle.

The raising and fattening of hogs is the principal industry on a majority of farms. Grades of Duroc-Jersey and Poland-China breeds predominate. Corn is the principal feed.

Sheep raising is carried on only to a small extent, and chiefly on the farms which include a considerable acreage of rough pasture land.

Modern farm implements are in general use, although tractors are not as common as might be expected, because of the prevailing hilly topography, small size of the farms, and diversity of crops grown. Most of the farms have substantial dwellings, large painted barns, and well-kept premises.

Crop rotation is practiced on all farms where the staple field crops are grown, the most common plan consisting of a four-year rotation. Corn is grown for two years, followed by oats, with which timothy and clover are seeded.

Barnyard manure generally is considered as the most efficient fertilizer and is chiefly relied upon for the maintenance of productiveness and good tilth. The largest applications are made for corn. Commercial fertilizers are not regarded by the farmers as necessary at present for the production of profitable yields.[1] Liming of the land is not generally practiced, although a few farmers have made applications in a more or less experimental way.

Farm labor in the last few years has been scarce and has commanded high wages. However, most of the farms are not so large but that the owner or operator can perform the necessary labor with the assistance of his family and the hire of temporary labor during the busiest parts of the year. Interchange of labor among neighbors also assists in solving the help problem.

According to the United States census of 1920, 95.2 per cent of the total area of the county included 2,372 farms with an average of 154.3 acres per farm, of which 73.7 per cent is classed as improved land. Owners operate 77.2 per cent of the farms, tenants 21.9 per cent, and managers 0.9 per cent. Both share and cash systems of rental are practiced, the cash system having been favored to a greater extent in recent years.

The selling price of land at present (1920) is $200 to $250 an acre for the most desirable farms, from the point of view of topography, soil, and improvements. There are many instances of inflated values, and small tracts have sold for much higher prices. The more hilly and more remotely located farms are valued at $100 to $150 an acre. The nonarable land, consisting of bluffs and such land as can be used only for pastures and the production of trees for timber and fuel, sells for $30 to $60 an acre.

SOILS.

The general characteristics of the soils of the region in which this area is located are: Brown and brown-black surface soils having a moderately high content of humus, the organic matter being thoroughly humified and intimately incorporated with the mineral base; a subsurface layer heavier in texture and more compact in structure than the surface or substratum; a moderate content of lime carbonate, and moderate to high fertility. Leaching of the soluble mineral salts commonly found in soils is somewhat greater than in the semiarid region of the Great Plains farther west, and somewhat less than in the warmer, more humid region of the central-southern and southeastern part of the United States.

The system of soil classification and mapping developed by the Bureau of Soils includes the establishing of soil types that differ from each other in color, texture, structure, and chemical character. The classification is generally based on a combination of characteristics rather than any one, and the use of chemical characteristics is limited because of lack of practical methods for making sufficiently accurate tests in the field. A soil series consists of soil types that are similar in origin, color, and other essential features, but differ from each other in the texture of the surface soil. The soil type is the unit of soil mapping.

[1] On the basis of results of experiments and analyses on similar soils in Scott and Clinton Counties by the Iowa Agricultural Experiment Station, it is probable that phosphorus may be needed on some fields at present or in the near future. See Soil Survey Reports of Scott County and Clinton County, Iowa, published by the Iowa Agricultural Experiment Station.

The soils of Dubuque County may be arranged in five groups, each group presenting differences in color, textural, and structural characteristics of the profile. These groups are correlated with the geologic and physiographic divisions of the county.

The soils of the first group are composed mainly of silt and very fine sand to a depth of 3 to 5 feet or more. They have a range in surface color from gray through light brown to dark brown, but, aside from purely local variations in the thickness of the upper or humus layer, they are nearly uniform in texture, structure, and other characteristics of the soil profile. The profile is characterized by a horizon of maximum content of clay, a yellowish or buff-colored compact layer of silty clay loam or very fine sandy clay loam generally beginning at a depth of 10 or 12 inches and extending to 30 inches. Below this is a more friable and less retentive buff-colored or yellowish soil which grades into the substratum at depths of 4 or 5 feet. The lighter colored types of this group have been classified as the Clinton very fine sandy loam and Clinton silt loam, and the darker colored as the Tama silt loam. These soils do not effervesce with acid, but are probably fairly well supplied with lime and contain bases nearly equal to or in excess of acids. They possess moderate fertility and are retentive of moisture. The color differences at the surface may be due in part to local differences in topography, but more probably bear a relation to the type of native vegetation which occupied the land. These are the dominant soils of the county and comprise about 70 per cent of the total area.

In their distribution these soils bear a close relation to a silt formation of the Pleistocene age, known as loess, which occupies a narrow strip of country lying along the Mississippi River. Locally this formation reaches a thickness of 10 to 30 feet or more, constituting a mantle over sheets of glacial drift and formations of limestone and shale. It is composed uniformly of grayish and yellow silt, showing only faint stratification, nonindurated, permeable, and friable in structure. It is complex mineralogically. The unweathered silt is calcareous, but in the soil or weathered part the lime carbonate apparently has been partly leached out. Weathering has also changed the original gray into a yellowish color.

The soils of the second group are characterized by a comparatively high percentage of mineral particles coarser than silt or clay and ranging from fine sand to coarse sand and gravel. These soils vary considerably in texture at the surface, but are coarser in some part of the soil profile than those of the first group. Also on the whole they are probably a little more pervious, less retentive, and probably lower in percentage of readily available plant food. These soils have been derived from the Iowan glacial drift. The darker colored and more loamy type has been classified as Carrington loam, and the lighter colored soils as the Shelby fine sandy loam, Shelby loam, and Lindley fine sand. A type developed in situations of poor drainage is characterized by a dark-colored surface soil and a relatively compact and stiff, gritty clay subsurface layer, underlain by sand and gravel. This is classified as Clyde silt loam. The soils of the second group constitute about 10 per cent of the total area.

A third group of soils is characterized by light-brown or grayish-brown and dark-brown surface soils underlain by yellowish and reddish clay and an impenetrable substratum of limestone at shallow

depths. These soils, on the whole, where the clay layer has any considerable thickness, are probably stiffer in the subsurface than those of the first two groups, and also probably contain higher percentages of carbonates either at the surface or at shallow depths. The soils are developed where the original covering of drift and loess was very thin or has been removed by erosion. The subsurface clay is a residual product derived by weathering of the limestones before the deposition of the drift and loess. Where the top soil has the characteristics of the types of the first group to a depth of a foot or so, the soil has been classified as the Dubuque silt loam. Where the top soil is darker in color and a loam in texture, and the limestone substratum is reached at a depth of a few inches to a foot or so, the soil has been classified as the Gasconade loam. The soils of this group constitute about 8 per cent of the total area.

The fourth group includes sand, silt, and clay soils which are developed on terraces and are grouped on the basis of sameness of geologic origin. Toward the close of the Wisconsin period of the Pleistocene age the valleys of the Mississippi River and its tributaries, at their mouths, were flooded and filled to a great depth by detritus.[2] Subsequent cutting of stream channels has largely removed this filling, but has left remnants of it as terraces or benches lying 30 to 50 feet above the present flood plains. The Judson loamy sand and Judson silt loam are characterized by uniformity in texture and structure to a depth of 3 feet or more. These soils do not differ materially in profile from the sand and silt soils of the first two groups, but are separated purely on the assumption that the difference in geologic origin of the parent material implies differences in physical and chemical characteristics of importance in plant growth. The O'Neill loam differs from the Judson types in that loose sand and gravel are present at varying but shallow depths. The Davenport clay loam, which is developed in one locality on these terraces, is characterized by the peculiar stiff structure and limy nature of the underlying clay.

The fifth group consists of soils developed from alluvial deposits of the first bottoms or flood plains along the streams. The soils are practically equivalent to the alluvium itself, which is a recent geologic formation, composed mainly of silt and clay and containing more or less organic matter throughout, but exhibits abrupt textural changes both vertically and horizontally. The light-brownish to grayish soils are classified as Genesee fine sandy loam, silt loam, and silty clay loam. The dark-brown to almost black soil is mapped as the Wabash silt loam.

The soil on the lower slopes of the high bluffs along the Mississippi and other streams consists of strong colluvial material. Since no soil profile, due to soil-forming processes or soil weathering, has developed as in the soils of the other groups, and since the soil resembles the Wabash in its dark color, it has been mapped as a colluvial phase of the Wabash stony silt loam.

The soils of Dubuque County are described in detail in subsequent pages of this report. Their distribution is shown on the accompanying soil map. Their actual and relative extent are given in the table below.

[2] Geology of Dubuque County, by Samuel Calvin, Annual Report of the Iowa Geological Survey, 1899.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Clinton silt loam	173,632	50.4	Genesee silty clay loam	4,480	1.2
Steep phase	20,224		Judson loamy sand	2,112	.5
Tama silt loam	30,336	19.6	O'Neill loam	1,664	.4
Light-colored phase	45,056		Riverwash	1,536	.4
Dubuque silt loam	29,056	7.6	Genesee fine sandy loam	1,408	.4
Carrington loam	17,536	4.6	Gasconade loam	1,344	.3
Genesee silt loam	16,064	4.2	Clyde silt loam	1,024	.3
Shelby fine sandy loam	9,792	2.5	Judson silt loam	960	.2
Wabash silt loam	8,192	2.1	Lindley fine sand	640	.2
Shelby loam	7,808	2.0	Davenport clay loam	256	.1
Wabash stony silt loam, colluvial phase	6,208	1.6	Total	384,640	.....
Clinton very fine sandy loam	5,312	1.4			

CLINTON VERY FINE SANDY LOAM.

The Clinton very fine sandy loam type consists of grayish and light-brown very fine sandy loam, with an average depth of 10 to 15 inches, underlain by a buff-colored, more compact, very fine sandy clay loam. This material becomes more friable or less clayey at depths of 30 to 40 inches and at about 4 or 5 feet grades into the substratum, which consists of a grayish and yellowish, loose, faintly stratified mixture of very fine sand and silt. The usual slight variations in thickness and the color shades of the surface soil bear a relation to local erosion and position on a slope.

The soil is derived from the sandier deposits of the loess which lie adjacent to the lobes of the Iowan glacial drift which extend into this county. Possibly in some places the soil is derived from the finer textured phases of the drift itself.

This type occurs in a number of small separate bodies in Cascade, Dodge, Taylor, and Prairie Creek Townships. Its aggregate area amounts to about 8 square miles. The topography of the region in which it occurs is rolling to moderately hilly, including some fairly steep slopes. The land was originally forested, the species consisting mainly of bur oak, red oak, white oak, hickory, and aspen. Most of the land is now cleared and under cultivation.

The general farm crops of the county—corn, oats, and hay—are grown. The yields are nearly the same as on the Clinton silt loam, possibly a little less on the average. The higher content of very fine sand probably makes this soil slightly less retentive of moisture than the silt loam; consequently crops may suffer a little injury during dry periods, but on the other hand they make a little more rapid growth in the spring.

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

Mechanical analyses of Clinton very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
334155	Soil, 0 to 12 inches	1.4	1.1	1.8	22.6	23.6	37.5	11.9
334156	Subsurface, 12 to 48 inches.	.0	.2	.9	17.0	33.6	41.4	7.0
334157	Subsoil, 48 to 72 inches.	.0	.2	1.0	12.9	46.0	35.0	5.0

CLINTON SILT LOAM.

The surface soil of the Clinton silt loam consists of a grayish and light-brown silt loam 4 to 8 inches in thickness. Below this there is typically a layer of 2 to 6 inches of ash-colored or very light gray silt which is more floury or pulverulent than the material above or below.[3] Beginning rather abruptly at average depths of 12 to 15 inches, the soil is a buff-colored silty clay loam which is more compact and more retentive of moisture than the layers above. At 30 to 40 inches this changes to a more friable silt and thence grades into the grayish, iron-stained silt of the geologic substratum.

Minor variations occur in thickness of the humus layer and in shades of color, such as obtain in any area of hilly topography. In general the surface soil has a darker color and greater thickness at the bases of slopes and in the shallow swales at the heads of the drainage branches. On slopes most subject to erosion the surface soil is naturally thin and numerous yellowish spots in cultivated fields indicate places where the top layer of silt has been removed by erosion down to the buff-colored subsurface layer. In certain situations the surface soil is so light colored as to appear almost white when dry. This is particularly the case in small areas of nearly level land, such as the flat tops of narrow salients or ridges of the Niagara escarpment and the level land found in places just back from the brink of the limestone cliffs bordering the Mississippi. These variations are relatively small in extent and do not have sufficient agricultural significance to warrant separation on the soil map.

Chemical analyses[4] made of this type of soil in other counties of the State, but which are also applicable here, indicate that there is only a moderate content of organic matter in the surface soil, no lime carbonate, and a slightly acid condition. In the field tests no lime was indicated in the first 3 feet, but below this depth the silt is ordinarily moderately calcareous.

The Clinton silt loam type is widely distributed over the county and occurs in large continuous bodies. It is the principal type in extent, and constitutes about one-half of the total acreage of the county.

The topography is rolling to hilly and includes rather steep slopes. However, owing to the nature of the underlying geologic formation, the hills are rounded or softened in outline and the slopes are generally smooth. Practically all of the land is sufficiently well drained for the growing of staple crops.

At the time of the settlement of the county this land was covered by a mixed hardwood forest in which white oak, hickory, red oak, and aspen were the dominant species. The greater part is now under cultivation, and the part not cultivated has been partly cleared for fuel and lumber and to improve the pastures. Probably less than 5 per cent remains in the virgin condition.

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[3] The presence of a subsurface gray layer in this soil and the abrupt transition from the gray horizon to the heavy horizon beneath it shows that this soil has passed somewhat beyond the stage of development in which the typical characteristics of the soils of the Clinton series are predominant and has already assumed some of the characteristics of a related group of soils known in Iowa as those of the Marion series. The Marion characteristics are not pronounced enough to warrant calling this soil Marion silt loam. It is Clinton silt loam, but is not typically so. It is in process of transition from the Clinton condition to the Marion condition. Where other conditions are equal it should be more productive than the Marion silt loam and a little less productive than the typical Clinton silt loam.

[4] Analyses by Iowa Agricultural Experiment Station. Soil Survey Report No. 8, Clinton County, Iowa, pages 12 and 39; Soil Survey Report No. 9, Scott County, Iowa, pages 11 and 38; published by Iowa Agricultural Experiment Station.

A system of live-stock farming and dairying is practiced. Corn, timothy and clover hay, and oats are the staple crops. These crops are largely consumed on the farms where grown, and the farm income is derived from the sale of hogs, cattle, and dairy products. A small acreage is planted to wheat and barley, but these crops are not planted every year and do not form a regular part of the farm operations. Irish potatoes are grown for home use and to a small extent for the supply of local markets. Garden vegetables, bush fruits, and grapes are grown on a small scale near the city of Dubuque. Orchard fruits, such as apples, cherries, and plums are grown for home use.

On land which receives the usual care in cultivation and which is regularly manured, the average yield of corn is probably near 40 bushels per acre. Timothy and clover hay yields about 1½ tons per acre or slightly less; oats, 30 to 40 bushels; and wheat and barley, about 15 bushels per acre.

The nature of the soil is such that a good tilth is easily maintained where precautions have been taken to prevent excessive erosion. The surface soil is mellow and loamy and turns easily in plowing. The subsurface layer is moderately retentive of moisture, so that crops are not seriously damaged from the ordinary summer droughts. On the steeper slopes that are in cultivated crops, serious loss from soil erosion takes place unless preventive measures are adopted.

The average selling price of farms of 80 to 160 acres, composed largely or entirely of this type of soil and including ordinary improvements, is about $200 an acre at present (1920). The price, however, varies according to the usual controlling factors, such as location and state of improvement, so that the extremes of values may be much below or above the average given.

Clinton silt loam, steep phase.—The steep phase of the Clinton silt loam is mapped separately on the basis of topography. The soil is not different in any essential feature from that mapped as typical Clinton silt loam. This phase is confined to slopes which are uniformly steep and which are deeply furrowed at intervals by streams. The area mapped comprises the lower slopes of the Niagara escarpment or the slopes lying just below the scarp or bluffs of limestone. It, therefore, appears on the map as a more or less continuous, irregular strip extending from the southeastern corner through the central part to the northern line of the county. Other equally steep slopes occur elsewhere in the loess hills, but because the separate areas are small and scattered it is impracticable to show them separately on the map.

As mapped the phase includes numerous small bodies of dark-gray or slaty black silt loam and clay loam, underlain by stiff clay or shale rock at shallow depths. The underlying clay and shale is moderately retentive and impervious, and much of this soil is found in seepage areas and is known as "spouty" land. This soil constitutes a distinct type, but it can not be shown on the soil map because of the small size of the separate bodies.

The land on these steep slopes has less agricultural value than that in areas of smoother and more even surface, because of the slightly greater labor and expense of tillage and because it is impracticable to lay out regular or rectangular fields of considerable size without including considerable area of waste land. Greater precautions are also necessary to prevent excessive erosion and gullying. Probably

60 to 70 per cent of the area shown on the map is under cultivation and is utilized chiefly for the general farm crops, corn, hay, and oats.

The slopes were originally covered by a mixed hardwood forest in which white oak, bur oak, hickory, elm, and aspen were the principal species. A small amount of the land still remains in original forest, and in other places the trees have been partly or entirely removed with the double purpose of obtaining lumber and fuel and of improving the pastures.

TAMA SILT LOAM.

The surface soil of the Tama silt loam consists of a dark-brown mellow silt loam, with average depths of 12 to 18 inches. This grades into lighter brown, slightly more compact silt loam, which passes at depths of 24 to 30 inches into buff-colored compact silty clay loam. A substratum of grayish and yellowish mottled silt, less clayey than the subsurface soil layer, is encountered at depths of 4 to 5 feet. Color from organic matter is noticeable to depths of as much as 20 to 30 inches. No part of the soil profile contains enough calcium carbonate to cause effervescence when tested with acid, although the loess substratum is moderately calcareous. The soil does not, however, appear to be highly acid. It is probably well supplied with all the common elements of fertility.

Compared with the Clinton silt loam, the surface soil of this type is darker and the color from organic matter extends to a greater depth. The loess substratum of both has the same lithologic character. The difference in color and content of humus probably bears a relation to differences in the types of native vegetation which occupied the land. The areas mapped as Tama silt loam probably coincide pretty closely with the boundaries of the original prairies. Grasses, therefore, furnished a greater part of the humus present in the soil.

This type occupies a much smaller acreage than the Clinton silt loam. The principal areas are in Dodge, Taylor, Vernon, Prairie Creek, and Washington Townships, in the western and southern parts of the county.

The surface is gently rolling. Most of the land is on the higher part of the upland and farthest removed from the larger streams and deepest valleys. The drainage courses are not deeply or sharply trenched, and the ultimate branches occupy broad, shallow swales. The natural drainage, however, is sufficient for growing the staple crops of the county.

All of the land is improved or under cultivation. Corn, oats, and timothy and clover hay are the staple crops, and a system of livestock farming is practiced. The average yields may be slightly higher than on the more hilly Clinton silt loam. The average yields of corn are probably about 45 bushels per acre, oats about 40 bushels, and hay 1½ to 2 tons per acre. No fertilizers other than the manure produced on the farms are used.

The top soil is mellow or loamy to depths of 12 inches or more and does not become compact nor clod seriously when wet, so that no especial tillage difficulties are encountered. The subsurface clay loam is moderately retentive without holding excessive quantities of water, so that crops are not often seriously injured during periods of dry weather or unusually long rainy periods. The comparatively smooth surface is also an advantage in farming operations.

Well-improved farms have a selling price at present (1920) of $250 to $300 an acre.

Tama silt loam, light-colored phase.—The light-colored phase of the Tama silt loam is slightly lighter in color in the surface soil than the typical Tama silt loam, but is otherwise essentially the same in texture and structure, in the succession of changes in the soil profile, and in geologic origin. The surface layer varies from 15 to 30 inches, with perhaps an average thickness of 18 to 20 inches. This phase is intermediate between the soil mapped as Clinton silt loam and that mapped as typical Tama silt loam. It therefore follows from the nature of things that boundaries drawn on a map must be to some extent arbitrary.

This phase is mapped principally in the central and western parts of the county, where it occurs in fairly large areas. Its aggregate acreage is somewhat larger than that of the typical soil.

The topography, like that of the typical Tama silt loam, is gently rolling or smooth and not as hilly as the Clinton silt loam. The ultimate branches of streams occupy broad and shallow drainage swales. Practically all of the land is sufficiently well drained for the growing of staple crops, and none of the slopes are steep enough to be subject to serious erosion where ordinary care is exercised in tillage.

It is probable that all or at least the greater part of the land was forested or covered with hazel brush at the time of the occupation by white men. The few spots remaining in forest have a thin open stand of trees consisting mainly of white oak and bur oak.

The agricultural value of the land may be slightly lower than that of the typical Tama silt loam.

CARRINGTON LOAM.

The surface soil of the Carrington loam consists of a brown to dark-brown, mellow, friable loam, 12 to 20 inches deep. This is underlain by a yellowish-brown gradational layer extending to depths of 20 to 30 inches, which changes into a yellowish, friable, sandy and gravelly clay or clay loam. A substratum of glacial drift, consisting of a mixture of sand, gravel, clay, and occasional bowlders, is encountered at depths ordinarily 3 to 4 feet from the surface. The yellowish subsoil layer is sufficiently clayey to be moderately retentive of moisture, but was not found at any place to be highly plastic or impervious. Pockets of sand constituting a lithologic variation in the drift occur locally at shallow depths. The soil, therefore, is not everywhere entirely uniform.

The type as mapped includes the darkest colored soils derived from Iowan glacial drift, which range in texture at the surface from a fine silty loam to a fine or very fine sandy loam, the latter containing a higher percentage of organic matter. The textural variations are not extensive enough for separate mapping and are probably of little agricultural significance. A humus color is generally found to greater depths in the more level places and drainage swales and to less depths on the knolls or low hills.

Most of the areas were originally prairie or were not densely forested, which fact may account in part for the darker color as compared with the soils classified as Clinton and Shelby. The principal physical difference between this type and the dark-colored soils derived

from the loess is in the higher percentage of coarse mineral particles, giving the Carrington loam a looser structure and relative perviousness. It is possible that there are some chemical differences of agricultural significance, although any statement to that effect in the absence of laboratory investigations would be based on the assumption that the lithologic differences between the drift and the loess imply corresponding chemical differences in the soil.

This type of soil occurs in the western and southwestern parts of the county, mainly in Dodge, Cascade, Taylor, and Prairie Creek Townships and near the towns of Dyersville, Farley, Worthington, Cascade, and Bernard. It is the principal soil type within the areas occupied by the lobes of Iowan glacial drift. However, it does not occur in large uniform bodies, but is dotted with spots of Clyde silt loam and is more or less intimately associated with the Shelby fine sandy loam and other types.

The topography is gently rolling or nearly level. Practically all of the land, however, can be farmed successfully without artificial drainage, and nearly all has been placed under cultivation.

Corn, oats, and timothy and clover hay are the staple crops grown, and a system of live-stock farming is carried on. The average yields of corn are about 40 bushels, oats 30 to 35 bushels, timothy and clover hay 1½ tons per acre or a little less. The average yield may be slightly less than on the Tama silt loam and on the deeper and less hilly areas of the Clinton silt loam. Corn may be injured to a greater extent during dry periods, but it grows a little faster and matures a few days earlier. It appears that a stand of red clover is not always easily obtained. Applications of lime to the land are recommended by the Iowa Agricultural Experiment Station for soils of this series on the basis of tests made on samples from Clinton County.[5] The soil is mellow or loamy, does not bake or clod, and is, therefore, easily maintained in good tilth.

SHELBY FINE SANDY LOAM.

The Shelby fine sandy loam is a brownish to dark grayish brown, loosely coherent fine sandy loam, which becomes lighter in color with depth and grades into yellowish sandy or gravelly clay loam at a depth of 3 feet or less. Generally an appreciably higher percentage of clay is present at depths of 20 to 30 inches than in the surface soil. The depth to which humus color extends varies from 6 to 24 inches.

The mineral base of the soil has been derived from the more sandy phase of the Iowan glacial drift. Such sandy soils in other counties[6] of the State have shown lower percentages of phosphorus and nitrogen and higher lime requirements than the loam soil from this drift sheet.

The type is confined to the western part of the county and occurs in separate small bodies in association with the Carrington loam. It is developed mainly on nearly level or gently sloping land and on low ridges or knolls, but also includes moderately steep slopes along some of the larger streams. All of the land is sufficiently well drained

[5] Soil Survey Report No. 8, Iowa Agricultural Experiment Station, 1918, pages 33-35.

[6] See Soil Survey Reports of Clinton and Scott Counties, Iowa, published by the Iowa State Agricultural Experiment Station.

for farming; the steeper slopes are likely to become gullied when placed under cultivation.

This type was originally forested and a few small spots of forest land still remain. The growth consists of mixed hardwoods, principally bur oak, red oak, black oak, and white oak.

The staple crops, corn, oats, and timothy and clover hay, are grown The average yields are much lower than on the associated Carrington and Clinton types, although with a liberal use of manure in the more favorable seasons the yield of corn may equal the yields on the naturally more fertile soils. Corn is likely to fire during dry periods, but on the other hand grows more rapidly in the spring and matures one to two weeks earlier than on the more retentive soils. The yield of oats is small, but the quality of the grain is generally good. Red clover is not as successful as on the silt loam and loam soils, and ordinarily the stands of timothy are thin.

Owing to its loose structure, the soil is easy to till, and because of its perviousness, it can be cultivated very soon after rains.

SHELBY LOAM.

The Shelby loam typically consists of brown to dark grayish brown mellow fine loam, with a depth of 8 to 15 inches, underlain by yellowish gritty or sandy clay loam, which is a little more compact and more retentive than the surface layer. A substratum of glacial drift, consisting of a yellowish mixture of sand, gravel, clay, and bowlders, is reached at depths of 20 to 40 inches. The type as mapped contains some variations toward a silt loam and toward a fine sandy loam. In places there is only a thin layer of drift resting on a bedrock of limestone, with an occasional outcrop of the bedrock. Because of the small size of the areas it was impracticable to show these variations separately on the soil map.

This soil has the same geologic derivation as the Carrington loam. It differs in the lighter color and the thinner humus layer. The type was originally covered by a thick stand of trees, and the greater part of it is more deeply trenched by stream erosion than the Carrington loam. The lighter color and the thinner surface soil can be accounted for by either or both of these conditions. These types grade into each other, so that where the areas join the line of division is more or less arbitrary.

The Shelby loam is relatively inextensive. It occurs in small separate bodies in association with the other types derived from the Iowan glacial drift, mainly in New Wine, Dodge, and Cascade Townships.

The greater part of the land is used for the staple crops, corn, oats, and hay. Its present productiveness is slightly less than of the Carrington loam and the silt loam types of the Clinton and Tama series.

LINDLEY FINE SAND.

The Lindley fine sand consists of loose or incoherent fine sand, with a depth of 3 feet or more. The surface is light brown or light grayish brown, indicating a comparatively small amount of humus, changing to pale yellow with depth. The color from organic matter extends to variable depths of 5 inches to 20 or 30 inches, depending upon the local topographic situation and modifications due to action of wind.

This type is mapped only in very small separate bodies, from 2 to 50 acres in extent, in association with the Shelby fine sandy loam and Shelby loam. It occurs on small knolls and low ridges and also as accumulations of sand at the bases of slopes. Much of the soil of this character occurs in patches too small to separate and has been included in the areas of Shelby fine sandy loam. The type as a whole is of little importance, since its total area is only 1 square mile.

The soil has low productiveness and is so loose in structure that it is subject to shifting by the wind where it has been placed under cultivation.

CLYDE SILT LOAM.

The surface soil of the Clyde silt loam is a compact silt loam, black and dark slaty gray in color and containing a very high percentage of organic matter. The soil becomes heavier in texture with depth, changing at 4 to 10 inches into a clay loam, which further grades into a drab or mottled yellowish and grayish, stiff, relatively impervious clay. A substratum of sand and gravel, or a moderately pervious drift consisting of a mixture of sand, gravel, and clay, is encountered at depths of 2 to 4 feet. Large bowlders of crystalline rocks are scattered over the surface in places. In virgin areas in the wetter situations there is a thin covering of 1 to 3 inches of black muck. This, however, soon disappears after drainage and cultivaton.

The Clyde silt loam is developed in shallow swales at the heads of drainage ways in the region of Iowan glacial drift. It occurs mainly in separate, small, very narrow, elongated and oval bodies scattered through the areas of Carrington loam. It is relatively unimportant on account of its small total acreage. The land is permanently wet in its virgin condition and supports a dense cover of sedges and coarse meadow grasses.

Artifical drainage is necessary for successful cultivation. Where it has been thoroughly drained by laying tile a short distance apart, it has proved to be productive for corn and hay.

A small area of black peat soil, lying in sections 20 and 21 of Dodge Township, is included with this type. The peat here reaches a thickness of 5 or 6 feet. Thorough drainage is the first step in the reclamation of such soil, followed by the seeding of timothy or some densely growing cover crop, before cultivation for corn is attempted. It is not unlikely that the use of potash fertilizer would be beneficial.

In the areas of this type in sections 31 and 32 in the extreme southwestern part of the county, the soil is a dark-brown silty clay loam to heavy silt loam, underlain by a finer textured clay than is found under the typical Clyde silt loam, and the coarse sand or gravelly clay substratum, if present at all, does not appear within 4 feet of the surface. The slope of the land is greater, so that the soil is naturally a little better drained than the typical soil. It resembles a heavy phase of the Tama silt loam, but is stiffer and more compact and more difficult to plow and cultivate after a rainy period.

GASCONADE LOAM.

The Gasconade loam consists of brown to very dark brown loam and sandy loam underlain by a thin layer of clay or clay loam, resting on limestone bedrock at shallow depths. The loam predominates over the sandy loam. A fine textural discrimination is prob-

ably of little significance in this soil. The thinner variation consists merely of 3 to 6 inches of dark humus soil resting directly on the rock, and in such places outcrop of rock is common. Other variations are characterized by a shallow layer of stiff reddish clay, containing chert fragments, intervening between the surface soil and the bedrock. Locally the soil is almost entirely residual from the weathering of the limestone, but in most places the surface soil is a mixture of mineral particles derived from the drift, loess, and limestone.

The type occurs on ridges, slopes, and knolls where the covering of drift and loess was originally very thin or has subsequently been removed by erosion. It is found in very small separate bodies, from 2 to 40 acres in extent, in the western and southwestern parts of the county, principally within the areas occupied by the lobes of Iowan glacial drift.

Much of the soil is so thin and stony that the land can not be plowed, and therefore is utilized for pasture. Cultivated crops suffer from lack of moisture during dry periods, and for the same reason pasture grasses, such as the native bluegrass, dry sooner and furnish less feed than on the deeper soils of the county. The deeper variations are cultivated where this type forms a part of fields composed mainly of other soils, such as the Carrington loam or Clinton silt loam. Good stands of red clover are obtained, and fair yields of corn and oats.

The results of mechanical analyses of samples of the soil and subsoil of the type are given in the table below:

Mechanical analyses of Gasconade loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
334158	Soil, 0 to 6 inches	0.6	8.9	11.9	28.9	9.8	33.2	6.8
334159	Subsoil, 6 to 10 inches.	3.3	3.7	17.8	30.9	5.4	33.9	5.9

DUBUQUE SILT LOAM.

The Dubuque silt loam consists of a grayish-brown or light-brown mellow silt loam, grading with depth into yellowish silty clay loam, which is underlain at depths of 20 to 36 inches by yellowish or reddish, moderately stiff gravelly clay resting on limestone. The mineral part of the surface soil is derived largely or entirely from loess, whereas the underlying clay is residual from limestone, but in places the loessial soil rests directly on the rock at shallow depths.

This type is confined to steep slopes and rims of bluffs along the larger streams and to the rim and upper slope of the Niagara escarpment, in situations where the covering of loess has been largely removed by erosion or was originally very thin.

From the nature of the topography and origin of the soil, variations in the thickness of the silty covering, the color shades, and the depth to bedrock are to be expected. As a general rule the soil capping the scarps or bluffs has a lighter color, while the underlying clay is stiffer in structure and more frequently is found to be reddish and cherty. Soil at the base of slopes is generally but not every-

where darker in color and is more loamy and pervious, owing to the presence of rock fragments. Because of their occurrence in narrow strips, it was found impracticable to show these phases separately on the soil map. However, most of soil in the areas mapped differs from the Clinton silt loam in having a more clayey subsoil and a higher content of lime or magnesia from the limestone.

On account of the unfavorable topography very little of the land has been placed under cultivation. All of it originally supported a mixed hardwood forest in which white oak, red oak, walnut, elm, and hickory were the most abundant species. Land that has been cleared or partly cleared of trees makes excellent pasture, as a sod of bluegrass quickly takes possession.

In the table below are given the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the type:

Mechanical analyses of Dubuque silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
334101	Soil, 0 to 4 inches	2.8	0.6	0.2	0.8	9.7	71.4	14.5
334102	Subsurface, 4 to 12 inches.	.2	.9	.4	1.7	15.7	65.5	15.6
334103	Subsoil, 12 to 48 inches.	2.3	16.2	7.7	9.9	11.2	37.3	15.3

JUDSON LOAMY SAND.

The Judson loamy sand consists mainly of loosely coherent sand that does not show any material change in texture or structure to a depth of 3 or 4 feet. A brown humus color extends to depths of 20 to 30 inches, below which the sand has a yellowish color. A basal layer of coarse sand is generally encountered at depths of 3 to 15 feet.

Variations in the soil as mapped consist mainly of differences in the shade of color at the surface and the depth to which a color from organic matter extends. In a few places a layer of clayey sand is present within 3 or 4 feet from the surface.

The principal areas lie within the limits of the city of Dubuque and a few miles north at the mouth of the Little Maquoketa River.

The soil represents alluvial detritus deposited probably during the Wisconsin glacial period and existing at present as remnants of terraces or benches along the Mississippi River and its larger tributaries. In the two small bodies at Worthington and at Dyersville, in the western part of the county, the soil is not precisely the same in origin as that along the Mississippi.

A part of the type on the lower part of the terrace at the mouth of the Little Maquoketa River east of Sageville is a dark-brown soil consisting mainly of coarse sand and fine gravel, but containing sufficient finer particles and organic matter to produce a somewhat loamy structure. The subsoil or substratum is also unconsolidated sand and gravel. Owing to the coarse texture and pervious structure at this place, the soil becomes at times excessively dry, but in normal seasons garden vegetables, melons, small fruits, and general farm crops are grown with fairly profitable yields.

The topography of the Judson loamy sand is level or but slightly uneven and hummocky. The soil is nearly always dry and in condition for cultivation, owing to the pervious structure of the material, which permits rain water to percolate downward rapidly.

Most of the land, other than that within the city of Dubuque, is utilized for general farming and for the growing of truck and small fruits. The thorough drainage and sandy, well-aerated nature of the soil in this locality, favoring early warmth, make it especially suitable for growing early vegetables. The average yields of corn, oats, and hay are lower than on the silt soils of the upland or on the lower lying bottom lands.

JUDSON SILT LOAM.

The Judson silt loam consists of a brownish silt loam, mellow or loamy in structure, underlain at 10 to 20 inches by yellowish or buff-colored silt. There is little change in texture with depth, although in general the subsurface soil is slightly more compact and clayey than the surface soil. On the whole this type differs very little in physical aspect from the Clinton silt loam of the upland.

The Judson silt loam occurs on terraces and is similar in geologic origin to the loamy sand type of this series. Probably in this instance more of the alluvium is of local origin or derived from the loess on the adjacent upland.

Only a few small areas are shown on the map, one at the mouth of Catfish Creek, another east of Sageville, and three others along Maquoketa River in the southwestern part of the county. A number of other patches too small to map were found.

The type is used for the general farm crops of the county, and has about the same agricultural value as the Clinton silt loam.

O'NEILL LOAM.

The surface soil of the O'Neill loam is a dark grayish brown or dark-brown loam varying in depth from 8 to 12 inches. In some places a part of the sand content is rather coarse and imparts a gritty character to the soil, but as a rule the sand is of the finer grades. The upper subsoil is a lighter brown, rather coarse loam, underlain at depths ranging from 18 to 30 inches by a loose, porous stratum consisting of coarse sand and gravel, with smaller proportions of fine material. On some of the flatter areas this layer is more variable in composition and in places contains large quantities of silt and also silty layers between beds of coarser material.

The O'Neill loam occupies a small total area. It occurs along the western side of the county, principally in the vicinity of Dyersville and Worthington. A few narrow areas lie along the North Fork of the Maquoketa River, in the southwestern corner of the county.

The O'Neill loam is an alluvial type occupying, in this area, low terraces standing a few feet above the present limits of flooding by the streams. The drainage of the type in all the areas is good. The loose, porous subsoil tends to make this land droughty in very dry seasons, but crops do not suffer in short droughts.

The greater part of this type is improved and under cultivation. Corn and grasses are the principal crops, and good average yields are obtained.

DAVENPORT CLAY LOAM.

The Davenport clay loam is a dark-gray, compact, slightly plastic, silty clay loam to a depth of 3 to 6 inches, where it changes to a fine-grained, stiff, relatively impervious clay which extends to depths of 3 feet or more. The subsoil clay is grayish, yellowish, and chocolate colored and generally calcareous. The substratum to a depth of 15 feet or more consists of alternate layers of stiff calcareous clay and silt or very fine sand.

This type occurs in one locality near Sageville, in Peru Township, where it occupies about 250 acres. It lies on a terrace about 40 or 50 feet above the first bottoms of the Little Maquoketa and Mississippi Rivers. The sedimentary deposit from which the soil is derived is probably a geologic formation of about the same age as the terrace deposits of sand and gravel which underlie the areas of Judson loamy sand a short distance east of Sageville and elsewhere along the Mississippi River. Subsurface drainage is poor on account of the impervious nature of the clay, and tillage is difficult on account of the stiff, plastic nature of the soil when wet. The land is not regularly used for cultivated crops, although the fertility appears to be high. Clover and timothy hay can be grown. A small patch of alfalfa here has been successful. A liberal use of manure would improve the tilth.

WABASH STONY SILT LOAM, COLLUVIAL PHASE.

The areas shown on the soil map as Wabash stony silt loam, colluvial phase, comprise the bluff land along the Mississippi River, the lower course of the Little Maquoketa River, and small patches along some of the other larger streams of the county. The upper slopes consist largely of outcrops of limestone rock, or cliffs on which there are scattered patches of soil. Most of the soil lies on the lower slopes or at the bases of the bluffs and is, therefore, talus or colluvial soil. This is mainly dark-brown silt loam and loam underlain by yellowish-brown clay loam or clay. Rock fragments of the size of stone and gravel comprise a large proportion of the débris and give it a pervious structure. The bluffs are capped with a thin mantle of loess, and more or less of this material has washed down over the slopes.

As compared with the areas mapped as Dubuque silt loam, a greater proportion of the land consists of precipitous rock bluffs, and in general the soil has a darker color, due probably to a higher percentage of humus received by surface wash, or a more complete humification of the organic matter.

The land is valued chiefly for its forest growth, but also has a small value for pasturage. There are small patches of soil at the bases of the bluffs which might be used for growing fruits or for gardens. The talus soil supports a dense stand of mixed hardwoods consisting of white oak, red oak, walnut, hickory, elm, hard maple, basswood, and aspen.

WABASH SILT LOAM.

The surface soil of the Wabash silt loam is a mellow silt loam of dark-brown to almost black color. This material passes gradually into a dark-brown, dark-gray, or mottled brown and gray, heavy clay loam. The type is derived from recently deposited alluvium and occurs along those streams that drain areas of the dark-colored upland

soils. As some of the tributary streams bring down sediment from light-colored soils and carry materials of various textures, there is naturally considerable variation in the color and texture of nearly all the narrow bottoms. In bottoms which are entered by streams from the Clinton types, a thin surface covering of light-colored silt loam lies over the typical black Wabash soil. This is a very recent deposition, and in some cases it has been spread over the older surface since the land has been cleared and cultivated.

The Wabash silt loam occurs on the strips of alluvium which border the small streams in the western part of the county. The very narrow bottoms in the eroded areas are inundated at every slight rise of the streams, but where the valleys are wider the type is covered only by very heavy floods.

The greater part of the Wabash silt loam is under cultivation. Corn is the principal crop, with average yields as high as on the upland. Hay crops and small grains are grown to some extent. Where the type is well drained, it is adapted to alfalfa.

GENESEE FINE SANDY LOAM.

The Genesee fine sandy loam is a light-brown, friable fine sandy loam to depths of 20 to 30 inches, below which the material is generally lighter in color and contains a higher percentage of clay but does not become plastic or impervious. A basal layer, varying from sand to a mixture of coarse sand, gravel, and clay, is generally present at depths of 4 to 8 feet. Variations consisting of a surface soil of sandy loam or very fine sandy loam are included with the fine sandy loam as mapped.

The soil is of alluvial origin. Its sandy nature is due to the fact that the material composing the alluvium has been largely derived from the glacial drift.

This type occurs in very narrow strips of bottom land along some of the streams in the southwestern part of the county. Owing to the small width of the bottoms and the frequency of overflows, very little of the land is cultivated. Bluegrass and white clover grow well and afford good pasturage.

GENESEE SILT LOAM.

The soil mapped as Genesee silt loam consists of light-brown and very dark gray silt loam and loam, underlain at depths between 20 and 40 inches by clay loam or clay. This type occupies most of the bottoms or alluvial lands along the streams of the county other than the Mississippi River. The greater part of the alluvium has been derived from the loess or the loessial soils—the Clinton silt loam and Tama silt loam—and is therefore fine in texture. However, where the streams have cut through the loess covering there is more or less influence from the limestone, and some material has been derived from glacial drift.

Most of the alluvial deposits are 4 to 8 feet deep. Dark colors from organic matter generally appear throughout the whole thickness of the alluvial deposit, and in many places the darkest color, a dark gray or black, appears at 20 to 36 inches from the surface. Stiff clay layers in the alluvium are not numerous. Generally the layer of sand or gravel at the base of the deposit is shallow, if present at all. As

is the rule with soils of alluvial origin, there are numerous minor variations in texture and color, depending upon the position of the soil with reference to the stream channel, the age of the deposit, and the local preponderance of sediment from some one geologic formation.

The strips of bottom land are everywhere narrow, seldom more than one-fourth mile wide and in many places less than 100 yards. The land lies for the most part only 3 to 8 feet above the beds of the streams and is subject to overflow. Most of the land could be farmed without artificial drainage; but a few wet spots occur, and nearly everywhere the grayish color and splotches of brownish and black iron oxide indicative of poor aeration are found at 20 to 30 inches from the surface.

Owing to the small width of the bottoms and the winding of stream channels, fields of a size and shape for the most profitable cultivation can not be laid out, so that most of the land remains uncultivated and is utilized for pasture. Where corn has been grown, the yields in favorable seasons have exceeded those on the upland. Small grain is seldom grown because of its tendency to lodge and the risk of damage from overflows.

The narrow strips of bottom land have been mapped, with some exaggeration in width, well toward the ends of the minor stream branches, particularly those that terminate as shallow drainage swales in which there is no stream channel or at least no more than a ditch cut by storm waters. The soil in such instances is not entirely alluvial, but represents the wash from adjacent slopes deposited in the drainage depressions without having been transported very far. The deposition of such soil has been accelerated since the land has been placed under cultivation. In a number of places filling to a depth of 2 to 3 feet or more was observed as having taken place in a comparatively few years as a result of blanket erosion of the fields. This soil, which consists mainly of wash from slopes occupied by the Clinton and Tama silt loam, is a light-brown to dark-brown silt loam, underlain at depths of 20 to 36 inches by grayish or bluish-black silty clay loam. As a rule it contains a high percentage of organic matter to depths of 3 feet or more and is very fertile. In places this land is wet and requires tile drainage. Excellent yields of corn and timothy and clover hay are obtained. Small grains grow rank and are likely to lodge.

GENESEE SILTY CLAY LOAM.

The Genesee silty clay loam consists of gray and light-brown compact silty clay loam, which grades at depths of 2 to 4 feet into slightly more compact clay loam or silty clay. A lead-gray color splotched or specked with brownish and blackish iron oxide, indicating poor subsurface drainage, appears at shallow depths. A coarser textured basal layer is always present, but is not reached at depths of less than 4 or 5 feet, and in places the alluvium may consist principally of silt or silty clay loam to depths of 8 feet or more.

Some of the soil included in this type is a silt loam, but on the whole it is lighter colored, less loamy, and not as pervious as the Genesee silt loam.

The Genesee silty clay loam comprises the bottom land along the lower courses of the Little Maquoketa River and Catfish Creek and most of the low-lying bottom land along the Mississippi River. In

mapping this type up the valley of the Little Maquoketa River from its mouth, the line separating it from the Genesee silt loam is purely arbitrary.

Most of the land is too imperfectly drained naturally for the best results under cultivation, but it can be farmed without artificial drainage. It lies only 6 to 10 feet above ordinary levels of the streams and is subject to overflow.

Corn is the principal crop. During a favorable season yields of as much as 60 to 70 bushels per acre are obtained. Heavy stands of timothy can be obtained, but the crop is likely to be damaged by high water or tends to become excessively weedy.

The higher land on the islands in the Mississippi River is densely forested with soft maple, ash, and elm, and the lower land is covered with a dense growth of willow. Owing to liability to damage from overflows, very little land has been cleared for cultivation.

RIVERWASH.

Riverwash comprises land in the Mississippi River bottoms, composed of the most recently deposited materials, which vary widely in texture and lithologic character. It includes some low-lying bottom land along the shores of the river and land on the margins and lower ends or points of the islands. The alluvium in these situations consists of loose sand; of alternating thin layers of grayish silt and sand; and of silt or silty mud underlain by sand at shallow depths.

The total area of Riverwash is small within this county, and separation of the various phases is impracticable. Some of it is permanently wet and all of it is subject to overflow. It supports a thicket growth of willows, with more or less cottonwood and soft maple. The land has practically no agricultural value. Some of the low bottom land within the city of Dubuque has been modifided by artificial filling in with earth from excavations and refuse, and the soil is therefore changed from its original condition.

SUMMARY.

Dubuque County is situated in the northeastern part of Iowa, adjacent to the Mississippi River. Its area is 601 square miles, or 384,640 acres.

The topography in general is rolling to moderately hilly, but there is a considerable area of bluffs and broken land along the river. The elevation of the bottom land along the Mississippi River is about 600 feet above sea level, and the elevation of the upland plain ranges from 900 to 1,100 feet, with a few points reaching a maximum elevation of 1,200 feet.

A complete dendritic system of streams has been developed, the multitude of branches penetrating every part of the area and providing thorough natural drainage.

The climate is characterized by mild summers and severe winters. The mean annual temperature is about 48° F. The mean annual precipitation is about 34 inches, the greater part falling as rain during the spring and summer months. Owing to the even distribution of rainfall throughout the growing season, crop failures from lack of moisture are unknown. The average frostless period is 165 days.

A system of live-stock farming and dairying is followed. Corn, hay (timothy and clover), and oats, named according to rank in acreage, are the staple crops. Practically all of the crops grown are consumed on the farms, and the income is derived from the sale of live stock, both hogs and cattle, and dairy products. Modern methods are followed and farmers as a rule are prosperous.

The soils in general are naturally fairly well supplied with humus or organic matter, are moderately retentive of moisture, probably possess fertility equal to the average for the State, and have proved to be durable. Silt loam soils greatly predominate, occupying nearly 85 per cent of the total area; loams and fine sandy loams occupy about 10 per cent, and the remainder is divided among loamy sand, fine sand, clay loam, silty clay loam, and stony silt loam. Three soil types, the Clinton silt loam, Tama silt loam, and Carrington loam, comprise the most important soils in extent and agricultural value.

The Clinton silt loam, including a steep phase, is the dominant soil type. This is a very light brown to brown mellow silt loam, underlain at depths of 10 to 24 inches by a buff-colored, compact, and fairly retentive silty clay loam. The soil is derived from loess. The topography is moderately hilly or rolling.

The Tama silt loam includes the darker colored soil derived from the loess, and is probably naturally the most productive land, but occupies a smaller acreage than the Clinton.

The Carrington loam consists of brown to dark-brown mellow loam to depths of 10 to 20 inches, underlain by yellowish sandy and friable clay loam or clay and a substratum consisting of a moderately pervious mixture of sand, clay, and gravel. The soil is derived from glacial drift. It is utilized for the staple farm crops and is equal in productiveness to the average of the Clinton silt loam.

The Shelby loam and fine sandy loam represent the lighter colored and more sandy soil derived from the glacial drift. The agricultural value of this land is less than that of the dominat types.

The Genesee silt loam and silty clay loam and the Wabash silt loam comprise the greater part of the bottom-land soils. The soils are fertile but are utilized only in part for cultivated field crops because of frequent overflows and restricted width of the bottoms.

The terrace soils are of minor agricultural importance. They include the Judson silt loam and loamy sand, the O'Neill loam, and the Davenport clay loam.

Soils influenced by the limestone underlying the loess mantle and glacial drift are classified as Dubuque silt loam and Gasconade loam.

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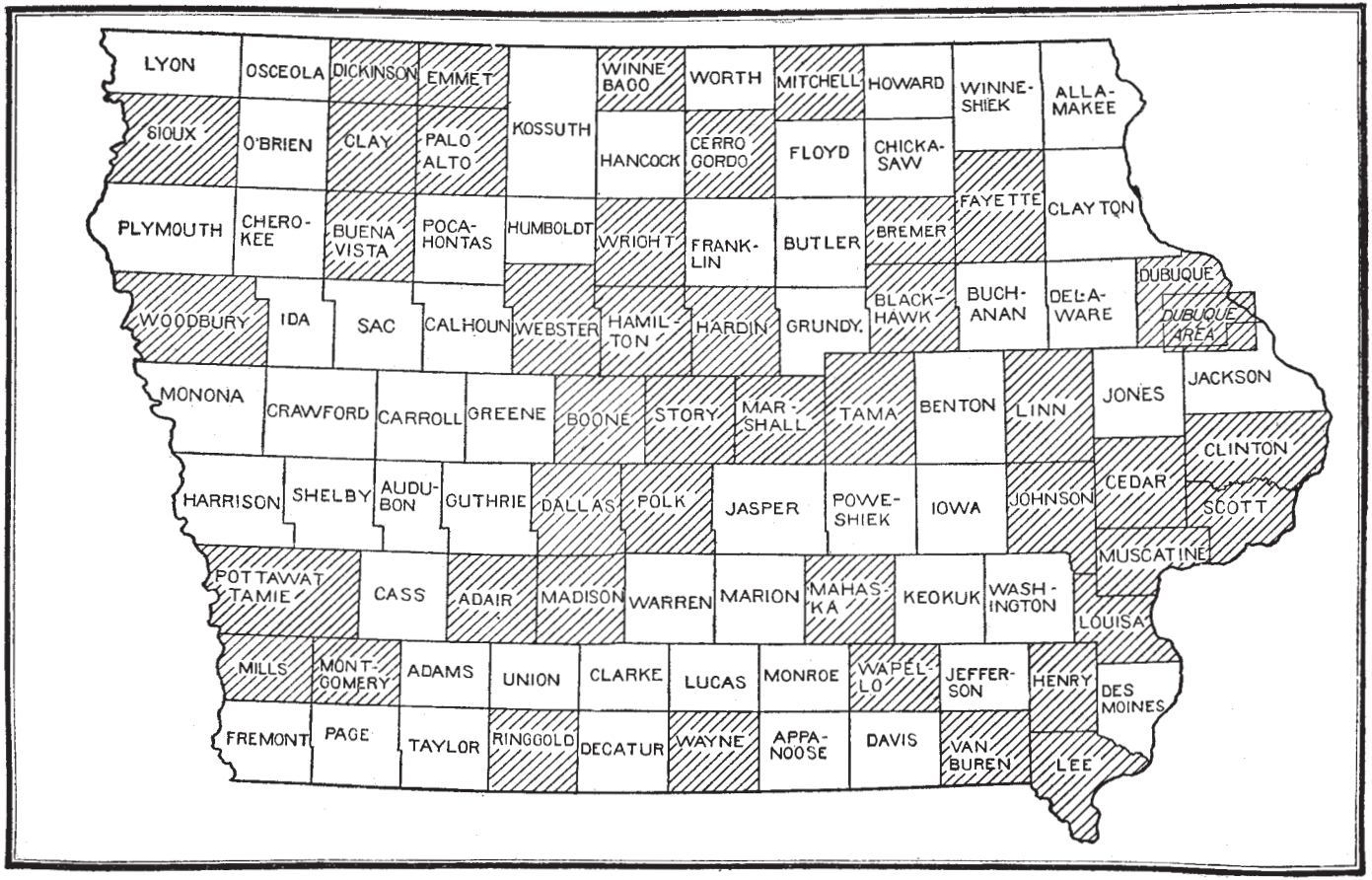

Areas surveyed in Iowa, shown by shading.

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