SOIL SURVEY OF TAMA COUNTY, IOWA.

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LOCATION AND BOUNDARIES OF THE AREA.

Tama County lies nearly in the center of the State of Iowa. It is bounded on the north by Blackhawk and Grundy counties; on the east by Benton County; on the south by Poweshiek County, and on the west by Marshall and Grundy counties. It lies between the meridians of 92° 17′ 30″ and 92° 47′ west longitude, and the parallels of 41° 51′ 45″ and 42° 16′ north latitude, and has an area of 720 square miles.

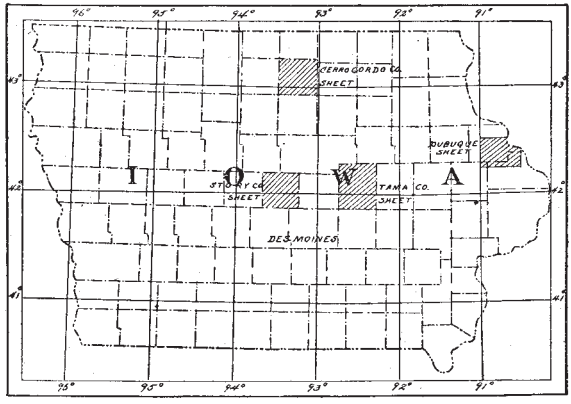

FIG. 32.—Sketch map showing location of the Tama County area, Iowa.

The town of Tama, situated in the southern part of the county, is 270 miles west of Chicago and 220 miles east of Omaha. The main lines of both the Chicago and Northwestern and the Chicago, Milwaukee and St. Paul railways pass through this place.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

Tama County was first settled in 1848, and by 1853 large numbers of immigrants had come in from Ohio, Indiana, and Illinois. There was also some immigration from Europe. In 1853 Tama County was organized, being detached from Benton County.

[a] When about half of the area had been surveyed it was necessary for Mr. Ely to absent himself from the work, and Mr. Coffey was placed in charge of the field work and carried it to completion.

The early settlers were attracted to the timber lands, covered with oak, elm, hickory, and hazel brush, which occupied the hills and bluffs along the Iowa River and other streams in the southern part of the county. These lands offered abundant building material for dwellings and fences, and also afforded protection from the cold winter winds which swept down from the prairie country to the north.

The staple crops of the early settlers were wheat and corn. Flax was also raised to some extent. Sheep were raised for wool, which supplied material for the homespun clothing of the period. Sheep raising was attended with some difficulties, as wolves were numerous and killed many sheep. Many of the settlers depended largely upon game for sustenance.

Prior to the advent of public roads communication in this undeveloped country was very difficult, and each community lived in a state of practical isolation. The first State road in the county was built along the south side of the Iowa River in 1853 and extended from Marengo to Fort Dodge. Dubuque was the early market for the northern half of the county and Muscatine for the southern half. On account of the distance to these points and the inadequate transportation facilities available at that time only a few trips were made annually. The Mississippi and Missouri River Railroad was extended to Iowa City about 1850, and the Chicago and Northwestern Railroad reached Tama in 1863. These two roads assisted very materially in the development of the county. The Chicago, Rock Island and Pacific Railroad reached Traer in 1872. With the advent of railroads settlement increased rapidly, and by 1875 nearly all the land in the county had been taken up and inclosed.

For a time there had been a large amount of timber land along the streams and the prairies had remained untouched. As the country became more thickly settled, however, all the timber land was taken up and the prairies began to be utilized. At first they were used for pasture, but as fast as they could be fenced the sod was broken and crops were planted. In 1875 there were only 75,000 acres of original timber land in the county, and most of this has since been cleared off, so that what now remains is chiefly second growth.

For a great many years after the first settlement spring wheat proved a reliable, profitable, and easily marketed crop, and it was grown year after year on the same soil without rotation until the yields finally fell below the limit of profitable production. In 1875 there were more acres in wheat than in corn. The early settlers raised but little stock, as they had few fences, and were constantly menaced by wolves; but as farms were improved and fences extended the number of farm animals increased, and this created a demand for corn and other feeding grains. Wheat gradually ceased to be grown,

and the chinch-bug plague of 1882 practically put an end to its cultivation in this section. At present some sentiment exists in favor of including it in the system of crop rotation, as it is generally recognized that lack of rotation has been largely responsible for the decreased yields.

The cultivated fruits, especially pears and apples, were grown quite extensively for home use in the earlier days, but in late years few new orchards have been planted and the old ones have ceased to bear, so that very little fruit is seen. An attempt is being made at the present time to grow small fruits for the local markets on some of the hilly areas in the county, and thus far the venture appears to have been quite successful.

Since the decline of wheat growing there has been a tendency to raise more live stock, especially beef cattle and hogs, which are shipped to eastern markets.

CLIMATE.

The following table, taken from the records of the Weather Bureau stations at Toledo, Belle Plaine, and Grundy Center, shows the normal monthly and annual temperature and precipitation for this region. Toledo, the county seat, is a few miles southwest of the center of the county; Belle Plaine is just outside the southeast corner, and Grundy Center is a few miles north of the northeast corner of the county.

Normal monthly and annual temperature and precipitation.

Month.	Toledo.		Belle Plaine.		Grundy Center.	
	Temperature.	Precipitation.	Temperature.	Precipitation.	Temperature.	Precipitation.
	°F.	In.	°F.	In.	°F.	In.
January	19.7	0.81	18.3	1.55	16.5	0.66
February	19.6	.69	20.8	1.21	17.8	.71
March	33.2	1.75	32.0	2.52	30.9	1.61
April	49.9	3.17	45.6	3.70	47.7	3.53
May	61.8	3.71	59.0	4.22	58.3	4.72
June	70.7	3.60	70.3	3.99	66.5	4.91
July	74.9	3.23	73.6	3.42	72.4	3.76
August	72.9	3.15	70.8	3.49	71.0	3.00
September	64.6	2.94	64.1	2.67	63.3	3.20
October	52.4	1.96	50.4	2.23	51.3	2.77
November	35.2	1.41	33.7	1.72	32.1	1.18
December	23.6	1.09	24.3	1.41	22.5	1.21
Year	48.2	27.51	46.9	32.13	45.9	31.26

The total precipitation is somewhat less than the average for the humid section, but its distribution through the growing season produces better crops than might result from a much heavier rainfall occurring more largely in the winter months. Over 70 per cent of

the rainfall occurs during the seven months from April to October, inclusive.

Based on the records of the three stations given in the table, the average date of the last killing frost in spring is May 3, and that of the first in autumn is September 28, which gives a growing season of 148 days.

PHYSIOGRAPHY AND GEOLOGY.

The mean elevation of Tama County above sea level is approximately 925 feet. Berlin, located near the northwest corner, has an altitude of 1,056 feet, and is about the highest point in the county. Dysart, in the northeastern part, and Tama and Chelsea, in the southern part of the county, have elevations of 958, 827, and 789 feet, respectively.

The drainage of most of the two northern tiers of townships is toward the east through Wolf Creek, and ultimately into the Cedar River. Aside from this section, the drainage of the entire county passes into the Iowa River. Sugar Creek drains most of the southeastern portion north of the river, and Deer Creek the southwestern part. The Iowa River flows through the county in a direction somewhat south of east, and leaves it near the southeast corner. Richland Creek, the only tributary of any size south of the river, flows almost directly east. These streams all flow in preglacial valleys excavated from the rock long before the invasion of the glacial ice. Since then these valleys have become partially filled by débris left by this ice, so that at present the streams are characterized by low flat bottoms, much too large for the present volume of the stream, and broken only rarely by sloughs. Through these bottoms the water winds in a series of curves and bends, with occasional cut-offs, this characteristic being especially marked in the Iowa River. Many of these streams have one-sided basins, a large number of long streams entering from one side and a few short streams from the other, while the major stream flows along one side of the basin which it drains. Several explanations have been suggested for this condition, none of which are entirely satisfactory.

The topography of most of the northern half of the county is that of a very gently rolling to almost level prairie. The lesser streams rise in small marshy areas and have cut almost no channels in the surface. Nearly all the draws are wet, even during the summer, and need artificial aids to drainage in order to obtain the best results. Spring Creek, Lincoln, and Grant townships, much of Buckingham, Perry, and Clark townships, and the southern part of Crystal Township are of this character. Geneseo Township is somewhat more rolling. A more or less well defined morainal ridge is found just north of Wolf Creek in this township, and a few scattered hills of

this character, rising from 20 to 40 feet above the surrounding prairie, are seen in the southern portion of the county. Another morainal ridge extends along the north side of Wolf Creek from Traer westward for a distance of 7 miles. Except for these variations, the gently rolling character of the country extends down to the stream bottoms. Along these moraines the bluffs rise from 40 to 50 feet above the stream, and erosion has developed deep gullies and ridges opening toward the stream.

The southern half of the county is much more broken than the northern half. A somewhat sinuous line of hills enters the county near the southwestern corner of Carlton Township and extends a little north of east to Deer Creek, where it follows the Iowan moraine along the creek for a distance of 4 or 5 miles. Between these hills and the Iowa River and Deer Creek the country is rugged and hilly, the bluffs rise from 40 to 70 feet above the bottoms, and the numerous small streams have cut deep V-shaped gullies through the hills, making the country a succession of deep gullies and sharp ridges, though occasionally a flat area, from one-eighth to one-fourth of a mile in width, is found on the tops of the hills. The same is true of the area of Miami silt loam inclosed by Salt Creek and the Iowa River and of other places where it occurs in the county. The most hilly sections of the county, however, are the two areas which have been specifically described.

In the southern part of the county the surface of the Marshall silt loam is more billowy. There is a general absence of the small marshy areas in which the lesser streams take their rise, and natural drainage is better established than in the northern part. A number of scattered rounded morainal hills, rising from 30 to 40 feet above the surrounding prairie, are seen in Howard and Toledo townships. The country south of the river, aside from the bluffy and hilly portions, is characterized by a series of low ridges and rises, running approximately east and west between the streams. Artificial drainage is rarely necessary, except in the bottoms, since practically the entire body of the uplands is rolling enough to carry off the surplus water. However, in the extreme southern portion the country becomes almost level again, and some tile are used in the extreme southern and southwestern sections. A well-marked moraine, 20 to 40 feet high, extends a few miles eastward into the county from the southwestern corner of Indian Village Township. Along most of its course the Iowa River is lined with gullied bluffs; so also is much of the north side of Richland Creek, while in other places the gently rolling or sloping country extends to the stream bottoms.

The basal structure of most of Tama County is made up of rocks of the Lower Carboniferous series. None are exposed except in the

western part of Carlton and Indian Village townships, where some Kinderhook limestone is seen. A small area of Des Moines is also seen in the latter township. Over the remainder of the county the rocks have been buried from 50 to 200 feet deep by a layer of glacial drift and loess. Exposures in other parts of the State, however, indicate that the northeastern corner of the county is underlain by Devonian rock.

This area has experienced three invasions of the ice sheet. The first of these was the pre-Kansan glacier, of which few remains are seen. This was followed by the Kansan, which ground down the rock surfaces, filled up the valleys, and covered nearly the entire county with a layer of drift from 50 to 200 feet thick. This ice sheet carried an immense amount of débris. After its retreat there was a long interval of time in which drainage channels were developed and severe erosion took place. This eroded Kansan drift covered by loess is seen in Carlton Township, in the northern part of Indian Village Township, in the northwestern part of Toledo Township, in nearly all of Carroll and Otter Creek townships, in the western part of York and Salt Creek townships, in the southern part of Richland Township, and in the northern part of Columbia Township.

While a very small part of the soils of this area is formed directly from the Kansan drift, the hilly topography, where it is not covered by the later Iowan, has favored the development of the Miami silt loam rather than that of the Marshall silt loam after the loess was deposited, by giving ready drainage and preventing the wet and slightly marshy condition which must have obtained in the prairie for a long time. In the areas just mentioned it is thought that the topography of the Kansan is much the same as it was before the advent of the Iowan ice. The latter did not cover all of the county, but extended over most of the northern half. A lobe extended down to the river in the vicinity of Tama and Toledo and another reached from Marshall County eastward into Highland Township. This ice did not carry so much drift, but planed down the eroded surface of the Kansan, leaving the country level or only gently rolling and the conditions favorable for the formation of the prairies.

Over the entire county, except in the bottoms, and covering both the Kansan and Iowan drifts, has been spread a layer of almost pure silt or loess from 3 to 30 feet thick. The exact method of this deposition is unknown, but it is thought to be the finely ground-up particles of rock carried by the glacier, which, as it retreated, left deposits to be scattered by the waters and wind, probably in this case largely by the wind. From this covering of loess all the soils in the uplands, except the Miami fine sand and the Marshall loam, have been derived. The Marshall silt loam was formed under slightly wet conditions, which

favored the growth of the prairie grasses and the consequent incorporation of organic matter, while the Miami silt loam was formed under conditions practically the reverse.

SOILS.

Five types of soil were recognized in this area. The actual and relative extent of each is shown below:

Areas of different soils.

Soil.	Acres.	Per cent.
Marshall silt loam	308,288	66.9
Miami silt loam	76,224	16.5
Kaskaskia loam	70,592	15.3
Miami fine sand	3,968	.9
Marshall loam	1,728	.4
Total	460,800	

MARSHALL SILT LOAM.

The Marshall silt loam is distinctly a silty soil and is very uniform. Except for small differences in the content of organic matter and the depth of soil, a sample taken from one place in the area is identical with one taken from any other place. To a depth of from 16 to 24 inches there is a dark-brown, friable silt loam, free from either stones, gravel, or sand. When dry it has a somewhat ashy appearance, but when very wet it is in some places almost black in color. It has a slight plasticity when damp, yet does not bake. Unless stirred at the wrong time it is friable and easily broken up, and farmers encounter no difficulty in preparing it for crops. In some instances the soil takes on a slight reddish tinge below the plow line, which continues to the yellow subsoil. In other cases the soil is exactly the same all the way down. On the more rolling areas, especially in Toledo and Highland townships, the soil has been washed to some extent. The yellow subsoil comes to within 16 inches of the surface, and the ground has a reddish-brown tinge instead of the typical clear brown.

The subsoil is a yellow, slightly clayey silt, slightly plastic like the soil when very wet, but friable when dry and easily broken up. It is similar in texture to the soil, the chief difference being in the amount of organic matter present. The subsoil, when very dry, shows some tendency to break up into angular clods one-fourth of an inch in diameter, and usually cubical in form. This material, generally called "yellow clay" by the farmers, varies from 3 to 30 feet in thickness, the greater part being about 5 feet thick.

The particles of which both the soil and the subsoil of this type are composed are mostly of one size, known as "silt," and intermediate between sand and clay. Even when the clods are exposed to continued rains no particles of sand are seen on their surface. When cultivated the clods are easily broken apart, and the soil is put in a fine condition of tilth. The fineness of the grains of soil is such as to afford a large feeding surface to the roots of plants and enables the soil to hold a considerable amount of moisture. This property is further increased by the organic matter in the soil, and yet, unless very level, the soil permits the water to percolate downward, and even the most level portions are easily drained artificially. To these desirable physical properties the Marshall silt loam owes a very large measure of its productiveness.

Practically all the northern half of the county is covered with this type of soil; also nearly all of the area south of the Iowa River. Lincoln, Grant, Clark, Springfield, and Highland are townships in which almost no other soil type is found. Small areas occur on the crests of hills in the more hilly portions of the county.

The surface of the Marshall silt loam is that of a level to gently rolling prairie. It is more rolling toward the streams and the boundaries of the Miami silt loam. In the more level areas are numerous small seepy and marshy places, and draws, down which at times streams flow. During the greater part of the year these places are too wet to be cultivated and are left in grass. Most of them are comparatively narrow, and one tile drain down the center would fit them for cultivation, at the same time aiding the surrounding land to withstand excessive rains without injury to crops. This is one improvement which deserves the immediate attention of the farmers of Tama County. Something has been done already in this direction, but the work should not stop until every wet, marshy area is tile-drained. Most of that body of the Marshall silt loam lying south of the river is well drained naturally, as its topography is more rolling than that of the northern portion. Even here, however, tile drains judiciously used would prove a paying investment, especially in the extreme southern and southwestern portions of the county.

This soil type is derived by weathering from the loess which covers practically all of Tama County. It was originally covered with prairie grass and its present dark color is due to the organic matter which has been incorporated in the soil. Its level character prevented washing and kept the soil more or less damp, so that decomposition was not very rapid and any organic matter once in the soil remained there for some time. The difference between this type of soil and the Miami silt loam is largely one of organic matter, and this has been brought about by the difference in topography and in

native vegetation. When cultivated for many years without manures or rotation of crops this soil loses organic matter and takes on a reddish tinge, especially when subject to washing. The particles of which this loess is composed are ground-up fragments of rock only partially decomposed, and the separate minerals are easily detected by microscopic examination.

Corn is the principal crop on this type. The average yield is between 40 and 50 bushels per acre, while yields as large as 70 and 80 bushels are often reported. Oats are second in importance, averaging slightly less than corn in the number of bushels per acre. Barley, rye, and wheat are grown to some extent. Hay is an important crop, averaging from 1½ to 2 tons per acre. The Marshall silt loam was formerly considered a good wheat soil, but little is grown at the present time. Some areas are seeded down to pasture. Very little fruit of any kind is seen.

It is difficult to imagine a type of soil better adapted to general farming than the Marshall silt loam. It is an almost ideal soil for corn and oats. Wheat does well where rotation of crops is practiced. Clover and alfalfa are cultivated successfully in some sections.

The following table gives mechanical analyses of typical samples of this type:

Mechanical analyses of Marshall silt loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10858	2¾ miles W. of Traer.	Brown silty loam, 0 to 22 inches.	0.1	0.7	0.4	0.6	5.9	74.2	18.1
10860	½ mile E. of Toledo.	Brown silty loam, 0 to 18 inches.	.1	.5	.4	.9	6.7	66.9	24.4
10862	1½ miles W. of Gladbrook.	Brown silty loam, 0 to 17 inches.	.0	.3	.2	.5	6.4	67.2	25.3
10863	Subsoil of 10862	Yellow clayey silt, 17 to 36 inches.	.1	.3	.1	.6	9.0	68.4	21.6
10859	Subsoil of 10858	Yellow clayey silt, 22 to 36 inches.	.1	.7	.3	.6	9.2	65.6	23.4
10861	Subsoil of 10860	Yellow clayey silt, 18 to 36 inches.	.0	.2	.3	.9	7.0	67.0	24.4

MIAMI SILT LOAM.

On the hills and bluffs along the Iowa River and other streams a different type of soil has been developed, although the material from which it is derived is the same as that from which the Marshall silt

loam has been formed. This condition has also been noticed in other areas, and the names Marshall silt loam and Miami silt loam have been used to distinguish the two types. The Miami silt loam consists of a light-gray, mealy silt loam about 12 inches deep, underlain by yellow, somewhat compact, clayey silt, which is practically identical with the subsoil of the Marshall silt loam. In the field, however, it is apt to be drier, and hence shows a greater tendency to break up into cubical masses. This is more marked during dry weather and in late summer, when it is quite common to find the third foot down very dry and hard.

The type was originally timbered with oak, hickory, elm, maple, and hazel brush. Where this has never been cleared away, the soil from 3 to 6 inches is a light-brown or gray silt loam, similar to that seen in some places in the Marshall silt loam, yet feeling more loose and mealy, and apparently containing more fine sand. Underneath this is a yellowish silt loam of the same texture, but without the organic matter, which is underlain at 8 to 14 inches by the usual clayey silt subsoil. When plowed the two layers of soil become mixed and a more or less uniform gray silt is formed. When cultivated for a few years without manure, the extreme phases of this soil tend to become white and chalky after a few warm, dry days. The greater part, however, is gray in color, except on the badly washed hillsides, where the yellow subsoil has been exposed. Farmers usually speak of this soil as "hills," "clay land," or "timbered land," to distinguish it from the prairie.

Aside from the difficulties due to topography, the Miami silt loam is easily cultivated. The fineness of the particles gives the soil a fair moisture-retaining capacity, but without the stickiness and coherency of a clay. Hence they are easily broken apart unless handled when very wet. This same quality, however, permits easy washing, and the steep hillsides are rapidly eroded if left exposed.

The largest areas of this type are found on the hills north of the river and west of Deer Creek, in Indian Village, Carlton, and Toledo townships; north of the river and west of Salt Creek, in York, Otter Creek, Salt Creek, and Carroll townships, and on the south side of the river in the eastern part of the county. Smaller areas are found elsewhere.

The Miami silt loam occupies the most hilly land in the county. All the smaller streams have cut deep V-shaped gorges from 40 to 70 feet deep, so that a succession of steep hillsides and valleys is presented. Sometimes gorges are seen whose stream beds are dry except immediately after a rain. Occasionally narrow, flat, and rounded hilltops are found almost surrounded by gullies and sharp ridges.

In these cases only the more level hilltops are cultivated, and the slopes are left in pasture. The most hilly areas are those directly north of Montour and Chelsea. Viewed from the top of a ridge, the surrounding country appears to be of the same height. This would indicate that the hills and gullies might have been carved out of a region once nearly level.

This topography would of itself give good natural drainage, even if the slightly open character of the soil did not permit water to pass down to some extent. The soil does not suffer during rainy seasons save from washing. Many farmers claim that for a series of years it will yield as good returns as the other types of soil. When planted to cultivated crops, such as corn, or left untilled, this soil is subject to much washing, and the most careful management is required to prevent damage from this source. Much of it is underlain at no great depth by a sandy or gravelly glacial till, which is not likely to prove so productive as the present soil, and if cultivated to corn it is only a question of time when this underlying material will be exposed in a great many places, to the serious detriment of the land. Gullies, too, may form and damage the fields.

As already stated, the Miami silt loam is derived from the same loess layer which formed the Marshall silt loam. The Miami silt loam was originally timbered land, and the decay of the roots and leaves of the trees did not add so much organic matter to the soil as did the prairie grass which originally covered the Marshall silt loam. The better drainage of the former soil caused more rapid oxidation of what organic matter there was, so that at present the principal difference between the two soil types lies in their topography and in the amount of organic matter which they contain.

Practically the same crops are grown on this type as on the Marshall silt loam. Corn yields from 30 to 50 bushels per acre and other crops in proportion. Probably one-third of the Miami silt loam in the area is still in timber and pasture. A few strawberries are grown on the tops of the ridges, where the topography gives good atmospheric drainage and there is less danger from frosts than elsewhere. The Miami silt loam is well adapted to apples, pears, and small fruits, to pasture, and, in the less hilly portions, to the general crops of the area. Good yields of wheat should be secured from this soil. The steep hillsides should be seeded down to pasture and broken up, if at all, only at long intervals. Much attention should be given to the incorporation of organic matter in the more level portions by the use of manures and by the turning under of green crops. If this were done for several years, the Miami silt loam would become a very productive soil.

The following table gives mechanical analyses of typical samples of the Miami silt loam:

Mechanical analyses of Miami silt loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10870	5 miles NE. of Toledo.	Gray silty loam, 0 to 6 inches.	0.1	0.4	0.3	1.1	13.6	67.6	16.9
10872	3¼ miles N. of Montour.	Gray silty loam, 0 to 12 inches.	.0	.3	.2	.7	9.1	70.2	19.0
10874	7 miles W. of Vining.	Gray silty loam, 0 to 11 inches.	.0	.3	.2	.7	7.4	71.7	19.7
10875	Subsoil of 10874	Yellow clayey silt, 11 to 36 inches.	.0	.2	.2	.4	5.7	72.6	20.7
10871	Subsoil of 10870	Yellow clayey silt, 6 to 36 inches.	.0	.1	.1	.4	9.5	68.3	21.5
10873	Subsoil of 10872	Yellow clayey silt, 12 to 36 inches.	.0	.2	.1	.3	7.8	68.7	22.9

KASKASKIA LOAM.

In the broad bottoms which characterize most of the streams of this area a soil considerably darker than any of the upland types is found. The Kaskaskia loam is a dark-brown loam carrying a comparatively high percentage of silt, which gives it many of the characteristics of a heavy silty loam. This material is from 18 to 36 inches deep and is underlain by a drab heavy loam or silty clay. The soil is deeper along the smaller streams, the depth in most cases exceeding 36 inches. It contains more coarse and fine sand than either of the preceding types, as is readily seen when the clods are exposed to the rain for some time. Its color is darker than that of any other soil within the area and the content of organic matter is greater. It granulates and falls to pieces readily when cultivated at the proper time, yet if plowed when wet forms very hard clods. Roads over this type in winter and early spring and during wet seasons become very muddy and sticky and are sometimes almost impassable. If badly cut up, they become almost as hard as rock when they dry out. It is necessary to rework the roads every spring.

The soil is somewhat more silty along the smaller streams than it is near the larger ones, and is very similar in texture to that of the uplands, from which it is largely formed by wash. That along the Iowa River is somewhat more sandy in the western part of the area than in the eastern part.

The largest body of Kaskaskia loam occurs along the Iowa River, where a strip about 2 miles wide extends the whole length of the county. It also occupies considerable areas along Salt, Wolf, and Deer creeks. Like nearly all alluvial soils, its surface is very flat and level and is only very rarely broken by a small slough. Near the streams the soil is usually well drained and there is no difficulty in producing crops. Closer to the bluffs, however, many of the areas are nearly always wet until late in the year, and on some of them cultivation is rarely attempted. This is especially true of the land along the Iowa River, where the bottoms are so wide and the land so flat that the water running off from the bluffs or falling as rain finds it difficult to reach an outlet to the river. One or two ditches have been dug in an attempt to drain some of this bottom land and a few levees have been built. Most of the farmers, in discussing the question of draining this land, say that drainage is needed only when the river is up, and at such times the drains are ineffective. However, it seems possible that a system of ditches and levees could be established whereby all the land could be drained. Besides these wet places, a few small ponds are seen, in which the water stands nearly all the year. This is more particularly true of the streams in the northern part of the area. The question of drainage for these and other wet places is worthy of careful study by those who own the land.

The Kaskaskia loam is an alluvial deposit left on the bottoms when the streams overflowed, added to, to some extent, near the hills and on the smaller streams by wash from the surrounding types. As these bottoms were once timbered and were more or less damp, the organic matter was not completely removed by decomposition processes, but accumulated from year to year, which accounts for their present dark color. In places the streams show some tendency to cut deeper into the bottoms and form others lower down, but this has not been done as yet, and the streams are only 10 or 12 feet lower than the surface of the soil.

Corn, oats, and hay are the chief crops of the Kaskaskia loam. Corn yields from 30 to 70 bushels and hay from 1 ton to 2 tons per acre. Oats average from 25 to 50 bushels. During favorable seasons the yields are larger, but the average is cut down by overflows and wet seasons. Practically all the smaller bottoms and a good part of the larger ones are left in pasture, especially where they are inclined to be wet. With proper drainage and diking some of these areas could be cultivated and handsome profits realized from certain crops.

The following table gives mechanical analyses of typical samples of the Kaskaskia loam:

Mechanical analyses of Kaskaskia loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10856	2½ miles W. of Traer.	Dark-brown silty loam, 0 to 18 inches.	0.2	0.9	0.8	2.3	12.2	67.6	15.6
10876	¼ mile NE. of Longpoint.	Dark-brown silty loam, 0 to 18 inches.	.1	1.2	1.5	4.7	9.9	59.9	22.7
10878	5½ miles W. of Tama.	Dark-brown silty loam, 0 to 22 inches.	.1	.9	1.7	3.1	10.7	58.7	24.8
10857	Subsoil of 10856	Gray heavy silty loam, 18 to 36 inches.	.3	.9	.8	1.6	9.5	66.0	20.9
10877	Subsoil of 10876	Gray silty clay, 18 to 36 inches.	.2	.7	1.6	6.7	11.6	56.6	22.4
10879	Subsoil of 10878	Gray silty clay, 22 to 36 inches.	.2	1.0	1.8	3.7	9.2	56.7	27.4

MIAMI FINE SAND.

The Miami fine sand is a light-brown or gray loamy fine sand, from 8 to 14 inches deep, underlain by a yellow fine sand of about the same texture as the soil but containing much less organic matter. Sometimes both soil and subsoil are very loose and sandy; at other times, and this is especially true around the edges of areas where the sand grades into other types, it is very loamy and often heavy enough for a light sandy loam. There are one or two places where the soil is loose enough to be blown about by the wind. Here the surface soil is nearly white and organic matter is almost entirely lacking. Most of this type is almost a pure quartz sand, free from either stones or gravel and with very little coarse sand.

The greater part of the Miami fine sand is found on the bluffs and hillsides along the river in the southeastern part of the county. It always occurs in small areas ranging from half a square mile down to 5 acres or less in extent. A few areas are found near streams in other parts of the county. Some are too hilly to cultivate.

The topography of this soil type and its location near streams would give it good natural drainage even were it not for the fact that the texture of the soil permits the ready passage of water through it to such an extent that it does not wash so badly as the Miami silt loam, though the soil is more loose and incoherent. Crops sometimes suffer from lack of moisture.

The Miami fine sand is a wind-blown deposit, which was probably brought down by the waters of the streams at or shortly after the retreat of the Iowan ice and transported to its present place by winds. Some areas are yet blown about by winds. Whenever vegetation gets a foothold and organic matter is incorporated, the soil becomes stationary. This deposit covers the loess, but deposits of a similar nature are occasionally found underneath the loess.

At present the Miami fine sand is planted to the same crops as the other soils of the area. Corn yields from 20 to 40 bushels per acre, oats from 20 to 30 bushels, and other crops in proportion. No hay is produced on this type, but some areas are utilized for pasture with more or less success. This is the only soil type within the county which at all resembles an early truck soil. Watermelons, cantaloupes, early peas, tomatoes, and green corn would thrive upon it. Early Irish potatoes would do well on the more loamy areas. Peaches, plums, and cherries have been grown successfully upon this type at other points. It is quite probable that some of the crops just mentioned would pay better than the grain crops to which this type is at present devoted. Few of such crops, however, are seen within the area, and as there is only a small body of this sandy type it is probable that nearby markets could be found for all the truck produced within the county.

The following table gives mechanical analyses of typical samples of this soil:

Mechanical analyses of Miami fine sand.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10868	3 miles N. of Montour.	Gray fine sand, 0 to 12 inches.	0.1	4.2	15.0	49.2	11.2	15.4	4.4
10866	4½ miles NE. of Toledo.	Gray fine sand, 0 to 14 inches.	.3	5.6	21.9	47.6	7.0	10.3	7.4
10869	Subsoil of 10868.	Yellow fine sand, 12 to 36 inches.	.1	3.0	14.8	49.4	11.8	14.2	6.8
10867	Subsoil of 10866.	Yellow fine sand, 14 to 36 inches.	.1	4.1	19.7	50.2	7.9	10.5	7.5

MARSHALL LOAM.

The Marshall loam, to a depth of 10 to 14 inches, is a rather heavy brown loam, similar in color to the Marshall silt loam, but differing from it in containing considerably more fine and coarse sand. This is underlain by a yellow loam, in which particles of coarse sand and

some whitish sand grains are visible, or by a gravelly yellow clay, and sometimes by an almost pure sand. It is the most variable soil in the area. Occasionally a few stones are found in the soil, and more often in the subsoil, which is an unchanged glacial till. Farmers speak of this type as being underlain by sand in order to distinguish it from the Marshall silt loam, which they say is underlain by clay. Even where the immediate subsoil is a loam, sand may be found at less than 3 feet.

The greater part of this soil type is found in Howard Township, on the tops or slopes of the scattered morainal hills which are a feature of the topography in that section. It also occurs on slopes near streams in other parts of the county. These slopes are generally rather steep. The type is always found in small, scattered areas, ranging from 5 acres up to half a square mile in extent, and is naturally well drained. It is the only soil in Tama County formed directly from glacial drift, and is developed in places where the loess was deposited as a very thin layer or where it has been washed away. Usually some silty material has become mixed with the drift, which gives the soil the characteristics of a heavy loam. The subsoil is practically unaltered drift.

Where the Marshall loam is cultivated corn and oats are the chief crops. Corn yields from 35 to 50 bushels per acre, and oats slightly less. There is not much difference between the yields on this type and those on the Marshall silt loam, save where the subsoil is very sandy, and these places are used generally for pasture.

The Marshall loam is well adapted to general farming. The hilly spots would make good orchard sites, and the steep slopes should be left in pasture. The more level areas would grow fine Irish potatoes and other vegetables. More attention should be paid to incorporating organic matter with the soil.

The following table gives the mechanical analyses of fine earth of typical samples of the Marshall loam:

Mechanical analyses of Marshall loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10881	3¼ miles N. of Toledo.	Brown loam, 0 to 14 inches	0.4	4.3	5.7	10.3	10.2	44.3	24.6
10882	Subsoil of 10881	Yellow loam, 14 to 36 inches	1.6	7.6	11.7	22.2	10.3	25.3	21.1

AGRICULTURAL METHODS.

The methods of farming in Tama County do not differ materially from those practiced in other sections of the Middle West. The chief interest centers in the production of corn, which is the main crop throughout the county. Gang and sulky plows, together with some walking plows, are used to prepare the ground for cultivation. Gang plows are used to a much greater extent on the more level lands. The usual practice is to plow as much as possible of the corn land in the fall, as this materially lessens the rush of work the next spring. The land is then prepared with harrows—disk and tooth—and with rollers. The corn is planted in checks and cultivated from three to five times, the small shovel cultivators being more commonly used.

A large part of the corn is cut for fodder, the corn being husked from the shock and the whole stalk fed to the cattle. Corn binders are coming into use. Sometimes the fodder is shredded, and on account of the great number of live stock kept in the county it is likely that this practice will become more common. Oats are generally sown broadcast and disked in. Barley, rye, and wheat are generally sown with drills. All of these grains are cut with self-binders. Part is thrashed out of the shock, while the remainder is stacked in the field. Where one person has two or more of these grain crops he usually stacks some of them, so that all may be thrashed at the same time. Grass is sown in the oats or small grain. Machines operated by horsepower are in common use for stacking hay. Wherever possible, machinery is made to take the place of manual labor.

The rotation best suited to the needs of this area, according to the more progressive farmers, is corn for two years, oats or small grain one year, followed by grass or clover. A great many farmers, however, make no pretense of following this or any other plan of rotation and grow corn and oats for many years on the same land. Comparatively little clover is grown. In 1900, out of a total of over 390,000 acres in the county in crops, only 1,300 acres were in clover. Very little difficulty is experienced in getting a stand of clover, though there is some danger of damage by freezing. The introduction of more leguminous crops into the rotation would no doubt be beneficial to the land, even to the dark prairie soils. Alfalfa has been grown successfully on the Marshall silt loam, and probably can be grown on most of the other soils in the county, except in the damp places on the bottoms. Rape is also grown to some extent as pasture for sheep and hogs, and seems to do well.

A large quantity of manure is produced within the county. Much of it finally reaches the fields, but as it is first thrown out under the eaves, on hillsides, and in other places where it is exposed to the weather, a considerable part of its original value is lost. Machine

spreaders are in use, but some of the manure is spread by hand. Some of the straw produced on the farms is fed to stock and used for bedding purposes, but a great deal of it is burned. Not very much attention is paid to turning under green crops for manure. The proper use of these crops and the incorporation of organic matter with the soil should be given more attention by the farmers. This is especially true with regard to the Miami silt loam and the Miami fine sand, and even with the Marshall silt loam the humus in the soil should be maintained if the best results are to be expected.

The importance of housing farm machinery and implements is not fully appreciated in Tama County. It is a very common sight to see self-binders and other valuable machines standing out all winter in the fields where they were last used. The manufacturers, taking this fact into consideration, regard the average working life of a binder as not much over thirty days of actual service, which would make its value about $4 a day when used. Housing and caring for these machines would at least double their working life, and it would seem to be a profitable investment to build sheds for them.

Tile drains for the marshy places and drains in the Marshall silt loam would be a step forward. The hills of the Miami silt loam should be seeded down to permanent pastures, and broken up only at long intervals, if at all. If a good grade of stock is kept and pastured on these places, about as profitable returns can be secured as in any other way, and the danger from washing will be removed, while, at the same time, the land will increase in productiveness. When these lands are cultivated, the rows should be made to follow the topography, and terraces should be built at intervals.

AGRICULTURAL CONDITIONS.

Over the greater part of the area occupied by the Marshall silt loam the general appearance of the farm buildings and their surroundings indicates a highly prosperous agricultural community. The average value of buildings on farms, according to the Twelfth Census, is $1,500, but houses alone costing from $3,000 to $10,000, and even more, are not uncommon. On rented land the buildings are not so good and bring down the average value. Where the owners live on their farms few residences of less value than $2,000 are seen. Both residences and barns are usually painted, many looking as if they had been built quite recently. As a rule, the buildings are not quite so good on the areas occupied by the Miami silt loam, but there are many beautiful residences among the hills. Only a few farmers live on the Kaskaskia loam.

Those who came here when the county was first settled have made small fortunes from farming and the rise in land values. Many have

retired from active work, having leased or rented their farms, and now live in the towns.

Practically every foot of the Marshall silt loam can be used for growing crops, and there is no land in the county which can not be utilized for some agricultural purpose. The best lands, when near the towns, can not be bought for much less than $100 an acre. In less desirable localities the price ranges from $70 to $90 an acre. Land on the Miami silt loam and the Kaskaskia loam can be bought for from $50 to $75 an acre. In the last few years, owing to excessive rainfall during the growing seasons, the crop yields have been materially lessened.

Comparatively few farms are mortgaged. Rural telephones are much in use. Cooperative lines, owned by the farmers, are noticed on almost every road, and few farmers in the county are without telephone service. As an investment the farms of Tama County pay a rather low rate of interest unless operated by the owners themselves, because the rent is disproportionately small as compared with the value of the land. Slightly over one-half of the farms are operated by the owners, the remainder being in the hands of tenants, who pay a rental of from $3 to $4.50 an acre, varying with the quality of the land, the improvements, and the distance from markets. A few are operated for a grain rent of from two-fifths to one-half of the total amount produced, according to the amount of seed furnished by each party. The cash-rent system is most common, and in some sections is almost universal.

The average size of farms in Tama County is 161 acres. Quarter-section farms are the general rule, but farms ranging in size from 80 to 640 acres are also seen. Many landholders own as much as 4,000 or 5,000 acres, but these large holdings are always rented out in smaller tracts, usually in quarter sections. The difficulty of securing labor has had some tendency to restrict the size of farms, but this has been offset to some extent by seeding down to grass.

The labor in the area is exclusively white and is secured mainly from among those who were born and reared here, though some Bohemians and Germans are employed. The wages vary from $20 to $30 a month, almost anyone being able to get $20 a month and board, besides the maintenance of a horse. As far as possible the farm work is done by machinery. There is a demand, therefore, for skilled laborers who can handle gang plows, self-binders, four-horse teams, etc., and anyone who can do this seldom has any trouble in securing employment at the higher rates of wages. Most of the labor employed is efficient. At times there is a scarcity of labor, and many farmers have been compelled to seed down their farms because they were unable to obtain sufficient help to cultivate them. As a rule, hands are employed from seven to nine months in the

year, and where a considerable amount of stock is kept they are hired for the whole year. On the smaller farms day laborers are occasionally desired. According to the Twelfth Census, the average expenditure for labor per farm is $85 a year. As this would only pay the wages of one man for three or four months, and as hands are hired for about twice that length of time, it would seem that on about half the farms in the county all the labor is performed by the farmer and his family.

Corn is the principal product of this area. In the year 1899, according to the last census, over 28 per cent of the land in the entire county, or 33 per cent of the improved land, was planted to this crop, which produced 5,341,740 bushels, or an average of 41.6 bushels per acre. Oats are second in importance, occupying from 10 to 15 per cent of the land. The average yield for the entire county is about 35 bushels per acre. Barley and wheat are also crops of some consequence, and a considerable quantity of hay of various kinds is grown. Comparatively little clover is grown. Bluegrass is used almost universally for pasture in the uplands, and it soon forms a dense sod.

Very little fruit of any kind is seen. It is said that several years ago apples and pears were produced in sufficient quantities for home use, but the old orchards have died out and few new ones have been planted. It would seem that more attention should be given to orcharding, especially in the hilly sections. The winters are so severe, however, that only the hardy varieties should be cultivated. Some small fruits, such as strawberries and raspberries, are grown for the local markets in the vicinity of Garwin and at some other points.

Aside from the products obtained directly from the soil, one of the most important industries of Tama County is the raising of live stock, which consists chiefly of cattle and hogs, with a few horses and some sheep. The cattle are mainly of the beef breeds, the Herefords predominating in the southern and the Shorthorns in the northern section of the county, with a few Angus at various places in the area. Very little attention is given to dairying, although there are a few creameries in the area. Most of the hay, grain, and fodder produced in the county is consumed within its limits, being fed largely to the cattle and hogs. Some of the more progressive farmers even buy corn from their neighbors to feed to their stock. The value of the live stock in the county in 1900 was $3,895,000, or $1,425 per farm. A few stock farms of some reputation are found within the area, though it can not be said that the raising of pure-bred live stock has attained much importance as yet. Most of the animals are of a fair grade and many farmers use registered males.

The Marshall silt loam is recognized as being well adapted to corn, oats, and hay and is cultivated to these crops. About the same proportion of the Miami silt loam is planted to the above-named crops.

Some farmers say that the Miami silt loam withstands dry weather as well as the Marshall silt loam and that its topography prevents it from becoming too wet for crops during rainy seasons; hence they prefer it. The danger of damage from washing, however, is much greater on the Miami silt loam. Almost all the bottoms are planted to corn, oats, and hay, except where drainage is needed, and there they are left in pasture. It would be hard to find soils better adapted to general farming than these two types, especially the Marshall silt loam. Tile drainage of the draws and sloughs would, of course, greatly increase the yields of cultivated crops. Strawberries and other small fruits have been grown on the tops of hills and ridges in the Miami silt loam, it being generally recognized that there is less danger of frost on the hills than on the level lands. For the same reason these hills are suited to apples, pears, etc., as the soil is naturally adapted to those crops. Owing to the great danger of damage from washing, all the steep slopes and gullies of this type should be seeded down to grass and left in pasture. Good returns from the land can be secured in that way.

The Kaskaskia loam is well adapted to corn and oats, but a great deal of it would yield larger returns if diked and drained. The Miami fine sand is usually planted to the same crops as the other soils. It is best adapted, however, to watermelons, cantaloupes, and other truck crops, and in the more loamy places to potatoes. The extent of this sandy type in the area is so small that everything produced upon it ought to find a ready market within the county. The possibilities of this soil for truck crops are not yet fully appreciated by the farmers in the area.

Good dirt roads are found on nearly every section line throughout the more level portions of the county. In the hills some attempts have been made to follow the topography, but in many instances the roads go straight down the land lines and up and down hills in such a manner as to render the hauling of heavy loads very difficult. These roads are all made by simply grading up the dirt, clay, etc., which is at hand, there being scarcely any rock or gravel which could be utilized as a road-surfacing material. During the winter and early spring the roads, more particularly on the level prairie and the bottoms, sometimes become almost impassable for heavy hauling. In Indian Village and South townships there are quantities of limestone, which, if crushed, would make a fine roadbed, but this is not utilized at present, even in the immediate vicinity of the quarries. The main roads are graded up again every spring, and when once dry are good throughout the summer.

Branches of four railway systems touch Tama County. The main lines of both the Chicago and Northwestern and the Chicago, Milwaukee and St. Paul railways, from Chicago to Omaha, pass through

the southern part of the county. From Tama and Belle Plaine branches of the Chicago and Northwestern extend northward across the eastern and western sections of the county, respectively. The Chicago, Rock Island and Pacific Railroad crosses the northeast corner of the county and the Chicago and Great Western Railroad the northwest corner. This leaves a large area in the center of the county untouched by any railroad, and many farmers in that section have to drive 8 or 9 miles to reach a shipping point.

Tama and Toledo are the largest towns within the area. Tama has a population of about 2,800, while Toledo has about 2,300. Chicago is the great market for the products of this county. Grain elevators are found at nearly all the small towns and stations along the railroads. Live stock is loaded on the cars and shipped direct to Chicago. The transportation charges are of course high—the distance is 270 miles—and reduce somewhat the profits of the farmers.

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