

SOIL SURVEY OF STORY COUNTY, IOWA.

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LOCATION AND BOUNDARIES OF THE AREA.

Story County occupies the geographical center of the State of Iowa. Its area comprises 16 townships of 36 square miles each, making a total of 576 square miles, or 368,640 acres. The county is bounded on the north by Hamilton and Hardin counties, on the east by Marshall County, on the south by Polk and Jasper counties, and on the west by Boone County.

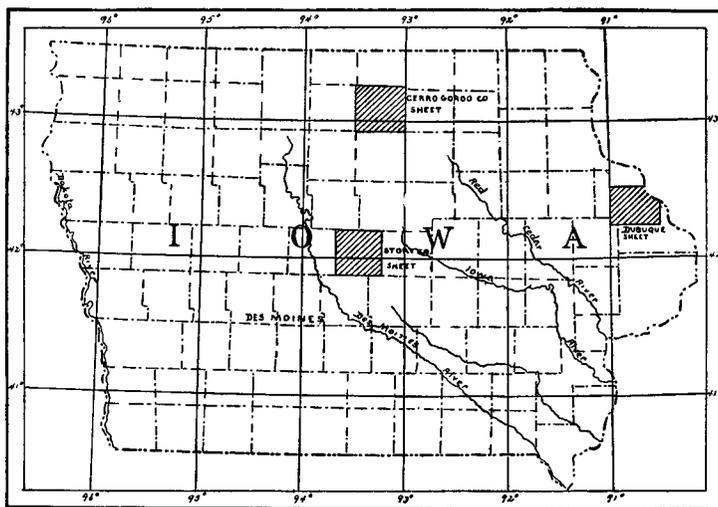


FIG. 41.—Sketch map showing location of the Story County area, Iowa.

Nevada, the county seat, is a town of about 2,500 people, situated on the Chicago and Northwestern Railway. It is about 320 miles from Chicago, 175 miles from Omaha, and 35 miles from Des Moines, which lies directly south of it. At Ames, in the western part of the county, is located the Iowa State College and Agricultural Experiment Station.

The county is favorably situated with respect to markets for its agricultural products, and is amply supplied with railroads for the transportation of these products. The Chicago and Northwestern, the

Chicago, Milwaukee and St. Paul, the Iowa Central, and the Des Moines, Iowa Falls and Northern railroads all traverse the territory of Story County.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

This territory was first opened up to white settlement by the treaty with the Indians known as the "Black Hawk purchase," which took effect in 1833. The greater part of central Iowa was made available for occupancy by the whites in 1846, when the Indian tribes were removed to their Kansas reservation. The first settlement was made at Ballard Grove in 1848, but it was not until 1850 and the year or two following that there was any great demand for the choice claims in Story County.

Instead of settling upon the open, treeless prairie, where farms were already cleared for them, the pioneers chose sites along the wooded borders of the streams, where water was plentiful and wood for fuel and building could be obtained. As is usually the case, the tide of immigration followed up the courses of the streams, and the land along their borders was occupied long before any settlements were made in the open inland country. Indeed, it was thought at that time that the open prairies, covered by tall grass and annually swept by fierce prairie fires, were not fit for agricultural purposes and would never be settled. But in the early fifties a tide of immigration swept into the country, and most of the land was taken up, either by farmers or by nonresident speculators.

From that time to the present the agriculture of the county has been marked more by steady and rapid growth than by any great changes in character. Corn and wheat were the first crops grown, and corn is still the principal crop of the county. For a time wheat was quite extensively grown, but as conditions are said not to favor this crop, and as the yields of spring wheat became comparatively small, its place was largely taken by corn and oats. The live-stock industry has steadily increased, and in recent years dairying has become quite an important industry in some sections of the area.

CLIMATE.

The climate of Story County is characterized by the wide variations in temperature common to inland countries beyond the influence of that great regulator of temperature, the sea. The precipitation, though none too abundant, is well distributed throughout the growing season and is adequate for the growth of all crops commonly raised in humid climates. The table following shows the normal monthly and annual temperature and precipitation for Ames, which is within the county, and for Iowa Falls, which lies a short distance to the north,

Normal monthly and annual temperature and precipitation.

Month.	Ames.		Iowa Falls.		Month.	Ames.		Iowa Falls.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	° F.	Inches.	° F.	Inches.		° F.	Inches.	° F.	Inches.
January	15.8	1.04	12.2	0.91	August.....	72.0	3.40	69.0	2.92
February	22.4	.92	17.2	.83	September ..	59.6	3.71	62.5	2.99
March	32.4	1.39	31.7	1.26	October	49.9	2.34	48.0	2.26
April	49.1	2.85	47.0	4.22	November ..	31.8	1.22	29.7	1.35
May	59.0	3.84	59.0	3.68	December...	21.8	.99	21.0	1.10
June.....	70.0	4.44	68.7	3.62	Year...	46.9	30.59	44.9	27.96
July	79.5	4.45	72.3	2.82					

PHYSIOGRAPHY AND GEOLOGY.

The bed rock underlying the whole area of Story County belongs to the Carboniferous period. The Upper Carboniferous, or Coal Measures, forms the rock of fully seven-eighths of the county. These rocks consist mainly of shales, fire clays, and argillaceous sandstones, with thin beds of slate and coal. In the middle western part of the county an arching of the crust has brought the lower strata nearer to the surface. Here erosion has removed the greater part of the Coal Measures, leaving the Subcarboniferous or St. Louis limestone to form the bed rock. All of these hard strata are so deeply covered by the mantle of unconsolidated material that they have had little or no direct influence upon the soil formation of this area. In only a few isolated cases are they exposed to view by the deep cutting of stream erosion.

Although Paleozoic geology has played so small a part in determining the character of the soils in Story County, the relation of the soils to Pleistocene geology is most intimate. All the soils of the area may be said to be of glacial origin. The upland soils are primarily so, while the alluvial soils of the stream bottoms are merely the glacial drift from the uplands reworked by stream action, and may thus be considered of postglacial origin.

During comparatively recent geological time the whole of the northern part of the country was subjected to an invasion of ice from the north. A great continental glacier, such as now covers the continent of Greenland, is known to have spread over the northern part of the continent, bringing with it great quantities of earth and rock which it picked up along the way. Upon the melting of this ice sheet the earthy material was deposited in a thick mantle over the surface of the country, in many cases entirely altering the aspect of the natural features. In Story County the thickness of this covering of glacial debris is from 100 to 300 feet. It seems difficult to conceive of a glacier bearing so great a load of debris as this, but it should be borne

in mind that not one but several invasions of the ice sheet, separated by considerable periods of time, are supposed to have taken place.

Viewed broadly, the surface of Story County is a level plain. Its average elevation above sea level is about 1,000 feet. The greatest elevation is reached near Summit, at a point on the Gary Moraine, which is 1,075 feet above tide, and the lowest level is reached in the valley of the Skunk River, where that stream leaves the county at an elevation of 830 feet above sea level. Kamelike eminences occur quite frequently in the moraine belts and, rising in groups of gravelly knolls, form a salient feature of the landscape in some sections of the county.

The drainage features of the area may be described as extremely immature. It needs but a casual glance at the surface of the county to see that the present stream system is entirely inadequate to carry off the annual rainfall. The main drainage systems are the Skunk River, with its tributary, Squaw Creek, and Indian Creek, which flows into the Skunk River beyond the limits of the county. Skunk River, in the southern part of the county, occupies a broad, level valley and meanders widely upon its flood plain. Here it undoubtedly occupies a preglacial drainage valley, which has been filled in to a depth of 100 or more feet by glacial and fluvial material. Above Harmonies Mill, however, the valley shows more signs of youth and the river seems to be active in deepening its channel rather than broadening its flood plain. This part of its course is probably of postglacial formation.

A glance at the map will show that tributaries to these main streams are comparatively few, in marked contrast to those regions in which the drainage features are fully developed and the surface of the country is covered with a network of ramifying streams and brooks. In Story County the great ice sheet has left the surface of the prairie with a gently rolling topography. Low knolls are separated by saucerlike depressions, in which emponded water often stands the year around. In many cases these low-lying areas have been reclaimed by artificial drainage, but in the main the rainwater which falls upon the uplands has to escape by seepage or evaporation. Little ponds and marshes are found in almost innumerable places scattered all over the county. In a number of cases small undrained areas were observed almost within a stone's throw of one of the main stream courses, showing how little headway erosion has made in re-establishing the natural drainage since Glacial times.

SOILS.

Six soils were recognized and mapped in the area surveyed. Of these one type, the Marshall loam, covers over 82 per cent of the area, the remaining five types thus covering less than 20 per cent. The

names and the actual and relative areas of these soil types are given in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Marshall loam.....	303,808	82.4	Marshall clay loam.....	8,384	2.3
Miami black clay loam.....	21,952	6.0	Marshall fine sand.....	3,072	.8
Meadow.....	18,048	4.9	Total.....	368,640
Miami clay loam.....	13,376	3.6			

MARSHALL LOAM.

The Marshall loam is a mellow, black soil, varying considerably in mechanical composition. It always contains a relatively high percentage of humus, but the amount of this material also is subject to some variation. Typically the soil to a depth of 18 inches is a black sandy loam, heavy when wet, but mellow and friable when dry. It contains a higher percentage of clay than most soils classed as sandy loams, but there is enough of the coarser grades of sand present to give it a distinctively sandy character. At an average depth of 18 inches the material becomes lighter in color, changing from a black to a brown and finally in the deep subsoil to a pale yellow clay with a considerable admixture of coarse sand, pebbles, and sharp fragments of decomposing rock. Concretions of calcareous matter and some iron nodules are frequently present in the subsoil.

From this average of the type the soil varies on the one hand to a shallower, more sandy phase, found on the crests of the little knolls which characterize the surface of the Marshall loam. On the other hand, the soil is found to be deeper and heavier in the many little saucerlike depressions which lie between the knolls of lighter soil. Here the black humus soil may extend with practically no change to a depth of 3 feet or more.

A phase of the Marshall loam occurs in small areas in some of the moraine districts, but these are not sufficiently extensive or important to class as a new type. The topography is generally more rolling and the sand a little coarser and more abundant. Gravelly areas of from 1 to 4 or 5 acres in extent occur scattered through the small areas of this phase. Upon the soil map the localities in which this gravel is likely to occur are outlined and indicated by the conventional gravel symbol. It should not be understood, however, that all that portion of the map covered by the symbol is characterized by a gravel soil, but only that within such areas frequent small patches of gravel may occur.

When carefully handled the Marshall loam soil is friable and not difficult to work, but after heavy rains and where the drainage is inadequate it sometimes becomes necessary to use the plow before the

soil has sufficiently dried out. This is sure to be followed by baking and clodding, and should be avoided as far as possible.

The Marshall loam is found in every part of the area, covering about four-fifths of Story County. In general it occupies level or gently rolling prairie. Differences of more than 25 or 30 feet in elevation are rare, although in the regions of the glacial moraines small kame-like eminences occur, which rise to a considerable altitude above the surrounding prairie.

The origin, physiography, and drainage features of this soil are very intimately related to each other. The material was originally derived by glacial action at the time of the great Ice Age. In its retreat the ice sheet left a mass of *débris* of somewhat uneven thickness, covering the entire surface of the country. This great mass of material upon settling assumed the slightly hummocky surface which is now seen to characterize the prairie regions. The consequence was that there were innumerable little saucer-shaped depressions which had no natural outlet for the draining off of surface waters.

Sufficient time has not elapsed since the Glacial period to correct this defect of drainage, although agencies are now at work establishing a natural drainage system. With each fall of rain some of the material from the knolls is carried down and deposited in the low spots, and it is only a matter of time—long as we count time, but short from the geological viewpoint—until a perfect grade will have been established and the surplus water will be carried off over gradual slopes.

The farmer of to-day has to meet this problem of drainage, and there is perhaps none more serious for the Story County farmer. Texturally, the Marshall loam is not a poorly drained soil, but no soil except one undesirably porous would be well drained under similar conditions of topography. More will be said of this matter under the chapter on drainage.

In general it may be said that nearly every agency which has operated in the formation of this soil has contributed to make it a productive one. In the first place the glacial till of which it is composed has been derived from so wide a range of country that practically all of the elements necessary for the formation of a strong soil are present. The soil contains a large amount of lime. Lime—calcium carbonate—is comparatively soluble in soil water and is one of the first components to be leached away in the decomposition and disintegration of rocks in the process of soil formation. But upon this soil, where the surface has been laid bare by cultivation, a white crust of calcium carbonate often appears as the soil dries after a soaking rain, and evaporation brings the salt-laden waters to the surface.

The level surface and rank growth of prairie grass and other vegetation which the soil sustained previous to its occupation by man has resulted in the accumulation of a large amount of vegetable matter.

This organic matter decomposing has formed the black humus and gives the black color which is so characteristic of all the soils of the area. It gives to the soil its friable, loamy structure, adds warmth, keeps it open and porous so that soil atmosphere can circulate, and helps to retain moisture in the soil.

The Marshall loam is adapted to a wide variety of crops. It is eminently well suited to most of those now grown, chief among which are corn, hay, and oats. The conditions are ideal for the production of corn and grass, and these crops are more extensively grown than any others. The average yield of corn is 40 or 45 bushels per acre, with occasional yields of 75 or 80 bushels. Timothy does very well, and a great deal of clover is also grown. There is some trouble from the latter freezing in severe winters, especially when it is used for fall pasture and is grazed too close. A common practice is to sow timothy and clover together, which gives very satisfactory results. A large acreage of oats is sown on this soil each year and the average yield is about 40 bushels per acre, varying from 25 to 60 or 70 bushels, according to the season. It is generally felt, however, that conditions are not altogether favorable for this crop. Straw is made at the expense of grain and there is considerable trouble from lodging.

In the past a good deal of spring wheat was raised on this soil, but as the average yield fell off from year to year and the trouble from rust increased, this crop was gradually replaced with corn and oats.

Winter wheat does well where it withstands the severity of winter freezes. It is thought that with the selection of hardy varieties and by choosing the more protected fields winter wheat might be profitably introduced.

Bluegrass and white clover thrive upon the Marshall loam, and pastures of these make excellent grazing for stock. On some areas considerable dairying is carried on, and the conditions seem to be very favorable to this industry.

Apples, plums, cherries, grapes, and all kinds of small fruits do well upon this soil, and it produces good yields of all those varieties of vegetables which are adapted to the climate.

The table following shows the texture of the fine earth of typical samples of the soil and subsoil of this type.

Mechanical analyses of Marshall loam.

No.	Locality.	Description.	Organic matter.	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.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
8786	1 mile N. of Nevada.	Black sandy loam, 0 to 18 inches.	1.73	1.72	7.52	9.12	19.62	13.82	24.30	23.60
8788	4 miles E. of Ames.	Sandy loam, 0 to 16 inches.	2.08	1.50	6.38	7.96	19.38	16.28	23.20	24.60
8790	2 miles E. of Nevada.	Heavy sandy loam, 0 to 18 inches.	4.47	1.70	5.86	6.42	15.76	12.66	30.60	26.60
8787	Subsoil of 8786....	Sandy clay loam, 18 to 36 inches.	.99	2.16	6.98	8.38	21.10	14.28	25.20	21.94
8789	Subsoil of 8788....	Sandy clay loam, 16 to 36 inches.	1.43	1.30	7.60	9.00	20.64	14.64	22.04	24.46
8791	Subsoil of 8790....	Clay loam, 18 to 36 inches.	1.00	1.50	5.80	6.40	16.00	12.94	23.58	28.64

The following samples contained more than one-half per cent of calcium carbonate (CaCO₃): No. 8787, 4.31 per cent; No. 8789, 0.87 per cent.

MARSHALL FINE SAND.

The Marshall fine sand is a rather incoherent black or dark-brown fine sand from 10 to 18 inches deep, underlain by loose, incoherent fine sand, orange or yellowish in color and very uniform and homogeneous in texture. Where an unusually large amount of organic matter is present the soil takes on a loamy character, and is marked by more coherency than in other cases. This is considered a desirable phase, as the soil is more retentive of moisture and not so liable to suffer in times of drought.

The Marshall fine sand is the black prototype of the Miami sand of the Central States. It is similar in texture and occurrence, differing chiefly in the high percentage of organic matter which it contains and the characteristics consequent upon this property. Its area in Story County is quite limited, covering in all but 3,072 acres. It extends in a narrow strip about half a mile wide along the border of the Skunk River Valley, forming the low bluffs which bound the river flood plain on the east. With the exception of a few small areas east of Indian Creek in the neighborhood of Maxwell the Marshall fine sand is found in no other parts of the county. The topography is broken and rolling, being cut into by frequent small streams which find their way across it to the Skunk River. Generally it extends to the foot of the bluff, and is bordered on the west by the Miami black clay loam of the river flood plain, but in a few cases it is separated from the latter by a talus slope of Marshall loam formed by the mingling of materials of the bottoms.

This soil formation attains its maximum thickness at the bluff front, where it is from 25 to 40 feet thick. From this the depth of the sand decreases back from the stream bottom until it becomes merely a veneer covering a heavier subsoil, which is met with 2 or 3 feet from the surface. In such areas the soil is less perfectly drained, and is not so apt to suffer for lack of moisture. In those areas where the depth of loose sand is very great the natural drainage is so complete that in dry weather it is impossible for the soil to maintain capillary connection with the stores of underground moisture.

The origin of this soil is somewhat obscure. It is safe to say that it is primarily of glacial origin, but just what has been its mode of formation, by what process it has been sorted out and laid down in its present position, it is not so easy to explain. It is composed chiefly of quartz sand rather fine in texture, mixed with humus. The sand is considerably rounded, showing water action, but it is doubtful whether it was deposited in its present position by the agency of water. Evidences seem to point to its being of æolian origin. The prevailing winds of this region are from the west and northwest and probably have been for past ages. It is not difficult to conceive that these winds in crossing the valley of Skunk River have picked up and borne along the sands washed down and deposited upon its banks in flood time. Strips and patches of light, loose sand are to be seen to-day lying along the borders of the stream course unprotected by any covering of vegetation and easily available to these western gales. These winds would receive a check to their velocity upon reaching the bluffs to the east, and so would drop their burden there, as a stream of water drops its load when the velocity of its current is retarded.

The crop value of the Marshall fine sand varies considerably according to its relation to moisture. Where the sand of the subsoil is very deep it produces poor crops except in the wettest seasons. Where the heavy subsoil is met at no great depth—i. e., toward the eastern border of the area, the crop yields compare very favorably with those of the county as a whole. All things considered, however, this type is regarded as one of the least desirable in the area, and is not well adapted to corn or grass. Of the grain crops, rye yields best, producing on an average about 20 bushels per acre.

The Marshall fine sand is a typical early soil adapted to potatoes and other market-garden produce, and especially to melons. Its adaptability to melon growing is recognized, and one or two farmers are engaging in the watermelon industry. From them it was learned that returns of from \$30 to \$50 an acre are realized. The melons are carted to nearby towns, and the surplus is shipped to neighboring cities by the carload. Occasionally there is a failure of the crop due to a cold, wet season following the plowing, which causes the young vines to rot, but this is only in exceptional years. It is to be won-

dered at that more of the farmers owning fields of this soil type do not follow the lead of the few successful growers now engaged in the industry.

As before stated, the soil is well adapted to potatoes, small patches grown for home consumption showing a yield of from 200 to 250 bushels per acre. After potatoes and melons, which require considerable manuring and intensive cultivation, all crops produce good yields. Clover seed is another product peculiarly adapted to this type. The yield of hay is not so heavy as on other soils, but it is claimed that almost double the yield of seed is produced.

The following table shows the texture of typical samples of the soil and subsoil of this type:

Mechanical analyses of Marshall fine sand.

No.	Locality.	Description.	Organic matter.	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.
				<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
8804	1 mile E. of Cambridge.	Medium, loamy sand, 0 to 9 inches.	1.30	0.56	2.18	7.66	57.76	21.46	4.20	5.88
8802	3 miles N. of Cambridge.	Medium sand, 0 to 8 inches.	1.20	.30	3.10	12.80	57.30	14.40	6.00	6.10
8803	Subsoil of 8802....	Loose medium sand, 8 to 36 inches.	.92	.40	3.44	14.80	57.64	13.04	5.34	5.30
8805	Subsoil of 8804....	Medium sand, 9 to 36 inches.	.32	.00	1.10	6.90	55.10	26.70	4.18	5.46

MARSHALL CLAY LOAM.

As found in Story County the Marshall clay loam is not an important soil type, covering in all 8,384 acres, or 2.3 per cent of the total area of the county. In neighboring areas, however, it is a type of great extent and importance.

The soil to a depth of 14 inches is a black or very dark-brown loam, mellow with organic material and containing a considerable amount of very fine sand. This is underlain by a dark-brown clay loam, which becomes a stiff yellow clay at a depth of about 24 inches. The subsoil contains a few coarse fragments, but these are not nearly so plentiful as in the Marshall loam subsoil.

The Marshall clay loam in some respects is similar to the Marshall loam. The soil is generally rich in organic matter, but is shallower and less sandy, a typical loam in texture. Though it contains less of the coarser sands than the Marshall loam, it seems to be more friable and less liable to bake into hard clods. This is probably due in part to the fact that it contains a larger proportion of very fine sand and silt.

The only occurrence of this type within Story County is in Lincoln

Township, in the neighborhood of Zearing, where it covers about 13 square miles. It is a glacial soil, formed in the same manner as the Marshall loam; but the thickness of the drift is much less than in the case of the Marshall loam, and it is probable that the underlying limestone rock, ground up and mingled with foreign material by the glacier, forms a large component of the soil.

The physiographic features of this type, though not marked, differ in some important respects from those which characterize the areas of Marshall loam. The surface of the country is broadly rolling, with better developed drainage lines, and the kettle-hole depressions and boggy spots, so characteristic of the sandy loam areas, are replaced in this type by broad, gentle slopes, insuring a good condition of drainage.

The crops chiefly grown on this soil are corn, oats, and hay. The soil is an ideal corn soil and the yield from year to year will average 50 bushels per acre. Grass is grown extensively, the yield of hay being about 2 tons per acre for timothy and clover. Considerable dairying is carried on in this locality and the conditions seem to be very well adapted to this industry.

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

Mechanical analyses of Marshall clay loam.

No.	Locality.	Description.	Organic matter.	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.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
8792	2½ miles E. of Zearing.	Loam, 0 to 14 inches..	3.38	1.10	3.80	4.30	13.10	19.00	31.58	26.60
8794	1 mile W. of Zearing.	Loam, 0 to 14 inches..	4.16	.60	3.10	3.60	8.80	10.30	40.24	32.52
8793	Subsoil of 8792....	Clay loam, 14 to 36 inches.	.89	1.20	4.92	4.44	12.36	19.06	31.80	26.08
8795	Subsoil of 8794....	Clay loam, 14 to 36 inches.	.38	.80	3.56	3.68	9.28	12.08	36.60	31.50

MIAMI CLAY LOAM.

The Miami clay loam is that type of soil which is often spoken of locally as the "clay hills." It is one of the less important soils of the county, covering in all about 13,376 acres. The soil is quite variable, but generally consists of a brown or grayish sandy and silty loam of considerable coherency and a peculiar mealy feel. Sometimes a layer of 2 or 3 inches of humus is found upon the surface, but there is never a very large amount of organic matter present, a fact which distinguishes this soil from all the other types in the area. The soil, which is from 5 to 8 inches deep, is underlain by sticky sand passing quickly into stiff, reddish-yellow clay. The subsoil differs little from

that of the Marshall loam, being the glacial clays of the drift. Though stiff and heavy, it is full of coarse fragments and pebbles, giving it a gritty texture. On some of the steeper slopes the soil has been entirely removed by erosion, and the clay subsoil is exposed at the surface. This fact, together with the slight depth at which the heavy subsoil is met, is the reason for its being locally called a "clay," though it is usually mantled with a thin coating of sandy soil.

This type is found along the hills bordering Skunk River and Indian Creek and their tributaries, where it is characterized by the most broken and rolling topography to be found in the county. It is glacial in origin, but owes its difference in character from the other glacial soils to its rugged topography and the character of the vegetation it has sustained. Because of its position it is a better drained soil than the Marshall loam, and consequently there has been less accumulation of vegetable matter, the more active erosion having a tendency to carry away the organic matter before it could become mixed with the soil. It is probable, moreover, that the fact that this soil was all covered with timber while the open prairie sustained a heavy growth of grass accounts in great measure for the difference in soil character.

The Miami clay loam is used almost exclusively for woodlots and pasturage. In a few localities there are fruit orchards upon this type, and the conditions seem highly favorable for apples, plums, and cherries. Little of it is cultivated to grain and grass crops. The yields of these are below the average for the county, and because of its hilly character it is not so well adapted to cultivation. Pasture grasses thrive remarkably well upon this soil, and as wood for fuel or lumber is exceedingly scarce in this part of the country, it is wisdom on the part of the farmer to maintain these groves, which can at the same time be used for grazing purposes.

The following table shows the texture of typical samples of the soil and subsoil of this type:

Mechanical analyses of Miami clay loam.

No.	Locality.	Description.	Organic matter.	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 0.06 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
8796	1 mile S. of Nevada.	Sandy loam, 0 to 5 inches.	2.28	2.70	8.04	8.84	25.64	17.68	21.90	14.28
8798	2 miles W. of Ames.	Sandy loam, 0 to 6 inches.	1.90	1.60	6.06	7.06	17.06	14.00	38.20	15.50
8799	Subsoil of 8798....	Clay, 6 to 36 inches..	.79	2.50	6.22	6.52	15.52	13.64	35.20	19.60
8797	Subsoil of 8796....	Clay, 5 to 36 inches..	.57	2.36	7.86	10.36	24.06	16.16	18.56	20.50

MIAMI BLACK CLAY LOAM.

The Miami black clay loam as it is found in Story County occurs in two phases differing slightly in character and position. The bottom land phase, which is the most extensive and important, is found along the alluvial floor of Skunk River and a few of the smaller streams. It is a heavy black loam or clay loam about 15 inches deep, underlain by a subsoil of similar character but rather more clayey and compact. The black color, which is due to the presence of a large amount of humus, extends to a great depth and shows little variation to a depth of 3 feet or more, though sometimes it changes to a dark drab or bluish gray at a greater depth. The soil seems to be made up in large part of silt and clay mixed with decayed organic material. Considerable fine sand is sometimes present, especially near the banks of the stream, where recent overflows have mingled some of the coarser material with the heavy soil. This gives it a more friable character that is advantageous, in that it renders the soil more mellow and easier to work. But as a rule the soil is quite heavy and plastic, and can not be worked when wet without causing it to bake and clod badly.

The other phase of the Miami black clay loam is found in one large area in Lafayette Township, occupying a perfectly level stretch of country west of Story City, between Skunk River and Kegleys Branch. One or two other areas occur in parts of the upland to the east of this, but are of no considerable extent.

The chief difference between this phase and that found along the river flood plain is in the different character of the subsoil. The usual heavy black clay loam is here underlain at a depth of about 14 inches by a sticky brownish clay which at a depth of 36 inches becomes a very heavy, tenacious yellow clay containing coarse sand and gravel and full of concretions of lime.

The topography points strongly to a lacustrine origin for this phase. Whether it was deposited under water or under the ice, the low-lying, level position is sufficient to account for the heavy character of this soil. The origin of the river-bottom phase is largely sedimentary, though it may be in part a colluvial soil.

The bottoms are subject to occasional overflow, at times causing great loss to the crops. All of this type is in need of artificial drainage, and much of it has been tiled. In some instances dikes have been constructed along the stream channel to prevent overflow, but in most cases they have proved ineffective. However, a strong, well-constructed dike, combined with thorough tile drainage, might greatly improve this soil and decrease the danger of loss from high water.

Crop yields upon the Miami black clay loam are extremely variable, as might naturally be expected. The soil is strong, producing in favorable seasons as high as 75 bushels of corn per acre. Grass does

well, and the soil is said to produce about 2 tons per acre of timothy and clover hay. Oats are also grown, but conditions are not so favorable for this crop, producing too heavy a growth of straw and a poor quality of grain.

In the upland or lacustrine phase conditions are generally too wet for the production of good yields. At present this soil is best fitted for hay production and grazing, and it is largely used for this purpose. If more open ditches were dug to furnish outlet for the tile lines and the land could be thoroughly drained, much of the soil would be greatly improved and fitted for the production of large crops of grain.

The following table shows the texture of typical samples of the soil and subsoil of this type:

Mechanical analyses of Miami black clay loam.

No.	Locality.	Description.	Organic matter.								
				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.	
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>I</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	
8784	3 miles NW. of Cambridge.	Black clay loam, 0 to 14 inches.	2.82	0.10	1.64	3.40	17.90	15.36	31.68	30.00	
8800	1 mile W. of Story City.	Sandy clay loam, 0 to 14 inches.	4.26	1.20	5.00	5.40	13.30	10.70	30.38	33.90	
8785	Subsoil of 8784.....	Sticky clay, 14 to 36 inches.	1.31	.40	1.50	3.20	20.10	17.38	29.90	27.46	
8801	Subsoil of 8800.....	Calcareous clay, 14 to 36 inches.	1.39	3.20	4.60	4.10	10.60	10.04	30.30	37.20	

The following samples contained more than one-half per cent of calcium carbonate (CaCO_3). No. 8800, 2.59 per cent; No. 8801, 9.17 per cent.

MEADOW.

The Meadow of this area is the usual type of low-lying wet land, occurring in narrow strips along the stream courses. These areas are subject to frequent overflow. They are cut up by many low ridges and depressions marking the former course of stream channels. Many of these little cut-off channels, or "oxbows," contain stagnant water.

The soil of these Meadow areas is exceedingly variable, ranging from a loose, incoherent wash sand to a heavy clay loam, according to the condition under which it was deposited. Most of the Meadow areas are covered with timber and being unfit for cultivation are used for pasturage.

A number of small undrained areas in the upland which are always wet and marshy have been indicated as Meadow upon the soil map.

All such areas are capable of being reclaimed by proper drainage, and when so reclaimed would fall into one of the upland types.

DRAINAGE.

Drainage, as before mentioned, is one of the most serious problems with which the farmers of Story County have to deal. With the exception of the Marshall fine sand, none of the types found in the area surveyed is without the need of artificial drainage in some places. In the case of the Marshall loam and the Marshall clay loam this is due to the extreme immaturity of its physiographic features. In the description of these types it was explained that the ice sheet, which at a former geological period covered this entire country, in melting away left the prairie with an uneven surface. Many depressions occur, covering from 2 or 3 to 20 or more acres, surrounded on all sides by low knolls and entirely cut off by higher ground from any superficial outlet to the streams. These undrained areas occur in great numbers in the upland, dotting the country with little ponds and marshy places, some of which contain standing water throughout the year. It is easy to see that this is a great detriment to the farmer, not only because of the land kept out of cultivation, but because it seriously interferes with systematic cultivation to have a field thus broken up into patches.

Formerly the only escape for this surplus water was by seepage through the soil or by evaporation from the surface. Seepage takes place slowly where the subsoil is as heavy as in the case of these glacial clays, and where the fall toward the drainage channels is so gradual, so that a great deal of the rainfall remained within the soil throughout the year. Thus a condition of humidity was maintained that was highly favorable to the growth of the prairie grasses that thrived here before the land was occupied by a civilized race. The prairie grasses, through the decay of their roots, have added to the productiveness of the soil, but the conditions which brought about this beneficial result prove to be detrimental now, and the farmer must resort to artificial drainage to carry off the surplus waters of the heavy spring rains. A great deal has already been done in the way of tiling and ditching. Most of the farms of the upland are equipped with a system of tile drains more or less complete and effective, but there is ample room for improvement. Tile are manufactured in several places in the county and can be had at reasonable prices. The cost of ditching is also quite reasonable, and yet it is often necessary to carry a line of tile a considerable distance before an outlet can be found. In planning to drain a boggy area the farmer must determine whether the value of the land when reclaimed will equal the cost of drainage. If not, it would be poor economy for him to attempt its reclamation. Much may be accomplished, however, by public-spirited cooperation. It is often

the case that the construction of an outlet drain will benefit two or three property owners, and by their combined efforts drainage operations can be profitably carried on where the expense would be too great for one man.

There is room for considerable improvement in the construction of main outlet ditches. This work is carried on by the county, upon petition of a certain percentage of the landowners concerned. The usual method is to enlarge and extend the natural stream channels, so as to make them more effective. But too often provision is not made for the great increase in volume in flood time. One case was noted where a thorough system of tiling was made ineffective because in a time of high water the backwater from the small and inadequate outlet ditch flooded the land and more than doubled the volume of water to be carried away by underdrainage.

In other localities outlet ditches are entirely lacking where their construction would prove a great benefit to the community, and it is to be hoped that this part of the work, which can be successfully carried on only by cooperation and county supervision, may be greatly improved and extended.

AGRICULTURAL CONDITIONS.

Iowa is preeminently an agricultural State, and Story County is typical of the State in this respect. Practically all of the wealth produced here has its source in agriculture and kindred industries. A very large percentage of the area of the State is now under cultivation, and almost every acre of the 576 square miles comprised within the boundaries of the county is adaptable to some sort of farming industry. It is therefore not surprising to find in such a locality a prosperous class of farmers. There are, perhaps, not a great many among the agricultural classes who could be called wealthy, but on the other hand there are remarkably few who are very poor, and the appearance of the residences and barns and the improvements about the farms attest the high average condition of thrift and prosperity which exists throughout the county. The average country dwelling is a well-built, comfortable home, equipped with many of the modern improvements which add to the comfort and convenience of the household. Garden patches and orchards are generally provided to furnish the necessary fruit and vegetables for home consumption. Indeed, where meat, grain, vegetables, and dairy products can so easily be produced on the same farm, there is little need for the farmer to send outside for the necessaries of life.

In great measure the farms are operated by their owners, and renting is the exception rather than the rule. Land when rented brings from \$3 to \$4 an acre, and the average selling price is in the neighborhood of \$75 an acre, ranging from \$50 or \$60 to \$100. With the extensive

methods of agriculture in use and where stock raising is so important an industry, a large farm can be operated advantageously by one man. The average size of farms in the county is about 160 acres. Labor is none too plentiful, but is not so hard to obtain as in some of the eastern districts. From \$20 to \$25 a month is paid during the summer season, and the quality of the labor is generally good.

Although the soils and climatic conditions of Story County are well adapted to a wide diversity of agricultural industries, and there is great opportunity for the introduction of new industries, the range of crop production is at present quite narrow. The production of corn, oats, and grass, and the feeding of cattle and hogs, with some dairying, comprise the chief agricultural industries of the area. In 1902 the area planted to corn amounted to 110,000 acres, or nearly one-third of the total area of the county, while 49,000 acres were planted to oats, 21,000 acres were in hay meadows, and about 69,000 acres were devoted to pasturage. From the fact that of the 360,000 acres comprising the area of the county, cultivated and uncultivated, about 250,000 acres were last year devoted to corn, oats, and grass, some idea may be gained of the relatively great importance of these crops. Besides these crops, spring wheat, barley, sorghum, Irish potatoes, and fruit figure as minor products. Thirty years ago wheat was one of the best-paying crops of the district, but as the average yield decreased from year to year the acreage devoted to this crop constantly fell off. Last season (1902) less than 4,500 acres were sown to spring wheat. One of the causes of this decrease in the yield was the serious ravages of rust. When the land was new the grain was not so susceptible to this disease as now. The soils were then lighter and considerably more porous, allowing freer circulation of the air. This was due chiefly to the presence of decaying wild grass roots, and this condition should be restored and continued as far as possible by the growing of grass and clover and by thorough drainage, which is one of the best means of securing proper aeration of the soil. A few have experimented with winter wheat, and where varieties which can withstand the severe winters have been used, good yields have been secured.

Some barley is grown in the area, but only to a limited extent. That which is now grown belongs to the feeding varieties, and it is thought that the introduction of some of the malting varieties might well be attempted, as these give much more profitable returns.

As has already been stated, conditions here are suited to the growing of apples, plums, cherries, and all kinds of small fruits.

One market garden was visited, which was under efficient management, and was operated on a paying basis. The prosperity of this garden, which sold to outside as well as local markets, proves that the industry is one of the many in which the Story County farmer might profitably engage.

Upon the Marshall fine sand some watermelons are grown, but the acreage devoted to this crop is exceedingly small and might well be extended.

It is to be regretted that there is not a more complete and systematic rotation of crops in general practice. It is not uncommon for corn to be grown year after year upon the same field, and it is quite a common practice to alternate with corn and oats. In those cases where rotation is practiced corn, oats, and clover form the usual series.

In sowing oats the usual method is to scatter the seed upon the corn stubble with a broadcast seeder, then harrow with a disk harrow, and finally with a tooth harrow. This method has several advantages, as it allows of early planting and does away with the great labor of plowing, besides enabling the farmer to get in his oats before it is necessary to plow for and plant corn. A good deal of trouble is experienced with oats from the rank growth of straw and consequent liability of the grain to lodge. In some cases this might be prevented if the seed were scattered less thickly. Fall plowing, with thorough harrowing in the spring, where it can be practiced, is really the best method of preparing the ground for oats.

In a country where so much stock is fed as in this locality, the subject of forage crops is one of great importance. Timothy, clover, and corn fodder form the bulk of this supply, with some millet, sorghum, and rape. The use of sorghum is highly recommended by those who have tried it. When cured in the field and fed as a "roughness" it is eaten with great relish by the stock.

Experiments recently carried on at the State experiment station lead to the conclusion that conditions here are well suited to alfalfa. The addition of this forage crop to those now grown would be of inestimable value to the farmers of Story County. A good deal of patience, however, is sometimes needed to get alfalfa well started. During the first year it must be cut back frequently to keep the weeds from crowding it out. But when once well established it easily takes care of itself and will stand for ten or twelve years without reseeding, producing three or four crops a year with an annual yield of 4 or 5 tons per acre.

Within recent years dairying has become an important industry in Story County and is rapidly growing. The conditions are highly favorable to the development of this industry. Water is plentiful, pasturage is of the highest quality, and fodder is cheap. There are creameries in most of the towns throughout the county, some operated by private capital and others run upon the cooperative plan. It is not common to find herds of strictly dairy grades of cattle. The plan is generally to combine beef-making with milk-producing qualities, and the plan seems to work very well. Shorthorn or Red Polled cattle

make the best stock for this combination. There is an increasing tendency to use hand separators upon the farm, so that the skim milk can be used for feeding the young calves while the animal heat is still in it. When fed in this way it has been shown that separator milk can be economically used for fattening calves for market.

Story County is well supplied with railroads for the transportation of its produce to market. Chicago is the market for a large part of its exports, while considerable shipments are made to Des Moines, Marshalltown, and other nearby cities.

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