SOIL SURVEY OF MUSCATINE COUNTY, IOWA.

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DESCRIPTION OF THE AREA.

Muscatine County is situated in the southeastern part of Iowa along the Mississippi River. It is bounded on the north by Cedar and Scott Counties; on the east by Scott County; on the southeast by the Mississippi River, separating it from Rock Island County, Ill.; on the south by Louisa County; and on the west by Louisa and Johnson Counties. Except for the irregular boundary formed by the Mississippi River, the county has the shape of a rectangle, with a length of five Government townships east and west and a width of three townships north and south. It comprises an area of 432 square miles, or 276,480 acres.

The fundamental feature of the topography of the county, constituting 60 per cent of its total area, is a plain which is essentially smooth, except for the dissection to which it has been subjected since its formation. The elevation is greatest in the eastern part of the county, where it reaches a maximum of about 800 feet. The surface slopes gently westward to an elevation of a little less than 740 feet at Wilton, west of which it maintains an essentially uniform altitude to the western boundary of the county. Excluding the valleys that have been cut into it, the surface is smooth, in no place being more irregular than country ordinarily described as undulating. The most noticeable surface features consist of a few low, rather elongated and round-topped mounds, designated by the natives as "paha," a term adopted by McGee, who first described them.

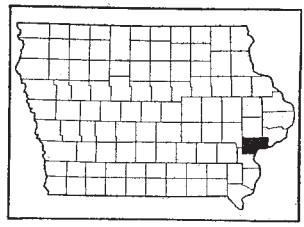

FIG. 46.—Sketch map showing location of the Muscatine County area, Iowa.

Erosion since its formation has effected two widely different modifications of this plain. The county is traversed by one large stream, and another extends along its boundary and has by erosion determined the features of a relatively small but important part of its area. The Cedar River flows across the western part of the county and has formed a broad valley designated as the West Liberty Plain. The Mississippi River flows along its southeastern boundary and at

a short distance below the city of Muscatine has opened a broad semicircular valley on the Iowa side, the greater part of which is known as Muscatine Island. These two features are described below.

The other streams of the county are small and have narrow valleys, though the dissections by them vary considerably in different parts of the county. All the tributary streams of Cedar River with the exception of Mud Creek traverse the lower part of the upland. The depth to which they can cut their valleys is less, therefore, than that of streams draining the higher parts under similar conditions. Mud Creek, on the other hand, drains a part of the northeastern and higher portion of the county, yet on account of the length of its course it is unable to utilize this condition and cut deeply into the county. Its valley is as shallow, therefore, as those of the much smaller streams which traverse the western and lower part of the county. Even the southern tributaries of the Cedar River which have worked their headwaters southward to points within about 5 miles of the Mississippi River in the eastern part of the county have not been able to cut through the layer of loess that covers the upland and to keep their valleys eroded clear of this material. In the western part of the upland, west of the Cedar River, the valleys are gently sloping swales, producing an undulating surface rather than a rolling one. Within the narrow fringe of country adjoining the Mississippi Valley the dissection is sharper, deeper, and more thorough. The belt is so narrow that the streams are short, and many of them, especially west of Muscatine, are mere ravines. They dissect the highest belt of upland in the county, flow by short and usually direct courses to the largest river, and therefore cut the belt of lowest land in the county. They are thus enabled to erode deep valleys, and the time during which they have been at work has not permitted them to form broad flood plains in the resistant material which they have encountered in their deeper sections. Practically all of them have gradients so steep that they are actively corrading their beds. The topography in this belt of country ranges from rolling along its northern and western border to hilly elsewhere.

The Cedar River enters the county from the northwest, where it traverses a region of thin drift overlying beds of sedimentary rocks. There the stream has a narrow valley. Where it crosses the county line into Muscatine County it enters a broad drift-filled valley with a northeast-southwest course, and, turning at right angles, follows it to the southern boundary of the county. Through this belt of unconsolidated material the river has opened a broad valley ranging in width from 3 miles at its upper end to about 8 miles at the county line. The old valley is a smooth plain practically without relief,

except for the present valley of the river, which has been cut to a level a few feet lower than the floor of the main valley. The modern valley is about one-half mile to 2 miles wide and is without relief except where remnants of former river channels traverse it. On the floor of the main valley low sand dunes occur at several places, and low belts, apparently representing former river channels, break its surface. At its northern end an island of the loessial upland occurs in the plain; the belt of lowland on its west side is about one-half mile wide, and that on its east side, occupied by the river, is about twice that width. The island is roughly circular and about 1 mile in diameter.

The eastern and western boundaries of the West Liberty Plain are both well defined, and in most places are formed by low bluffs which do not as a rule show rock exposures.

The Mississippi River Valley above the city of Muscatine is scarcely wider than the channel of the river. At a few places, shown on the soil map by the presence of alluvial soils, there is a narrow strip of bottom land, but at no place does it exceed one-half mile in width, and along most of its course it averages barely one-fourth mile. Immediately below Muscatine, however, there is a broad area comprising Muscatine Island, and its adjacent strip of bottom land bounded on the north and west by a circular line of bluffs, on the east by the nearly due north-south line of the river, and on the south by the county line running due east and west. This area is about 6 miles wide from its northern to its southern boundary, and about 7 miles long from its eastern to its western boundary.

The large area of Mississippi flood plain southwest of Muscatine consists of a low belt of recent-alluvial land, averaging about a mile in width, lying along Muscatine Slough; a belt of gently sloping land spread out from and fringing the foot of the slope of the river bluff, with a width of about a quarter mile; a low terrace, or bench, of bottom land between the Muscatine Slough belt and the river; and, finally, a small area of high alluvial terrace extending into the southeastern corner of the county from Louisa County, where it occupies a much larger area.

Although the county adjoins the Mississippi River, by far the larger part of its area is drained into the Cedar River. A narrow belt of upland reaching a maximum width of about 6 miles just north of Muscatine and a minimum width of about a mile in the southern part of the county is drained either directly into the Mississippi River or into its alluvial plain. The streams carrying this drainage are necessarily short. The remainder of the county is drained into the Cedar River. The largest tributary of this stream, Mud Creek, has a length of about 20 miles.

Before the advent of the white man, this general region was occupied by Indians, mainly of the Sac and Fox tribes. After the close of the Black Hawk War in 1832 a treaty was made with the Indians. The territory acquired by this treaty was known as "the Black Hawk Purchase," and included all of eastern Iowa. It was made a portion of the old Wisconsin Territory, and continued under its jurisdiction until the formation of the Territory of Iowa in 1838. The territory included in the cession under the Black Hawk treaty was divided into two counties, Dubuque to the north and Des Moines to the south. Muscatine County originally was a part of the latter county. The limits of Muscatine County were established by act of the Legislature of the Territory of Wisconsin in 1836, but were redefined in 1838. No change in the boundaries as then established has since been effected.

The settlement of Muscatine County by white men began in 1833 with the establishment of a trading point at the present site of Muscatine, then known as Sandstone Bluffs. Shortly afterwards settlements were made in various parts of the county. The village of Montpelier was established in 1834. Muscatine Island was first settled in 1836, in which year settlements were also made at West Liberty and Moscow. About this time or somewhat later settlements were made at Wilton and in the northeastern part of the county. The country in the vicinity of Conesville was opened for settlement about 1840. Immigration to this newly opened territory was slow at first, but steadily increased as settlement spread throughout the county.

Immigration into this section was mainly by river from the south and overland from the east. The early population consisted of pioneers from the more thickly settled areas to the east. The greater part was of American and German descent, and some were immigrants into the United States who made their initial settlement in this region.

The proportion of foreign-born whites in 1910 was between 10 and 15 per cent, while the native white population of foreign or mixed parentage comprised from 25 to 35 per cent. To the city of Muscatine is accredited a large proportion of these classes. In Muscatine Americans, Germans, and Irish predominate.

The population of the eastern part of the county is made up largely of people of German descent, while over the remainder of the county various other nationalities are well represented. The negro population is negligible.

The population of the county, according to the census of 1910, is 29,505, with 16,178 classed as urban and 13,327 as rural. Between

1880 and 1910 there was an increase in the total population of 6,335, but the rural population decreased somewhat during that time.

Muscatine, the largest city in the area and the county seat, ranks eleventh in the State in population, which is reported in the census of 1910 as 16,178. It is one of the important manufacturing cities of Iowa. West Liberty and Wilton, with reported populations of 1,666 and 1,157, respectively, are mainly commercial and residential towns, as are Nichols, with about 400 population, and Atalissa, Conesville, Fruitland, Fairport, and Montpelier, each with a smaller population. Ardon, Cranston, Bayfield, Sweetland, New Era, and Summit are small trading centers.

Three main railway lines traverse the county. The Chicago, Rock Island & Pacific, from Chicago to points in Colorado, passes through Stockton, Wilton, Moscow, Atalissa, and West Liberty. This was the first railway to enter the county, and was constructed in 1855 as the Mississippi & Missouri Railroad. The main lines of the Chicago, Rock Island & Pacific, and the Chicago, Milwaukee & St. Paul Railways between Chicago and Kansas City pass through Montpelier, Fairport, and Muscatine over a joint double-track line, the former road passing through Fruitland in a southwesterly direction, and the latter extending westward through Ardon and Cranston. The Muscatine North and South Railway, from Muscatine to Burlington, also passes through Fruitland. A north and south line of the Rock Island System passes through West Liberty, Nichols, and Conesville, while branch lines operate between Muscatine and Wilton, and from Muscatine to Nichols and beyond. A branch line passes through the northeastern part of the county through Stockton. The Davenport & Muscatine Railway Company operates an electric line which is of great convenience to the farmers living along it, since express and freight service is maintained in addition to passenger service.

The county has an extensive system of public roads, most of which are kept in good condition. An improved highway between Davenport and Omaha, known as "The Great White Way," passes through Sweetland and Muscatine, and across the Island. "The River to River Road," another improved road, extends through the northern part of the county, passing through Wilton, Moscow, Atalissa, and West Liberty. Branch roads connecting these two highways and extending from them to other towns are well improved. Many of the sandy roads of the county have been clayed, and the heavy clay roads sanded.

The county is well supplied with rural schools and country churches. The educational facilities of the larger towns are good. Community schools have been built in several places, and the one

at Cranston has proved particularly successful. Rural delivery of mail reaches every part of the county, and the telephone is found in nearly every farm house. Several electric transmission lines radiate eastward and northward from Muscatine, and along their routes current is furnished farmers for lighting and power.

Muscatine is the principal local market for all farm and truck products, Davenport being a market of secondary importance. Of the more distant markets, Chicago is undoubtedly the most important for stock, truck, and farm crops. Products are shipped also to Kansas City, St. Louis, Omaha, St. Paul, and Minneapolis to a large extent. The railway systems traversing the county afford excellent shipping facilities to these markets and special stock trains are operated.

CLIMATE.

The climate of Muscatine County is typical of the "corn belt" and is temperate and healthful. Prolonged periods of extremely hot and sultry weather in summer or of cold weather in winter are rare. No records of temperature within Muscatine County are available, but the climate at Davenport is similar to that of this county, and the records of the Weather Bureau station at that point are representative of local conditions. The average annual temperature at Davenport is reported as 48.8° F., with a range from 106°, the highest temperature recorded, to a minimum of —27°. The average temperature for the winter months is given as 24.3°, for the spring months 45.6°, for the summer months 72.7°, and for the fall months 52.4°.

The mean annual precipitation as compiled from records kept at Muscatine, is 37.76 inches, which when well distributed throughout the growing season is ample for the needs of all crops grown in the county. Droughts sometimes occur during the summer months, and when these occur early in the spring, or extend over a considerable period, crops suffer severely, watermelons, cantaloupes, sweet potatoes, tomatoes, and corn being among the first affected, the former especially on account of their natural adaptation to sandy soils. The droughts are seldom of sufficient length to cause total crop loss. The rainfall is lightest during the fall months, which is favorable to the harvesting of crops.

The average date of the first killing frost in the fall, estimated from the records of the Davenport station, is October 13, and of the last in the spring, April 22. This gives an average growing season of 174 days. The earliest date of killing frost in the fall recorded is September 18 and the latest date in the spring, May 22. Crops are

generally well matured before early frost, though tomatoes are occasionally injured.

The following table gives the normal monthly, seasonal, and annual temperature, with absolute maximums and minimums, as recorded at Davenport, Scott County, Iowa, and the normal monthly, seasonal, and annual precipitation, with total amounts for the wettest and driest years at Muscatine:

Normal monthly, seasonal, and annual temperature at Davenport, Iowa, and precipitation at Muscatine, Iowa.

Month.	Temperature, Davenport.			Precipitation, Muscatine.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	° *F.*	° *F.*	° *F.*	*Inches.*	*Inches.*	*Inches.*
December	27.6	65	−22	2.07	1.72	2.95
January	21.4	63	−27	1.91	1.46	1.55
February	24.0	67	−25	1.95	1.63	5.34
Winter	24.3			5.93	4.81	9.84
March	35.5	82	− 8	2.74	2.81	3.03
April	40.1	87	14	3.34	1.81	3.60
May	61.1	90	29	4.44	1.26	12.60
Spring	45.6			10.52	5.88	19.23
June	70.2	98	39	4.53	4.50	14.30
July	75.1	106	49	3.88	1.44	8.60
August	72.8	98	44	4.34	0.40	14.00
Summer	72.7			12.75	6.34	36.90
September	65.4	99	28	3.51	2.17	3.50
October	53.4	90	17	2.69	0.99	1.40
November	38.5	78	−10	2.36	0.95	3.63
Fall	52.4			8.56	4.11	8.53
Year	48.8	106	−27	37.76	21.14	74.50

AGRICULTURE.

Agriculture in Muscatine County had its beginning about 80 years ago, when the lands of eastern Iowa were thrown open to homesteaders, and, as in most of the great central prairie region, development was quite rapid and farming was soon on a prosperous basis. The extensive prairie lands were not only easily brought under cultivation and naturally very productive, but in their native condition they afforded excellent pasturage. The settlers soon centered their

interest in the growing of corn and the raising of beef cattle, sheep, and hogs. Some of the corn was marketed, but the bulk of it was fed on the farm, while the sale of animals and animal products afforded the chief source of income.

Many important changes have taken place in the agriculture since the early days, in the direction of specialization and in readjustments to meet changing economic conditions. When much of the land was not under cultivation and pasturage was plentiful, it was easy to raise all the cattle and other stock required to consume the corn crop and such forage as was produced, but with the introduction of improved types of farm machinery and implements, including those for harvesting wheat, oats, and hay, more and more of the land was brought under cultivation and little was left for pasture. As a result, the raising of sheep has become a minor industry, and it is estimated that only about 60 to 75 per cent of the cattle marketed are raised in the county, the others being shipped in as feeders. The raising and feeding of beef cattle is an important industry. Hog raising, which is not so dependent upon pasturage, has gained in favor and now ranks as one of the main industries. The dairying industry is being gradually developed, but it still is of minor importance.

Corn has continued as the chief crop of the county, the acreage devoted to it almost equaling that of all other crops combined. Hay, principally timothy and timothy and clover mixed, is the second crop in acreage, while oats rank third, barley fourth, wheat fifth, and rye sixth. After the introduction of improved harvesting machinery, wheat, with oats and hay crops, became important in the general agriculture and continued so until about 1880, after which there was a rapid decrease in the acreage.

There are no important crops in the general agriculture of the county other than those mentioned above, but special truck farming has become an important feature on Muscatine Island, in the vicinity of Conesville and Moscow, where watermelons, cantaloupes, and sweet potatoes are grown successfully, and in a small area north and east of Muscatine where cabbage, tomatoes, onions, and cucumbers are the main crops.

The census reports show little variation in the acreage of lands under improvement since 1880. The 1910 census reports 93.8 per cent of the area of the county in farms, and 81.9 per cent of the farm lands improved. The total number of farms is given as 1,820, and the average size of the farms as 142.3 acres, each tenancy being classed as a farm. About 40 per cent of the farms are operated by tenants. The value of all property per farm is reported as $17,878, divided as follows: Land 73.6 per cent; buildings 13.2 per cent; im-

plements 2.6 per cent, and domestic animals 10.6 per cent. The land has an average value of $92.45 an acre. In 1880 there were 1,920 farms in the county and all property per farm was valued at $5,885. About 87 per cent of the farm land was improved. The average size of the farms was 139 acres. According to the 1910 census, the value of animals sold and slaughtered in 1909 was $2,167,626, the value of cereals, mainly corn, was $1,846,063; other grains and seeds, $9,817; hay and forage, $500,194; vegetables, $333,015; poultry and eggs, $249,752; dairy products, $234,633; fruits and nuts, $43,782; and all other crops, $72,737.

The following table, prepared from data compiled by the township assessors of 14 townships[1] in the county, in compliance with State law, show the total acreage, total production, and average yield per acre of the chief grain crops and hay and alfalfa, the total number of hogs and cattle, the number of farms, acreage of pasturage, and acreage in farms, by townships, for the year 1913, with totals and averages for the county as a whole:

Total acreage, production, and average acreage yield of farm crops, 1913, with number of cattle and hogs on farms, number of farms and acreage, by townships, Muscatine County, Iowa.

Township.	Corn.			Wheat.[2]			Oats.		
	Total area.	Total production.	Average yield.	Total area.	Total production.	Average yield.	Total area.	Total production.	Average yield.
	Acres.	*Bush.*	*Bush.*	*Acres.*	*Bush.*	*Bush.*	*Acres.*	*Bush.*	*Bush.*
Bloomington	3,858	133,335	35	54	1,236	23	1,237	33,922	27
Cedar	2,040	102,370	50	51	918	18	749	28,970	39
Fruitland	3,344	75,670	23	20	900	45	205	4,721	23
Fulton	6,277	248,890	40	327	5,690	17	1,615	50,510	31
Goshen	6,161	243,580	40	114	2,802	25	2,895	95,717	33
Lake	5,487	182,075	33	162	3,471	21	1,126	31,300	28
Montpelier	2,244	58,992	26	267	4,169	16	1,133	29,373	26
Moscow[3]	4,809	150,086	31	156	3,256	21	1,315	34,008	26
Orono	3,147	88,868	28	.....	.....	.....	579	15,764	27
Pike	9,225	312,865	34	469	10,663	23	3,056	92,709	30
Seventy-six	5,458	210,185	39	314	5,496	18	1,089	33,151	30
Sweetland	5,403	179,585	33	288	5,351	19	1,608	45,534	28
Wapsinonoc	7,864	351,855	45	324	7,720	24	3,324	115,520	35
Wilton	6,948	264,190	38	303	5,248	17	1,880	54,150	29
Total	72,265	2,602,546	36	2,849	56,920	20	21,811	665,349	31

[1] Muscatine Township is coextensive with the city of Muscatine, and for that reason has been omitted from these tables.

[2] Includes spring wheat; total acreage 263, production 3,547 bushels, acreage average for county 13 bushels.

[3] The crop yields for Moscow Township were reported as average yield per acre, rather than total production. Total production was ascertained by multiplying average yield by acreage grown.

Total acreage, production, and average acreage yield of farm crops, 1913, with number of cattle and hogs on farms, number of farms and acreage, by townships, Muscatine County, Iowa—Continued.

Township.	Rye.			Barley.			Hay.[1]		
	Total area.	Total production.	Average yield.	Total area.	Total production.	Average yield.	Total area.	Total production.	Average yield.
	Acres.	*Bush.*	*Bush.*	*Acres.*	*Bush.*	*Bush.*	*Acres.*	*Tons.*	*Tons.*
Bloomington	61	680	11	174	3,891	22	2,145	2,504	1.2
Cedar	90	1,034	11	9	240	27	931	1,034	1.1
Fruitland	789	8,460	11	16	290	18	625	735	1.2
Fulton	186	3,215	17	3,404	74,840	22	2,874	4,054	1.4
Goshen	61	1,301	21	347	8,686	25	2,335	3,097	1.3
Lake	318	4,940	16	142	3,120	22	2,045	2,508	1.2
Montpelier	98	1,718	17	89	1,455	16	1,530	1,872	1.2
Moscow [2]	593	7,320	12	153	3,727	24	1,595	1,809	1.1
Orono	75	963	13	20	330	17	834	809	1.0
Pike	205	2,675	13	49	1,350	28	1,921	2,673	1.4
Seventy-six	133	1,962	15	211	4,105	19	1,667	2,481	1.5
Sweetland	51	675	13	371	7,352	20	3,465	4,178	1.2
Wapsinonoc	9	270	30	244	7,340	30	3,037	3,830	1.3
Wilton	92	1,660	18	2,624	53,185	20	3,106	3,544	1.1
Total	2,761	36,873	13	7,853	169,911	22	28,110	35,128	1.2

Township.	Alfalfa.			Stock.			Farm acreage.		
	Total area.	Total production.	Average yield.	Hogs on farms July 1, 1913.	Cows and heifers kept for milk.	Cattle not kept for milk.	Farms.[3]	Area in farms.	Area in pasture.
	Acres.	*Tons.*	*Tons.*	*No.*	*No.*	*No.*	*No.*	*Acres.*	*Acres.*
Bloomington	27	109	4.0	3,927	753	736	150	14,017	5,479
Cedar	4	18	4.5	3,670	203	610	57	9,428	3,131
Fruitland	3	11	3.7	800	551	345	102	11,935	2,725
Fulton	.....	.....	.....	11,030	1,090	2,169	146	21,890	5,460
Goshen	.....	.....	.....	5,481	477	1,453	123	18,410	4,912
Lake	.....	.....	.....	5,331	372	2,561	112	19,148	8,421
Montpelier	58	189	3.3	4,162	392	1,274	78	11,284	6,170
Moscow [2]	1	1	1.0	4,114	405	[4] 1,207	123	16,230	12,612
Orono	.....	.....	.....	1,777	147	369	63	9,045	2,794
Pike	6	.....	.....	8,312	492	1,525	136	24,813	7,808
Seventy-six	.....	3	.....	8,345	387	2,188	103	18,196	7,641
Sweetland	30	104	3.5	5,506	1,441	729	166	20,401	8,954
Wapsinonoc	37	64	1.7	8,915	767	2,480	180	24,419	7,967
Wilton	.....	.....	.....	6,935	886	1,155	170	22,883	6,952
Total	166	499	3.0	78,305	8,363	18,801	1,709	242,099	91,026

[1] Includes wild hay; total acreage 958, production 1,069 tons, acreage average for county 1.1 tons.

[2] The crop yields for Moscow Township were reported as average yield per acre, rather than total production. Total production was ascertained by multiplying average yield by acreage grown.

[3] Each tenancy is reported as a farm. This total also includes "farms" of 10 acres or less at the outskirts of cities and villages, on which crops were grown.

[4] Not reported for Moscow Township. Total arrived at by subtracting "Total number of cows and heifers kept for milk" from "Total number cattle, all ages."

The county statistics for 1913 show a total of 72,265 acres in corn, and the census for 1910 reports 71,499 acres devoted to that cereal. The lowest acreage reported in corn during the preceding 30 years was 64,000. The average yield of corn for Muscatine County in 1913 was 36 bushels per acre, average township yields ranging from 23 bushels on the light soils of Fruitland Township to 45 and 50 bushels on the heavier soils of Wapsinonoc and Cedar Townships, respectively. The total production for the county in 1913 was 2,602,546 bushels; the total in 1909 was 2,784,814 bushels from 71,499 acres, averaging 39 bushels per acre.

With such an enormous crop as that of 1913 only 740 carloads were shipped from the county.[1] The remainder was fed on the farms, largely in the raising and fattening of beef cattle and hogs, a considerable proportion being put up in silos for winter feeding.

Hay and forage crops are next in acreage importance. The 1910 census reports 28,706 acres in all tame grasses, with about half of this in timothy alone, and the remainder in timothy and clover mixed, except 690 acres in clover alone. The average yield of the two principal kinds of hay was slightly in excess of 1½ tons per acre. In addition to these grasses, 337 acres were devoted to miscellaneous grasses, including alfalfa and millet. Cowpea hay is popular on the lighter, sandier soils, and averages from 1 ton to 1½ tons per acre. Crab grass is the common weed pest on the sandier soils, but it is allowed to grow up with cowpeas, and the two are cut together. It is said that this makes a nourishing feed for horses. Cowpeas and clover are practically the only leguminous crops grown. Timothy and clover do well on all except the lightest soils. No particular difficulty is experienced in obtaining a stand of clover, though better yields might be obtained on the upland soils, which are sometimes quite acid, with the application of lime. Millet and rape grow in small patches, and are used principally as forage, the former for cattle and the latter for sheep and hogs. Millet is sown generally after oats and the rape in separate patches or with corn.

Oats have been quite popular since the establishment of agriculture. According to the county reports, 21,811 acres were devoted to oats in 1913, producing 665,349 bushels. The 1910 census reports an area of 16,368 acres in oats, with a yield of 460,357 bushels. Oats give good yields on all except the light soils on Muscatine Island and at Conesville, although on the heaviest soils they grow very rank and lodge badly. Oat smut is prevalent, but the practice of washing the seed in a formalin solution before sowing is becoming common, and loss from this disease is greatly reduced. The crop is used largely at home for feed, mainly for hogs and work stock. Only about 75,000 bushels were exported from the county in 1913.

[1] Computed from figures furnished by the railways traversing the county.

Barley is an important crop in Fulton and Wilton Townships and is grown to some extent throughout the remainder of the county. The total area reported for the county in 1913 was 7,853 acres, with a total yield of 169,911 bushels. In the greater part of the county barley is said to be an unprofitable crop. The yields seem to fluctuate greatly with seasonal conditions, profitable yields being obtained only during the best seasons. Between 55 and 60 per cent of the 1913 crop was exported from the county, the remainder being used for seed and feeding.

Prior to 1880 wheat was decidedly more popular than at present. The acreage in 1879 was 16,642, and the yield 141,818 bushels. This dropped to 2,791 acres in 1889, with a yield of 36,454 bushels. In 1913, 2,849 acres were devoted to the crop, the yield being 56,920 bushels. An impetus was given the early production of wheat by the introduction of thrashing machinery and the establishment of flour mills at Muscatine, where the wheat was sold and ground into flour for home use and for shipment. The decline in acreage resulted from decreased yields, due to excessive cropping and lower prices caused by the great extension of the wheat-growing belt. Owing to the decreased production of this crop, flour mills are no longer maintained in the county, except one general feed-grinding mill at Pine Mills. Only 9 per cent of the total wheat acreage in 1913 was devoted to spring wheat, which averaged 13 bushels per acre. "Turkey Red" is the common variety. It does fairly well on most of the soils of the county, with lower yields on the lighter soils. It has a tendency to lodge badly on the heaviest soils. About 18,000 bushels were exported from the county in 1913.

Rye is grown throughout the county, and on practically all the soils. In 1913, 2,761 acres were used for this crop, more than 25 per cent of which was in Fruitland Township. Average yields are low, ranging from 11 to 30 bushels per acre. This crop is grown mainly on the sandy soils, in rotation with melons. The total production in 1913 was 36,873 bushels, of which about 10,000 bushels were shipped out of the county.

The value of the sandy soils of Muscatine Island for trucking became apparent soon after the settlement of the island, and the importance of the industry became greater with the increased demand for truck crops.

The industry has changed considerably since it was first established and at present consists almost entirely of the production of watermelons, cantaloupes, sweet potatoes, and asparagus. Starting first on the island the truck industry later spread to the sandy lands in the vicinity of Conesville and near Moscow. Prior to 1905 the production of tomatoes and cabbage constituted an important industry on the island, but heavy losses were suffered through

droughts, and cabbage wilt and blossom-end rot of tomatoes became prevalent, due to long-continued cropping without rotation.

The total carload shipment of watermelons and cantaloupes[1] from the three sections of Muscatine County in which they are produced is as follows:

	1912	1913	1914
Moscow		1	6
Conesville	806	646	752
Muscatine Island	671	[2] 151	[2] 198

These figures give only an idea of the number shipped. In order to ascertain the total production it would be necessary to take into consideration the large number sold at local markets, those used for seed, and those remaining on the ground at the close of the season. It has been estimated that only 60 to 75 per cent of the total output is shipped to outside markets, principally Chicago, Kansas City, St. Louis, Omaha, St. Paul, and Minneapolis. In these markets melons grown in Muscatine County, owing to their superior quality, have a separate quotation, being classed as "Muscatine melons."

The average acreage yield of watermelons is from one-fourth to one-half carload. In seasons of well-distributed rainfall and where irrigation is practiced, the higher yields are obtained. The light soils of the Buckner series are favorable for cantaloupes, but their production is confined mainly to Muscatine Island. They have been grown in the Conesville district, and a good quality of melon produced, but watermelons have proved more popular and replaced them. Average yields of one-fourth to one-half carload per acre are obtained, the latter where irrigation is practiced and in seasons of well-distributed rainfall. The quality and flavor of both cantaloupes and melons is said to depend largely on the distribution of moisture during the growing season.

According to the 1910 census, 1,052 acres were devoted to the production of sweet potatoes, with a total yield of 115,247 bushels, or an average of about 110 bushels per acre. Of these, between 90 and 95 per cent were grown on Muscatine Island. They are not produced commercially in any other part of Muscatine County. The sand types are preferred to the sandy loams, since a smoother, more salable potato of better keeping quality is obtained. The quality of the Muscatine Island potato is said to be equal to that of the southern

[1] Compiled from figures furnished by the railways traversing the county. Individual figures for watermelons and cantaloupes could not be obtained, since both are classed as "melons" and are often shipped in mixed carloads. Carloads average 27,000 pounds or over.

[2] Droughty conditions and poor markets largely responsible for decreased shipments.

and eastern potatoes. The yields range from 75 to 125 bushels per acre, though larger yields are reported. The best yields are obtained in years of well-distributed rainfall and from irrigated fields.

It is estimated that between 200 and 300 acres on Muscatine Island are devoted to the production of asparagus. The crop is sold mainly to local canneries. About twenty 5-inch cuttings are obtained during a normal season, and with exceptionally favorable weather conditions a larger number of cuttings is obtained. The cutting period begins about April 1 and averages about six weeks in duration. According to authorities at the canneries this asparagus excels the California product in that it is less fibrous and of generally better quality. The beds, when once established, endure for 20 years or more. The seed is disposed of at local seed houses.

The culture of cabbage, tomatoes, onions, and cucumbers east and north of Muscatine is carried on largely for the purpose of supplying local canning and pickling establishments, although over 300 carloads of cabbage were shipped from the county in 1914. The time of maturity is not an important factor, and the crops are grown on comparatively heavy soils where heavy yields can be obtained. Cabbage and tomatoes occupy the largest acreage, about 1,200 acres of the former crop and 1,000 of the latter being grown in the county.

Cabbage yields average 8 to 10 tons per acre. A large proportion of the acreage of this crop is on farms owned by or under contract to local canning concerns. The average price paid is about $6 a ton. Cabbage wilt has caused almost total destruction of this crop in some fields. Apparently it is most prevalent in fields which have been continuously cropped to cabbage for four years or more. The growing of other crops for a number of years has been found to fit the soil again for cabbage culture, without immediate danger from the disease.

The average yield of tomatoes is from 8 to 10 tons per acre. The crop is sold mainly to the Muscatine canning concerns. The average price paid locally is $10 a ton. Cultural methods vary. Blossom-end rot is the main disease affecting tomatoes.

The onions produced are mainly of the small pickling variety and yield about 400 bushels per acre. Cucumbers are picked mainly when of small pickling size. Some are grown for seed. From 200 to 250 bushels of cucumbers per acre is the ordinary range in yield.

The canning of pumpkins for domestic purposes has recently been taken up and has given an impetus to the growing of standard varieties of this crop. The Memphis silt loam is well suited to their production. Yields vary from 18 to 25 tons per acre, and the average price paid is from $3 to $4 per ton. Considerable attention is paid to this industry in the vicinity of Ardon and Cranston. The

growing of sweet corn for canning is confined mainly to Fruitland Township, 34 tons being produced there in 1913 for that purpose.

The commercial production of Irish potatoes in Muscatine County is confined principally to Fulton Township. The 1910 census reports a yield of 206,919 bushels from 2,545 acres, an average of about 81 bushels per acre, in 1909. The crop receives considerable attention also in Sweetland Township.

Almost every farm in Muscatine County has an orchard, in which apples, cherries, pears, and plums predominate. Cherries are especially plentiful. Early peaches also are well represented, and do well in this climate. There are several commercial orchards in the county. Apples, of the standard varieties, average about 150 bushels per acre, peaches about 200 bushels, and pears and plums from 200 to 250 bushels per acre. Of the small fruits strawberries are the most important commercially, the average yield being about 2,500 to 3,500 boxes (quarts) per acre.

The animal industry of the county is confined mainly to cattle and hogs. With the exception of Fruitland Township, sheep are raised in all parts of the county, but mainly in Wapsinonoc Township, where a number of large flocks are kept. A few sheep are shipped in for feeding purposes.

Dairying is of minor importance as compared with the raising and feeding of beef cattle. The county statistics for 1913 show a total of 8,363 cows and heifers kept for milk, and 18,801 cattle not kept for milk. Probably between 60 and 75 per cent of the latter are raised there, the remainder being shipped into the county for feeding. The census of 1910 reports 3,270 calves and 19,810 other cattle sold or slaughtered in 1909. Shipments of cattle out of Muscatine County in 1913 aggregated 519 cars.

The greatest interest is taken in dairying in Sweetland, Fulton, Wilton, and Bloomington Townships. Muscatine is contiguous to the last named township, and dairies are maintained to meet the city's demand for milk products. From Sweetland, Wilton, and Fulton Townships considerable milk and cream are exported to Davenport, Rock Island, and Moline. A plant for the manufacture of French cheese is operated at Wilton. The dairy interest is becoming important in the vicinity of West Liberty, where a cooperative creamery is being constructed. The dairying is of the year-round type, and silos are found on nearly all the dairy farms.

Purebred cattle are common, mainly in the northern part of the county, though the most of the cattle in the county are grades. Wapsinonoc Township probably leads in the number of purebred stock. The value of blooded sires is universally appreciated. Beef cattle of the Shorthorn, Hereford, and Aberdeen Angus breeds predominate, the latter being found chiefly in the vicinity of Nichols.

In Wapsinonoc Township there are a large number of "dual-purpose" herds, with Shorthorn blood predominating. Of the dairy breeds, Jerseys, Holsteins, and Guernseys predominate. The greatest number of purebred dairy herds are found in the vicinity of Muscatine.

The total number of hogs on farms in Muscatine County July 1, 1913, is reported as 78,305, with Fulton and Wapsinonoc Townships leading in number. The total exportation in 1913 was 1,973 cars, according to data furnished by the railways. The predominating breeds are Poland China and Duroc Jersey, with Chester White, Hampshire, and Tamworth following probably in the order named. Considerable attention is paid to the breeding of purebred hogs in the northern part of the county, West Liberty, Nichols, Wilton, Sweetland, and Muscatine being the centers of this industry. Hog cholera has been a most destructive factor in hog production in Muscatine County. Owing to the efforts of local officers and the interest being taken in vaccination the disease is now being kept in check, and losses are not nearly so great as they have been in the past.

Special soil adaptations are recognized and have had an important influence on agricultural development and in the localization of special industries. The production of melons, sweet potatoes, and vegetables for the market where quality and earliness of maturity are important factors is confined almost entirely to the sandy, well-drained soils, as on Muscatine Island and in parts of the West Liberty Plain. The first-bottom soils, subject to overflow, are little used except for pasture, while in the uplands the black prairie soils are generally preferred to the lighter colored, originally forested soils for corn, grasses, and the smaller grains. Topography has not had any important influence on agriculture, except in limiting development in the rougher areas.

In general throughout the county the farm equipment is of the highest order. Good, substantial houses, painted and well kept, are typical, with large barns for housing the stock and storing large quantities of hay and forage. The latest improved types of machinery and implements for cultivating and harvesting the crops are in general use, and the work stock is mainly of medium to heavy draft type.

The value of crop rotations in relation to crop yields and the maintenance of soil fertility is universally recognized. In general farming 4 and 5 year rotations are practiced, the production of corn being the main purpose. The 5-year rotation consists generally of 2 years of corn, 1 year of small grain, 1 year of meadow, and 1 year or 2 years of pasture. In the 4-year rotation only 1 year is devoted to meadow or pasturage. The small grain is generally wheat or oats, except in the eastern part of the county, where con-

siderable barley is grown. Clover is generally sown with the small grain. In some instances corn is allowed to run as long as 3 or 4 years, but as a rule it is not grown for more than 2 years in succession.

The melon lands at Conesville are given a 5-year rotation—2 years of melons, followed by 1 year each of corn, cowpeas, and rye, not necessarily in that order. On Muscatine Island the general rotation is corn, rye, 1 or 2 years of sweet potatoes, followed by melons and cantaloupes for 1 or 2 years, or in some instances more.

The value of lime as a means of neutralizing the acid condition to which some of the more important soils of the county are subject is becoming more and more appreciated,[1] as is also the use of leguminous crops as a means of building up the nitrogen content of the soils.

Manure is used almost exclusively for fertilizing, the large quantities obtained from the local hog and cattle industry being supplemented by shipments from the Chicago stockyards, which are delivered by the railroads for 50 cents a ton. When obtained at Muscatine the price is generally about 50 cents a ton. The land used in the production of melons and other truck crops is manured heavily, but little commercial fertilizer has been used.

Irrigation is being extended on Muscatine Island. The water table is from 10 to 20 feet from the surface in this section, and comparatively cheap individual systems of irrigation may be maintained. The water is pumped and distributed through main ditches and laterals. Even in seasons of prolonged drought the crops are generally irrigated not more than four or five times. The low cost is offset by the increased yields and by the prevention of crop losses through drought.

Because of unfavorable topography or position along streams a large part of the forested land is poorly suited for agriculture, but small areas are being cleared annually. As a rule the larger farms of improved land are located on the best types, the Muscatine silt loam, Buckner silt loam, Bremer silty clay loam and clay, and the Memphis silt loam.

Both cash and share systems of renting farm land are followed. Cash rent in the upland varies from $4.50 to $8 per acre. Where the land is rented on shares, the owner usually receives one-third to one-half of the cultivated crop, cash rent being paid for pasture land.

[1] Of a large number of samples of the Mississippi loess soil which forms the upland of Muscatine County, 76 per cent were found acid in tests conducted in the laboratories of the Iowa State College of Agriculture and the Mechanic Arts. Four samples from Muscatine County, two from Lake, one from Bloomington, and one from Muscatine Township were included. Three of these proved acid and showed lime requirements of from 5,695 to 9,612 pounds per acre for the soils, 4,272 to 14,952 pounds for the subsurface soils, and 4,272 to 8,544 pounds for the subsoils to neutralize the acid condition. See Bulletin No. 151 of the Iowa State College of Agriculture and the Mechanic Arts, "Soil Acidity and the Liming of Iowa Soils."

On Muscatine Island the cash rent varies from $3 to $15 an acre, the latter applying in the immediate vicinity of Muscatine. Share rents vary from one-third to one-half of the cultivated crop, the latter where the owner furnishes the fertilizer. At Conesville the average cash rental is about $6 an acre, and share rents vary from two-fifths to one-half of the crop, fertilizer being furnished by the owner on the latter basis. The greater part of the renting is probably on the share basis. About one-third of the melon lands at Conesville and on Muscatine Island are under lease.

Farm laborers are paid from $1.50 to $2 per day with board, and from $20 to $35 a month with board if hired for the greater part of the year. In some instances where the laborer has a family a house is furnished, and a wage of about $40 a month paid. From 2½ cents to 4 cents per bushel is paid for husking corn, the rate depending on the condition of the crop. Farm labor is scarce, especially during the harvest season, and cooperation is practiced by the farmers in harvesting and thrashing.

SOILS.

The soils of Muscatine County are properly classed as glacial in origin, although to a very large extent the material has been worked over and redeposited by wind and water. As is general throughout the glacial region, the source of the soil-forming material is not determinable with much definiteness, being only in part derived from or bearing no relation whatever to the underlying formations.

The substructure of the county is formed by a series of Paleozoic rocks, lying one above another in almost horizontal strata. Before the glacial epoch these rocks had been undergoing disintegration and decomposition. They had been subjected to erosive agencies over a long period of time and a mantle of soil had formed. At least twice during glacial times the region was covered by great ice sheets from the north, and each time the retreat of the ice left a mass of glacial débris in place of the preexisting soils. At a later period still these coarser glacial or till deposits were covered with a layer of very smooth textured silty material.

During and since glacial times, with the reestablishment of drainage, valleys of varying widths have been formed and the uplands have given way in part to alluvial plains, now in the form of first bottoms and terraces. The alluvial soils adjoining the Mississippi and Cedar Rivers have been laid down by these streams, and those of the West Liberty Plain by a stream which is supposed to have had its course through it, with some lacustrine influence. The greater part of the substance composing these sediments is material from the drainage basins of the streams which transported the sediments and deposited them in their present position. It is derived

largely from the sediments of the various drift sheets to the north and the underlying Paleozoic sediments. There has, of course, been some local influence from small streams, and, at the edges of the West Liberty Plain, terraces, and bottoms, some colluvial influence. The alluvial deposits of the West Liberty Plain are known to be 250 feet deep in places, and it must be inferred that considerable material was carried in and that the transportation covered a long period. The Cedar River first bottoms are well developed, being 2 miles wide in places, and the first bottoms and terraces sometimes have a width of more than 3 miles. The greatest development of the Mississippi flood plain is on Muscatine Island, where it is 6 miles wide. In the rock-bound channel east of Muscatine the activity of the river was limited by the bluffs, and the strip of alluvial soils is quite narrow.

In the vicinity of the Cedar River, mainly along the bluffs and immediately back from them, but extending 3 miles from the stream in several places, there occur a number of dunelike knolls, mounds, and ridges of varying size and pattern and composed of fine sandy material. They owe their formation to aeolian agencies.

The till which occurs throughout the upland areas immediately underlying the silt layer, or loess, consists for the most part of an unassorted mass of clay, silt, sand of various grades, and rock fragments ranging from small gravel and pebbles to rather large bowlders. Except locally where it is little other than sand, it is generally a loam to clay which is not excessively stony and has a yellowish to reddish-yellow or red color. In origin it probably was derived in large part from the underlying sandstones, shales, and limestone and similar rocks extending far to the north of the county, with some influence from such crystalline rocks as occur along the northern border of the United States. Indicating limestone influence the material is still calcareous, but not nearly so strongly as the till sheets forming the soils of northern Iowa and other sections farther north.

The source of the loess is not known. Its generally fine, smooth texture without any stone fragments whatever is in striking contrast to the underlying material, and it undoubtedly was laid down in an entirely different way. Geologically its deposition is ascribed to aeolian agencies, and Udden has classed it as Mississippi loess. According to this authority, it varies in thickness from a few feet along the crests of some of the ridges to 40 feet on the bluffs at Muscatine, while the general average depth over the uplands is from 12 to 15 feet.[1] The greater depth of the material along the Mississippi River bluffs would indicate that the material was, to a large extent at least, blown out of the Mississippi River bottoms. If this is true its original source was about the same as that of the alluvial soils

[1] Geology of Muscatine County, by J. A. Udden.

which are derived from a variety of rocks with considerable limestone influence. While probably rather strongly calcareous when originally laid down, as the result of rather thorough weathering and leaching it is now only slightly calcareous to somewhat acid, in this respect differing widely from the Missouri loess in the western part of the State.

While the present alluvial deposits may be traced to the same general source as the upland material, it varies from highly quartzitic in the lighter sandy areas to slightly calcareous, with probably a very large proportion of limestone and shale material in the areas of heavier texture.

The material of the sand knolls and ridges has undoubtedly been removed from the Cedar River bottoms, differing only in a general way from that of some of the terraces, the West Liberty plain, and the immediate bottoms. At present these dunes are mainly stationary, but some of them are still being moved by winds.

The different deposits giving rise to the soils of the county range in geologic age from early glacial to recent. Udden[1] and other geologists accredit the till sheets to the Kansan and Illinoisan stages of glaciation. The loess, or silt mantle, is probably late glacial or postglacial, while the sand mounds and the alluvial lands range in age from glacial to very recent.

The present soils have resulted from weathering, erosion, and the growth of vegetation in the various classes of material. On the uplands and the very old alluvium these agencies have been at work for a much greater length of time than in the overflow bottoms, where the material is very much the same as when deposited and where fresh deposits of material are being laid down with each overflow.

Except between the uplands proper and the terraces and overflow lands, there are no physiographic features which have had an important influence on the distribution of soil material. In the uplands the distribution of soils follows in a general way some of the more important topographic differences resulting from erosion. The smoother areas, where there has been very little erosion, were prairies, and the soils are dark brown to black, while the rougher areas were forested with a mixed growth of oak and other hardwoods, and the soils are comparatively light in color. In some of the most eroded areas the loess has been entirely removed, exposing the underlying till. A very large part of Muscatine Island and the West Liberty Plain is prairie, and the soils range from brown to black in color, depending upon the thoroughness of drainage. The first bottoms were and are

[1] Ibid.

to a very large extent forested, and the soils are poorly drained and dark brown to black in color, except in local very sandy areas.

On the basis of differences in origin and mode of accumulation of the soil material the county is divided between the Glacial and Loessial and the River Flood Plains provinces, all of the uplands belonging in the former and the terraces and bottom lands in the latter. The upland soils have been grouped on the basis of color, structure, etc., with the Muscatine, Knox, Memphis, and Lindley series, the terrace soils with the Buckner, Bremer, and Calhoun series, and the first-bottom soils with the Wabash and Cass series. Twenty-eight soil types, including the miscellaneous soils, Marsh, Muck, Meadow, and Riverwash, are recognized in Muscatine County.

The table below gives the name and actual and relative extent of each soil type mapped. The silt loams predominate, though there is a large total area of heavier soils.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Muscatine silt loam	102,912	37.2	Cass loam	2,688	1.0
Memphis silt loam	54,592	19.7	Meadow	2,688	1.0
Buckner silt loam	17,600	7.5	Cass sand	2,624	.9
Colluvial phase	3,072		Cass silty clay loam	2,496	.9
Wabash silty clay loam	12,608	4.6	Buckner fine sandy loam	2,304	.8
Lindley silt loam	9,344	3.4	Buckner fine sand	1,856	.7
Buckner loam	8,256	3.0	Buckner coarse sandy loam	1,856	.7
Wabash loam	8,000	2.9	Wabash sandy loam	896	.3
Knox fine sand	7,808	2.8	Cass sandy loam	768	.3
Buckner coarse sand	6,720	2.4	Riverwash	576	.2
Buckner sandy loam	6,720	2.4	Muck	512	.2
Buckner sand	4,288	1.6	Knox fine sandy loam	448	.2
Calhoun silt loam	3,904	1.4	Marsh	192	.1
Muscatine silty clay loam	3,648	1.3			
Bremer silty clay loam	3,648	1.3	Total	276,480	
Bremer clay	3,456	1.2			

MUSCATINE SERIES.

The surface soils of the Muscatine series are dark brown to black and the subsoils gray with yellowish-brown mottlings. The subsoils are as heavy as or slightly heavier than the soils and are somewhat compact in structure. The Muscatine soils are derived from smooth-textured silty deposits, probably of loessial origin. They occupy nearly level to smoothly rolling uplands which originally existed in the prairie condition, and, except in local flat and depressed areas, they have fair to good drainage. The soils and subsoils are neutral to acid, and lime concretions rarely occur.

MUSCATINE SILT LOAM.

The soil of the Muscatine silt loam is a black to dark brownish gray, mellow silt loam with a depth of 12 to 16 inches. The subsoil is a brownish-gray or finely mottled yellowish-brown and gray, compact silty clay loam extending to a depth of 3 feet or more.

The type is uniform in texture and, except locally, in structure and color. In small areas about the heads of drainage ways and where the surface is quite flat the subsoil is somewhat darker in color and more plastic than the typical, while in other areas there is a faint development of a gray layer below the surface soil or a slight hardpan layer at varying depths in the 3-foot section.

Small areas of Shelby loam occur scattered over the area of the Muscatine silt loam. They have much the same appearance in the soil as the Muscatine, but the subsoil, instead of being heavy, dark colored, and plastic, is yellow, rather sandy, and more porous than the subsoil of the Muscatine. The total area of these spots amounts to only about 500 acres in the county, while that of the individual areas is less than 20 acres as an average.

The Muscatine silt loam has the greatest extent of any type in the county, being confined almost entirely to the open prairie country, where it occurs in large unbroken areas. The main body of the type occurs on the divide between the Cedar and Mississippi Rivers and extends from the northeastern corner of the county to the southern boundary. Another large area occurs in the northwestern corner of the county, and there are several detached areas in the West Liberty Plain near the Cedar River.

The topography of the area occupied by the Muscatine silt loam is gently rolling to rolling, and in some places hilly, especially near the edges, where it has been slightly more dissected. The altitude of the plain on which the type occurs varies from about 800 feet, south of Stockton, to 726 feet at Stockton and Summit, 683 feet at Wilton, and 681 feet at Bayfield.

The drainage of the greater part of the type is fair, though rather poor on the flat phase and on the "hardpan" phase. Tile drainage has been installed in many places to supplement natural drainage. This has proved profitable in most instances, and is particularly beneficial in the flat areas.

The material composing this type is of loessial origin, having been deposited over the glacial drift material of earlier deposition. The depth of the loessial material over the greater part of the county varies from 10 to 15 feet. On the tops of the ridges it is frequently shallower than the average, the underlying material of glacial or fluvial deposition appearing in road cuts at depths of 6 to 8 feet.

The area occupied by this type is used almost entirely for farming, the portion not under cultivation to grains and grasses being devoted to pasturage. The soil is easily cultivated, especially where care is taken to keep up a high organic-matter supply. In only a few places does the surface have sufficient slope to make the use of farm machinery impossible.

The Muscatine silt loam is a very desirable soil for all general farming, and there is no waste land. About 85 or 90 per cent of the type is under cultivation. It is probably less durable and fertile than some of the heavier alluvial types of the county, but crop yields are gen erally as good or better. Corn, hay, oats, barley, and wheat are the principal crops grown, with some rye. Yields of 60 to 80 bushels of corn per acre are frequently reported, though the general average is near 45 or 50 bushels. The acreage yield of wheat is from 18 to 25 bushels, oats from 30 to 40 bushels, barley from 20 to 25 bushels, rye from 15 to 20 bushels, and hay from 1 ton to 1½ tons. The only special crop grown on this soil is cabbage, the yields of which range from 8 to 10 tons per acre. Alfalfa is grown in several small patches, the yields varying from three-fourths to 1 ton per acre at each cutting, three or four cuttings generally being made each season. Orchards on the type are generally not of commercial size. Cattle raising and feeding and the raising of hogs are important industries on the type. Most of the corn grown is fed to the cattle and hogs. Dairying is of some importance, and the industry is expanding.

The type is better adapted to general farming than to the production of special crops. Some dairying is carried on north of Muscatine and in the vicinity of Wilton, Sweetland, and West Liberty. Considerable fine stock is raised at Stockton, attention being paid also to this branch of animal industry in other parts of the county covered by this type.

Crop rotation is generally practiced, the usual systems covering 4 or 5 years, 2 years of corn, 1 year of small grain, with timothy or clover seeded, and 1 year each of hay and pasturage, or 2 years of corn, 1 year of small grain, and only 1 year of either meadow or pasturage. No commercial fertilizers are used, but the use of organic manures is common, the applications ranging from 5 to 15 tons per acre, the larger quantity being applied generally not more than once during a rotation.

A large percentage of the soil of this type is acid, and a number of samples tested at the Iowa Agricultural Experiment Station showed applications of from 3 to 7 tons of lime per acre to be necessary. Considerable liming is practiced, the ground limestone being used exclusively. A few stands of alfalfa have been obtained

on the type without liming or inoculating, but with such treatment yields are materially increased.

The farms of this type are operated by a thrifty, progressive class of farmers, and are well maintained and improved. Improvements are everywhere of high order and of modern type. Some of the best farms in the county are found on this type. The nearness to markets and shipping points, farm improvements, and local conditions determine its value. The selling price ranges from $175 to $275 an acre, though the average value probably is about $200 to $225 an acre.

Following are the results of mechanical analyses of samples of the soil and subsoil of the Muscatine silt loam:

Mechanical analyses of Muscatine silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
330665	Soil	0.4	1.2	0.6	1.3	5.4	65.9	25.1
330666	Subsoil	.6	1.2	.4	1.0	5.8	66.5	24.5

MUSCATINE SILTY CLAY LOAM.

The surface soil of the Muscatine silty clay loam has a depth of 12 to 18 inches, and consists of a black silty clay loam which is quite compact in structure and has a dark-gray color when dry. Below this there occurs a black, tough, compact silty clay loam to silty clay, which grades at about 24 to 30 inches into a drab and yellowish-brown mottled silty clay. In some instances the subsoil is drab rather than black, grading finally into the mottled material. In places the substratum is made up of alternate layers of drab and yellowish brown, or layers in which the mottlings of either color may predominate. While this type appears distinctly heavier in texture than the Muscatine silt loam its apparent heaviness is due more to a structural than to a textural difference, and is the result of poorer drainage conditions.

This type occurs mainly at the sides and heads of drainage lines traversing the Muscatine silt loam, and in poorly drained depressions throughout that type. These depressions are in many instances too small to map without exaggeration. Where it occurs along streams, some distance from their heads it may be slightly modified by alluvial material. In several instances the type is mapped along streams traversing the Memphis silt loam. The type also includes a few small areas of light-colored silty clay loam.

The soil is sticky when wet, and when dry bakes and cracks badly, injuring crop roots to some extent. Care should be taken not to

work the soil or allow cattle on the type when wet on account of its tendency to puddle. In the cultivation of the type heavy machinery is necessary. In some instances the surface is slightly more loamy than usual, and here cultivation and the maintenance of a good tilth are decidedly easier than where the typical silty clay loam soil occurs directly at the surface.

The extent of this type in Muscatine County is small, and it is confined generally to small areas or long, narrow strips. The largest area occurs immediately north and west of Sweetland. This area is nearly level and has the appearance of a depression sloping slightly to the north. A large part of the type is tile drained to assist in the removal of excess moisture. The benefits are generally such as to more than offset the cost of tiling.

The greater part of the type was originally prairie. Along the immediate edge of the streams there is a growth of willows and water-loving shrubs. In its natural state it supports a good growth of bluegrass, and the type is mainly used for pasturage.

With favorable climatic conditions, good yields of corn, hay, and small grains are obtained. The small grains have a tendency to run to straw rather than seed, and also to lodge, and for that reason are unpopular on this heavy soil. Corn yields from 45 to 65 bushels per acre, 50 bushels being a fair average. Mixed clover and timothy hay yields from 1 ton to 1½ tons. Corn matures later on this soil than on the silt loam because of the necessity of planting later in the spring on account of its wet condition and the slower development of the crop where the soil is poorly drained.

Only at Sweetland does the type occur in areas large enough to include entire farms. Here it is valued at $175 to $250 an acre, depending on improvements and local conditions.

The results of mechanical analyses of samples of the soil and subsoil of the Muscatine silty clay loam are given in the following table:

Mechanical analyses of Muscatine silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
330669	Soil	0.1	0.4	0.4	1.4	5.6	66.2	25.9
330670	Subsoil	.2	.4	.4	1.9	5.8	65.9	25.4

KNOX SERIES.

The Knox series includes light-brown soils derived from loessial or other wind-blown deposits. The loessial covering of the series is always thick enough to form the subsoil as well as the surface soil, the deeper lying glacial till being far enough from the surface to

have no marked influence on the general character of the soil material.

KNOX FINE SAND.

The soil of the Knox fine sand to a depth of 10 to 12 inches consists of a brown, slightly loamy fine sand. The underlying material has the same texture, but becomes slightly lighter in color with depth, being generally light brown or yellowish brown at 36 inches. In the subsoil the loamy character of the surface soil disappears. In some areas at depths of 18 to 36 inches there is a stratum of fine sandy clay or clay loam ranging from 4 to 8 inches in thickness, under which occurs a yellowish-brown sand of medium texture. This, however, is of rare occurrence within the 3-foot section. In some road cuts in the type it is seen to be more than 10 feet from the surface.

On account of the porosity of the material composing the type, drainage is everywhere excessive and the type is droughty. It occurs as low knolls, mounds, and ridges, some of the latter being quite long and attaining an elevation of 25 feet or more, and presents on the whole a "dune" topography. Near the Cedar River some large areas occur in which the mound and ridge topography is not in evidence, and in such areas the surface includes hills and basins, or "kettle holes," forming intricate patterns. In some cases the bottoms of these basins represent the original material over which the soil was deposited. A large part of the type extends along the bluffs from the upland to the Cedar River and has a knoll and ridgelike topography, with elevations of 15 to 30 feet above the surrounding land. In some of the larger areas the knolls and ridges rise to 50 feet or more above the plain level.

Where the type occurs on the bottoms and terraces of the Cedar River and on the upland in association with the Memphis silt loam it is forested, but this is not generally the case where it occurs on the prairie uplands.

The dunes are usually permanent, but in cultivated areas the soil drifts badly, the wind blowing the soil away from crops and causing large "blowholes" in the sides and crests of the ridges. The type is generally kept in grass, to hold the material, and in some instances trees, mainly oak, soft maple, and osage, have been planted to serve as windbreaks.

The best use of the Knox fine sand is for the production of watermelons and cantaloupes and grasses. Watermelons do especially well in seasons of well-distributed rainfall. Corn is grown to some extent and rye is the principal grain. The former suffers severely during the mid-season droughts and the ears are generally

short and small. The yields do not average over 15 to 20 bushels per acre. Rye yields average 10 to 12 bushels.

Sand bur and crab grass quickly grow into the crops when cultivation ceases and are the main pest of this soil. In some instances cowpeas are sown, the crab grass is allowed to grow, and they are cut together for hay. The yields vary from three-fourths to 1 ton per acre.

The total acreage of this type is comparatively small, and as a rule it does not occur in sufficiently large areas to compose individual farms. Its value can not be given separately, but its occurrence is generally considered a disadvantage, and the value of the lands with which it is associated is lowered by its presence.

The incorporation of large quantities of organic matter to make the soil more loamy, thus preventing blowing to some extent and also increasing the moisture-holding content, is beneficial. The plowing under of a crop of cowpeas or rye occasionally is an excellent practice. The plowing under of the crab grass is fairly beneficial to the soil and also aids in the extermination of the weed.

KNOX FINE SANDY LOAM.

The surface soil of the Knox fine sandy loam, extending to a depth of 10 to 12 inches, consists of a brown fine sandy loam. The subsoil is a brown to light-brown loamy fine sand, grading at 24 to 28 inches into a light-brown to yellowish-brown fine sand. In some instances the sandy clay layer occurring in the fine sand of the same series is present, in which case it is underlain by the yellowish-brown medium sand.

This type occurs generally as low mounds and ridges on the uplands, the West Liberty Plain, and terraces of the Cedar River. The areas generally are not more than 20 to 25 feet above the level of the surrounding plain.

Drainage is usually excessive, and the type is droughty. Where the clayey layer occurs within the soil section it aids materially in furnishing moisture for the crops, since it is retentive of moisture. The crops grown are corn, wheat, rye, and hay. Small areas are pastured. Yields are slightly higher than on the fine sand of this series.

The total acreage of the type is small. Some small areas are included with the Knox fine sand where their separation is impracticable.

Heavy manuring and the incorporation of organic matter by plowing under crops of cowpeas or rye aid materially in increasing the moisture-holding content of the soil and making it more loamy.

Memphis Series.

The soils of the Memphis series are light brown to yellowish brown in color and overlie subsoils of yellowish-brown to faintly reddish brown color. The structure of the soil is usually loose and when dry it is powdery. The subsoil is heavier than the soil and compact, especially in the upper part, but is always friable. Immediately above the compact subsoil the lower part of the soil layer is gray in color or contains considerable grayish material. Thin grayish films lie between the granules which often occur in the deeper subsoil. These soils occur along the Mississippi River bluff belt from Louisiana northward and are derived from silty deposits probably of loessial origin.

MEMPHIS SILT LOAM.

The surface soil of the Memphis silt loam extends to a depth of 10 to 16 inches and consists of a light-brown to light grayish brown, mellow, friable silt loam, the silt content being great enough in some instances to give it a velvety feel even when moist. It is only fairly well supplied with organic matter, and this accounts to some extent at least for the difference in color between this type and the Muscatine silt loam. Where the soil has been exposed to the weather for some time it has a light-gray color, while when moist it has a darker brownish gray color.

The subsoil in its upper part consists of a light-brown or yellowish-brown, compact silty clay loam, which continues throughout the 3-foot section. The subsoil, though compact, is not especially resistant to the upward or downward movement of moisture. The transition from soil to subsoil is generally quite abrupt.

A few small areas of Shelby loam occur within the areas mapped as the Memphis silt loam, but these are too small and unimportant to be shown separately on the soil map.

This type comprises 95 per cent or more of the originally forested upland of the county. The largest area extends back from the Mississippi bottoms to where it merges gradually with the Muscatine silt loam. In some places this gradation is quite abrupt; in others it extends over a zone one-fourth mile in width, and it is possible to draw only arbitrary boundary lines in some instances. The type occurs also back from the bluffs along the east side of the West Liberty Plain, but here the areas are not continuous and generally are not so wide as along the Mississippi bluffs. On the east bluff of the upland at and east of West Liberty the type is confined mainly to the bluff slopes, only two fair-sized areas occurring, one west of West Branch of Wapsinonoc Creek and the other northeast of Atalissa, the latter extending back from the Cedar River.

The topography of the greater part of the type is gently rolling to slightly hilly and flat on the crests of divides between streams. These divide crests, however, are not very wide. As the edge of the bluffs is approached the type becomes more and more dissected and the topography is hilly to broken.

The drainage is fair to good, and tile drainage has not been found necessary except in the flat areas on the divides and in small, slightly depressed areas. In the vicinity of the hilly and broken areas the drainage is excessive on account of the sharp gradient and the depth to which subdrainage reaches because of the depth of the drainage channels. The subsoil is fairly retentive of moisture, yet sufficiently pervious to permit good underdrainage.

Oak is the predominating tree on the type, red, scarlet, and black oak being most common. There are some bur oaks and white oaks, though these have been largely removed, especially the latter. Walnut, hickory, hard and soft maple, elm, and honey locust also occur.

The loose, friable, mellow character of the soil permits easy cultivation and the maintenance of good tilth throughout the year. Surface water is quickly disposed of by surface and underdrainage, but both soil and subsoil retain moisture well. The type warms up early in the spring, permitting early cultivation and planting. The farms are of good size generally, though the percentage of improved land is smaller than on the Muscatine silt loam because of the rough areas. However, all but the rougher areas are under cultivation. The woodlots are generally used for pasture.

The principal crop is corn, to which from one-third to one-half the total acreage devoted to staple farm crops is devoted. The type gives good yields with a favorable distribution of rainfall during the growing season. In droughty seasons crops are inclined to "fire" earlier than on the Muscatine silt loam. The yields of corn range from 30 to 50 bushels, though maximum yields of 80 bushels per acre have been reported. Small grains are grown to some extent. Oats probably rank first among these in acreage, with an average yield of 25 to 30 bushels per acre. Rye yields from 16 to 20 bushels and winter wheat from 20 to 25 bushels per acre. Barley receives but little attention on this soil, the yields averaging not over 15 or 20 bushels per acre. Clover catches easily, and a good stand is generally obtained. When cut for hay it produces from 1 ton to 1¼ tons per acre, and when thrashed from 1 bushel to 2 bushels of seed per acre. Clover and timothy mixed yield from 1 ton to 1½ tons of hay per acre. Alfalfa is grown only in small patches and yields from three-fourths ton to 1¼ tons per acre at each cutting.

The type is favored for trucking on account of its mellow, friable character, and the ease with which the soil is cultivated and a good tilth maintained. A very large part of the tomatoes, cabbage, onions, and cucumbers grown for canning and pickling is produced on this type. Some attention also is being given to the production of pumpkins and squashes for canning. Cabbage and tomatoes yield from 8 to 10 tons per acre. Cucumbers yield from 225 to 275 bushels per acre of the gherkin and pickle size. Onions are mainly of the small pickling variety.

There are several orchards of commercial size on the type. Cherries are most commonly grown, and apples, early peaches, plums, and pears are the principal larger fruits. The fruit is sold mainly at local markets. Apples yield about 150 bushels, peaches about 200 bushels, and pears and plums from 200 to 250 bushels per acre. The fruit is generally of good quality. The yields vary largely with seasonal conditions. Several small vineyards have been established on slopes of southern exposure. The grapes are generally disposed of at local markets.

Barnyard manure is used to supply the soil with humus and keep up fertility. It is applied in quantities varying from 5 to 15 tons per acre, 10 tons being a high average. Rotation is practiced by a majority of the farmers.

The greater part of the type is acid, and is benefited by the application of lime in quantities ranging from 2 to 5 tons of ground limestone per acre, more being necessary in some cases.

It is generally necessary to lime and inoculate for alfalfa, though some fair stands have been secured without such treatment. Where a stand had been secured, and liming and inoculation subsequently practiced, yields were materially increased.

This type is about as thickly populated as the Muscatine silt loam, and the same high order of dwellings and farm buildings and equipment prevails. The farmers are generally of a thrifty, progressive class, and farms are generally systematically operated and kept in a high state of productiveness.

Improved land on the Memphis silt loam is valued at $175 to $250 an acre, while unimproved lands are held at $125 to $150 an acre. Near Muscatine, West Liberty, Atalissa, Cranston, and Ardon, which are located on the type, higher prices prevail. Local conditions, improvements, and amounts of cleared land, with distance to markets and shipping points, govern the selling price.

Lindley Series.

The soils of the Lindley series are yellowish gray or yellowish brown. The subsoils are yellow, reddish yellow, or light brown in color, and are composed of glacial drift material. The soils have

been influenced to a considerable extent by the former loessial covering. The series occupies steep stream slopes, originally forested with oak, hickory, and elm.

LINDLEY SILT LOAM.

The surface soil of the Lindley silt loam as mapped in Muscatine County consists of light-brown to grayish-brown silt loam of loessial origin, modified in places by subsequent colluvial action. It contains some fine sand and very fine sand, sometimes in sufficient quantities to make the soil a fine sandy loam. The subsoil consists of the brown to yellowish-brown clay of the underlying glacial drifts, in this area of the Illinoisan and Kansan glaciers. Usually it is stiff and compact, and contains some small gravel and pebbles, generally angular or subangular in shape. At greater depths lime concretions occur. In some instances gravel and small pebbles are found on the surface.

On the steeper slopes small areas of Rock outcrop exist, the rock generally consisting of limestone and in some instances of limestone and sandstone. Some residual soil from the weathering of these exposed rocks is disseminated over the slope and mixed with the covering of colluvial-loessial material.

The main occurrence of the Lindley silt loam is on the bluff slopes extending from the upland to the alluvial bottoms, and back along the deeply eroded stream channels draining the uplands. By far the greater part of the total area mapped occurs in the eroded area east of Muscatine. The type is forested, the growth being the same as that of the Memphis silt loam, with which this soil is associated.

Forestry and pasturage are the only uses to which the type can be devoted. West of Muscatine some groves of walnut are found on the bluff slope; these are valuable chiefly for cabinet and furniture wood. The area of the type under cultivation is so small that no data on crop yields could be obtained. Cultivated crops suffer from excessive drainage, drought, and the disastrous erosion to which the sharp slopes of the type are subject.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Lindley silt loam:

Mechanical analyses of Lindley silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
330673	Soil	0.1	0.8	0.7	2.8	14.2	65.8	15.5
330674	Subsoil	.6	1.9	1.7	8.2	8.8	44.7	33.8

Buckner Series.

The Buckner series includes brown to light-brown or yellowish-brown soils with subsoils of slightly lighter color. The series occupies stream terraces and flat alluvial lands along streams through which the channels are so deeply cut that overflows are of rare occurrence. In places strips of colluvial material occur, usually adjoining terraces or bottom lands.

BUCKNER COARSE SAND.

The soil of the Buckner coarse sand consists of a brown to dark-brown, loamy coarse sand, sometimes containing considerable fine material, to a depth of 20 to 30 inches. When dry the color of the surface material varies from grayish brown to dark brown. The color varies also with the quantity of organic matter present. This material is underlain generally by a brown to light-brown loamy coarse sand, generally less loamy than the surface soil, which extends to a depth of 3 feet or more. Some fine gravel is scattered throughout the section and over the surface.

This type occurs almost exclusively on Muscatine Island, where it occupies a second-bottom position above ordinary overflow. The levee protects that part of the type in the immediate vicinity of the Mississippi River, but even without the levee excessively high water would be required to flood this area. The elevation of the type is greatest in the interior of the island.

The topography is almost level. Drainage is good to excessive on account of the porous soil and subsoil. The water table is only about 10 to 15 feet below the surface, and this may account in a measure at least for the moisture contained in the soil even after moderate droughts. The type suffers from long-continued drought but withstands moderate droughts fairly well. Irrigation is practiced as a means of distributing moisture during dry seasons.

The greater part of the type occurs in a single body, and the remainder as small areas in the coarse sandy loams of those series with which this type is mainly associated. Slight depressions in the type contain soil generally sufficiently heavy for classification with the coarse sandy loam, but these areas are not of sufficient size to map separately.

Rotations are practiced on the type, and the soil is heavily manured with barnyard manure. Tillage is easy because of the loose condition of the soil. This same characteristic is responsible for the difficulty experienced in keeping ditches open where irrigation is practiced, and in maintaining ridge rows. The incorporation of manure has a tendency to make the soil more loamy and also to make it more

retentive of soil moisture. The plowing under of green crops as organic manure also is highly beneficial.

Practically all the type is under cultivation. Watermelons are the principal crop, with cantaloupes and sweet potatoes of almost equal importance. Corn and rye are grown mainly to complete the rotations rather than for crop yields. Cowpeas are grown with crab grass for hay. Where efforts have been made to eradicate the crab grass the hay is better. This soil, like the Buckner sand, is favored for asparagus, and good yields of a fair quality are obtained. Other vegetables also are grown.

The watermelons and cantaloupes are of good quality, and a smooth sweet potato of good texture is produced. Watermelons yield from one-fourth to one-half carload[1] per acre. Cantaloupes produce about the same yields. Sweet potatoes yield from 100 to 150 bushels, corn from 15 to 25 bushels, and rye from 10 to 15 bushels per acre. The hay yield varies somewhat, depending on the amount of crab grass present. It ranges generally from three-fourths ton to $1\frac{1}{4}$ tons per acre. Asparagus makes a good, strong growth, and with good climatic conditions yields from 15 to 20 cuttings per season. Vegetables of all kinds do well. Slightly higher yields are obtained where irrigation is practiced. Rye matures generally before the usual summer drought, but corn suffers badly, the stalks being short and the ears small.

The type is valued at $100 to $200 an acre, higher prices being demanded where good irrigation systems have been installed, where the large asparagus beds are located, and where farms are well improved and near market and shipping facilities.

BUCKNER SAND.

The soil of the Buckner sand to a depth of 18 to 20 inches consists of a brown to dark-brown, in some places nearly black, loamy sand of medium texture and loose, porous, friable structure. This is underlain by a subsoil of brown to yellowish-brown or grayish-brown slightly loamy sand, medium to coarse in texture and less coherent than the surface soil, in some instances grading into a fine sand at less than 3 feet below the surface. In the vicinity of Conesville the soil is more often grayish brown than brown, and frequently the subsoil at 20 to 28 inches is a yellow, in some instances almost a lemon yellow sand. The latter characteristic occurs also on Muscatine Island, but to a less extent.

[1] The term "carload" as used in this report is understood to mean nine hundred 30-pound melons, or about 27,000 pounds. The weight varies from 24,000 to 30,000 pounds, the lower figure probably representing the carload weight of cantaloupes.

In small areas throughout the type the typical soil is underlain at 15 to 24 inches by a subsoil containing considerable fine gravel and some water-rounded pebbles, in some instances in such large quantities that boring is impossible. In several areas the gravel is encountered within 10 or 12 inches from the surface. Gravel and small pebbles are scattered over the surface and throughout the soil and subsoil of the type, being most numerous in the soil of the gravelly subsoil phase.

The Buckner sand occurs as terraces along the Mississippi and Cedar Rivers and on the West Liberty Plain proper. Its main occurrence is on Muscatine Island and at Conesville, though it is encountered in scattered areas on the West Liberty Plain, generally in the vicinity of the Cedar River bottoms and on the terraces of that river. Along the south boundary line of the county, about one-fourth mile west of the Mississippi, occurs what appears to be the remnant of an old terrace, locally known as the "sand mound." It has an elevation of 35 to 40 feet above the level of the surrounding country and in Muscatine County covers about one-half square mile. It extends for a considerable distance into Louisa County.

The type lies above overflow, except on Muscatine Island along the Mississippi River where it would be subject to overflow along the banks when the water reaches the 18-foot stage, were it not protected by the levee. In the interior of the island it lies slightly higher and is subject to overflow only during exceptionally high stages of the river.

The topography of the top of the high terrace or mound is flat to only gently rolling, with a few small sand ridges where the material has been reworked by eolian agencies. Water-rounded pebbles occur throughout the soil and subsoil, and are indicative of the origin of the mound. The slopes are badly washed, and the surrounding material has been modified to some extent by this colluvial material and some wind-blown material from the surface. The soil is a brown to grayish-brown loamy sand. The color continues the same throughout the section, but the material becomes less loamy with depth. The topography of the remainder of the type is flat to only gently rolling, with occasional depressions in which occur areas of the sandy loam of this series. The surface is varied by some small ridges due to wind action. These occur more extensively in the district around Conesville, where they are mapped as the Knox fine sand. In the immediate vicinity of these the soil is medium in texture, the finer material having been removed by the wind and deposited as the ridges.

The type, notwithstanding its flat topography, is naturally well drained owing to the porous subsoil. In spite of the loose character of the soil and subsoil, they are very retentive of moisture. The

comparatively high water table, which on Muscatine Island is from 10 to 15 feet and at Conesville 12 to 20 feet from the surface, may have some influence in this respect. In seasons of prolonged drought crops suffer severely where not irrigated.

The greater part of the type was originally in prairie, some scrubby tree growth occurring where the type borders the streams. Where uncultivated the type supports a rank native growth of weeds and grasses.

On account of the loose, friable character of the soil, tillage operations are carried on with ease, yet the same condition causes the ridges in which the truck crops are planted to be beaten down by rains and makes constant opening of the ditches necessary where irrigation is carried on.

Practically all the type is under cultivation, and the greater part of it is devoted to the production of watermelons, cantaloupes, and sweet potatoes. Corn and rye are grown, but mainly in rotations, and cowpeas are grown for hay. Asparagus is becoming an important crop. Other vegetables are grown to a small extent.

The yields of watermelons, cantaloupes, and sweet potatoes vary greatly with the season, and are heavier where irrigation is practiced. The melons and cantaloupes on this type are of good quality and the yields are good, varying from one-fourth to one-half carload per acre. The type is favored for sweet potatoes, and average yields of 100 to 125 bushels per acre are obtained. The maximum yield reported for the type is about 200 bushels per acre. A smooth potato of excellent quality is obtained on this type. Corn yields from 15 to 30 bushels, and rye from 10 to 15 bushels per acre. Oats and wheat are rarely grown. Cowpea hay yields from 1 ton to 1½ tons per acre, and is generally well mixed with crab grass. Asparagus does well. This type and the coarse sand are preferred for the cultivation of this crop. It yields about 20 cuttings per season. The weight of the yield and the number of cuttings vary with the season, being less when the spring is hot and dry. Vegetables of all kinds do well. Yields are lighter on the gravelly subsoil phase and crops suffer more severely in dry seasons. Well-distributed rains during the growing season and plenty of warm weather are necessary for best results with all truck crops.

The same rotation is generally practiced as on all the sandy soils, and heavy applications of manure are made. Commercial fertilizers are not used. The use of large quantities of manure furnishes organic matter and renders the soil retentive of moisture.

The type is valued at $125 to $275 an acre, depending on improvements and location with respect to market and shipping facilities. Where large asparagus patches are maintained and in the vicinity of Muscatine the prices are higher than those given.

BUCKNER FINE SAND.

The soil of the Buckner fine sand consists of 16 to 20 inches of a brown or grayish-brown to dark-brown loamy fine sand. The subsoil is a brown to light-brown loamy fine sand, which gradually loses its loaminess toward the bottom of the section, and gradually takes on a yellowish-brown color. In some instances there occurs a substratum of yellow loam, fine sandy loam, or fine sand, but this is of rare occurrence. In some places the subsurface material is slightly more loamy than the surface soil or subsoil.

This type is mapped mainly in the vicinity of Conesville, to some extent at and around Moscow, and to a less extent on Muscatine Island. The type occupies areas of flat, level topography, the flat surface being relieved only by slight mounds or ridges where the type has been modified by wind action, and slight depressions, comprising the fine sandy loam of this series. The type is encountered in terrace positions along the Cedar and Mississippi Rivers, and on the West Liberty Plain.

There is no coarse material in either the soil or subsoil except fine, water-rounded gravel, which occurs mainly in the soil. Both soil and subsoil are loose and friable, and easily worked. The type is well drained. It is retentive of moisture, although during prolonged periods of drought crops suffer.

At Conesville watermelons are the chief crop produced on this type, while cantaloupes and sweet potatoes are grown at Moscow and on Muscatine Island. Asparagus and other vegetables are grown to some extent. Corn and rye are grown, but mainly in the rotation. Cowpeas are grown to some extent, mainly in the Conesville section.

Watermelon yields range from one-third to one-half carload per acre, and cantaloupes from one-fourth to one-third carload. A good quality of both is obtained. Yields of 100 to 150 bushels per acre of sweet potatoes of good quality are obtained. Asparagus yields from 15 to 20 cuttings, with well-distributed rainfall during the cutting season. Yields and weights vary with the season and climatic conditions. Corn yields from 15 to 25 or 30 bushels and rye from 10 to 15 bushels per acre. Cowpea hay yields from 1 ton to 1½ tons, and generally contains a large percentage of crab grass. A very small proportion of the type is irrigated. Seasons of well-distributed rainfall are necessary for best yields.

The type has about the same value and character of improvements as the Buckner sand.

BUCKNER COARSE SANDY LOAM.

The soil of the Buckner coarse sandy loam consists of a dark-brown to black coarse sandy loam, which extends to a depth of 12 to 18

inches. The subsoil is a dark-brown to brown coarse sandy loam, which becomes slightly less loamy and of lighter brown color with depth, in some instances closely approaching yellowish brown at the 3-foot depth. The subsoil frequently contains a large percentage of fine gravel, especially in the lower part of the section. The soil is generally quite loose and friable, but has a tendency to compact slightly if stirred when wet. It, too, contains some water-rounded gravel and small pebbles. Both soil and subsoil readily absorb surface waters, the coarse material of which they are composed aiding in this respect. Both retain moisture fairly well, however, though crops suffer from prolonged droughts. Very little of the type is irrigated.

The type occurs mainly on Muscatine Island, where it is closely associated with the coarse sand of this series. It occupies a slightly lower position than that type, and the slight elevations in the type are generally composed of the coarse sand.

The type has a flat topography, with only slightly elevated areas and slight depressions. In spite of the flat topography, drainage is good, because of the porous soil and subsoil material.

The type existed as prairie at the time of settlement, and supported a rank growth of weeds and grasses in common with the other members of the series.

The type is not favored for the production of watermelons, cantaloupes, and sweet potatoes so much as the coarse sand, but these are the main crops grown. In common with the sandy loam and fine sandy loam it gives as large yields of watermelons and cantaloupes as the sand members of the series or larger, but the quality is not so good, being described as more stringy, tough, and grainy. Larger yields of sweet potatoes also are obtained, but they are said to be rougher and of coarser grain, while smoothness and a fine grain are the desired qualities. Rye and corn are grown in rotation, and some cowpea hay is produced. Watermelons yield from one-third to one-half carload per acre, and cantaloupes about the same. Sweet potatoes average between 125 and 150 bushels per acre. Corn yields from 20 to 30 bushels and rye from 12 to 15 bushels per acre. Vegetables do well on this soil. Well-distributed rainfall is necessary for best yields, and in seasons of prolonged droughts crops are frequently injured.

Crop rotations are generally practiced on the type, and the soils are heavily manured with barnyard manure. This supplies needed organic matter and increases the moisture-holding capacity of the soil.

The value of the type ranges from $125 to $175 an acre, varying with local conditions, improvements, and location with respect to shipping facilities and markets.

Mechanical analyses of samples of the soil and subsoil gave the following results:

Mechanical analyses of Buckner coarse sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
330647	Soil	8.6	41.2	13.6	10.8	3.4	12.8	9.3
330648	Subsoil	16.4	40.0	14.6	10.2	2.2	9.7	6.7

BUCKNER SANDY LOAM.

The soil of the Buckner sandy loam to a depth of 15 to 20 inches consists of a dark-brown, and in places almost black, sandy loam resting upon a brown to light-brown sandy loam subsoil. In the subsoil there is usually a gradation in color and texture with depth from a brown sandy loam in the upper part to a brownish-yellow sand at a depth of 2½ to 3 feet, while the underlying material to a depth of several feet is a sand or gravelly sand.

This type is confined largely to Muscatine Island and the West Liberty Plain near Conesville, less important areas occurring in a terrace position along the Mississippi River east of Muscatine and along the Cedar River. It is level to gently undulating in topography and has good natural drainage, except in small, slightly depressed areas where the soil usually is moist and loamy and where water may stand for a considerable length of time after rains.

The Buckner sandy loam is of very limited extent in the county, but practically all of it is under cultivation and in a good state of improvement. On Muscatine Island it forms a part of the area that is devoted very largely to truck crops. Here it is used chiefly for the production of watermelons, and to a less extent for cantaloupes, sweet potatoes, and some of the general crops, such as corn, oats, and rye. Near Conesville the type is used to some extent for watermelons and sweet potatoes, but more largely for corn, oats, wheat, and hay crops, cowpeas being grown quite successfully. The small areas east of Muscatine and those occupying a terrace position along the Cedar River more distant from shipping points are used for the production of corn and other general crops of the region with fair to good results.

The yields of watermelons, cantaloupes, and sweet potatoes are somewhat heavier than on the lighter sandy types, although it is claimed that the quality is not quite so good. The ripening period, too, is a few days later than on the sandy members of the series. The melon crops yield from one-third to one-half carload, and sweet potatoes from 100 to 150 bushels per acre. Corn yields from 25 to 30

bushels, rye 12 to 18 bushels, wheat 12 to 18 bushels, and cowpeas three-fourths ton to 1¼ tons of hay per acre.

No commercial fertilizers are used, but barnyard manure is generally applied in connection with the truck crops, and to a less extent for the general crops, applications being made at the rate of 5 to 10 tons per acre.

The value of this type varies widely, depending upon distance to markets and transportation facilities and the system of farming followed. The best trucking areas probably are valued at $200 an acre, but for the type as a whole the value ranges from $125 to $175 an acre.

Following are the results of mechanical analyses of samples of the soil and subsoil of the Buckner sandy loam:

Mechanical analyses of Buckner sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
330613	Soil	0.6	16.6	18.2	46.0	2.4	10.6	5.1
330614	Subsoil	1.0	13.6	16.7	48.2	2.6	12.1	5.8

BUCKNER FINE SANDY LOAM.

The soil of the Buckner fine sandy loam consists of a brown to dark-brown fine sandy loam to a depth of 15 to 24 inches. It is underlain by a fine sandy loam of brown to light-brown color, which becomes less loamy with depth, and in the lower part of the 3-foot section is generally a loamy fine sand or fine sand of yellowish-brown color. When wet or where it contains a large quantity of organic matter, the soil is of darker color than with only a normal moisture and organic-matter content. When dry the surface is brown or grayish brown.

The largest area of this type occurs south of Moscow, occupying a terrace of the Cedar River. Some areas of fair size occur in the vicinity of Conesville. On Muscatine Island there are a few small areas. Where the type adjoins the upland bluff south of Moscow there is apparently some influence from the sandy material underlying the loess cap, which at times is exposed in the drift, and from wind-blown material.

The type occupies a terrace position and the topography is flat, with small depressions in which the Buckner loam is generally developed. Small areas of wind-blown material occur, and where of sufficient size these are mapped as the Knox fine sand or fine sandy loam. The natural drainage is good to excessive on account of the

porous subsoil, though both soil and subsoil retain moisture well. Crops suffer in seasons of prolonged drought.

Manure is generally added to supply organic matter and maintain the productiveness of the soil, and crop rotations are generally practiced. Commercial fertilizers are not used.

Nearly all of this type is under cultivation. Watermelons and cantaloupes are the main crops, the yields varying from one-third to one-half carload per acre. Sweet potatoes do well, yields of 125 to 150 bushels per acre being obtained. Corn and rye are grown, mainly to make up the rotation systems. Corn yields from 25 to 30 bushels and rye from 12 to 15 bushels per acre. Cowpea hay yields from 1 ton to 1¼ tons per acre, but generally contains a large percentage of crab grass. A number of vegetables do well, but scarcely any are grown for the market.

The Buckner fine sandy loam is valued at $125 to $175 an acre, depending on local conditions, location, and improvements.

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

Mechanical analyses of Buckner fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
330651	Soil	0.6	5.0	7.4	42.0	16.2	19.2	9.4
330652	Subsoil	.4	6.5	9.4	48.7	16.4	12.9	5.4

BUCKNER LOAM.

The soil of the Buckner loam has a depth of 12 to 18 inches, and consists of a black to dark grayish brown loam to fine loam, of mellow structure. It grades into a subsoil of black to dark-brown heavy loam to clay loam, which generally passes into a brown clay loam at about 24 to 28 inches, and at a depth of 3 feet the material is frequently light brown in color. In some instances the heavy loam of the subsoil continues to the 3-foot depth with the same color as the typical subsoil. Both soil and subsoil retain moisture well, but crops suffer when droughts of long duration occur. The surface is grayish when dry. The subsoil becomes hard and compact on drying out.

There are several small areas of this type in which the subsoil is a heavy loam of black to dark-brown color, and this at about 30 inches is underlain by loamy sand of medium texture. Where the type occurs along the Mississippi River it is frequently underlain by sand at depths varying from 3½ to 6 feet.

The Buckner loam is encountered east of Muscatine, where it occupies a terrace position along the Mississippi River. It occurs also on the east side of Muscatine Slough, on both sides of the Cedar River, where it occupies similar positions, and on the West Liberty Plain, where it is most extensively developed in the vicinity of Conesville and to the east and west of Nichols. It is associated mainly with the Buckner silt loam and sandy loam, small areas of which are included.

The topography of the type on the West Liberty Plain is level to very gently sloping, with slight depressions in which the soil is heavier, and slight elevations in which it is mainly of lighter texture. The sandy knolls and ridges characteristic of the Knox fine sand and fine sandy loam are scattered over the type. On the terraces the surface slopes slightly toward the streams to which they owe their origin, and here, too, the Knox soils are developed. Drainage is fair, even in the level areas, for the subsoil is not sufficiently compact to make it impervious to water. Near Conesville and Nichols artificial drainage is provided by constructing laterals to the main drainage ditches. Those areas along the Mississippi River east of Muscatine have a gradient sufficient to insure good natural drainage. The terrace areas are generally better drained than those on the West Liberty Plain.

The type as it occurs on the West Liberty Plain was originally prairie. A part of the type occurring as terraces was originally forested with a tree growth typical of the general region.

Tillage operations on this type are conducted with comparative ease, owing to the mellow, friable soil, and a good tilth is easily maintained. The soil breaks up readily and rarely clods, and is hardly sticky enough when slightly wet to make cultivation difficult.

All of the type is under cultivation, and corn is the principal crop. Oats, wheat, rye, and barley are grown to a less extent. Clover, timothy, and cowpeas are grown for hay. Cabbage, tomatoes, potatoes, cucumbers, and onions are the chief vegetables grown, and these are produced mainly east of Muscatine on the terrace. Corn yields from 30 to 50 bushels, oats from 25 to 35 bushels, wheat 18 to 20 bushels, and barley from 15 to 18 bushels per acre. Clover and timothy hay yields from three-fourths ton to 1¼ tons, and cowpea hay from 1 ton to 1¼ tons per acre. Cabbage yields from 6 to 8 tons, tomatoes 7 to 8 tons, cucumbers about 200 to 225 bushels, and onions from 300 to 350 bushels per acre. Some watermelons and cantaloupes are grown on the type, and while the yields compare favorably with those on the sandy loams, the quality is inferior and the melons mature later. A large part of the type is used for pasture, especially where forested.

Crop rotations are practiced, and manure is applied in large quantities. The farm improvements indicate generally a progressive and prosperous agriculture. The type is valued at $125 to $200 an acre, depending upon improvements and location.

BUCKNER SILT LOAM.

The soil of the Buckner silt loam consists of 12 to 16 inches of a black to dark-gray, friable silt loam, having occasionally a slightly brownish tinge, and containing in some places a fair percentage of very fine sand. This is underlain generally by a black to chocolate-brown, compact silty clay loam, which grades at about 24 to 30 inches into a brown to light-brown silty clay loam, also of compact structure.

In the better drained areas the subsoil has a brown color, grading almost immediately into light brown or yellowish brown, the texture and structure being the same as in the soil, except that the subsoil is slightly more pervious. In the less thoroughly drained areas the subsoil grades from black to dark drab and to grayish in the lower part of the 3-foot section. When wet the subsoil is quite plastic, but ordinarily it is rather tough. In some instances the subsoil is a heavy, compact silt loam of black or brown color, grading into a silty clay loam generally before the 3-foot depth is reached. Some brown mottling is present occasionally in the darker colored subsoils, and stains of rusty brown, due to the presence of oxide of iron concretions, are found. Where the type occupies terrace positions, water-rounded gravel and small pebbles are found in the soil and subsoil. Some areas containing lighter colored soils than typical, but overlying typical subsoils, are included in the type. East of Atalissa there are several small areas in which the gray silt layer, characteristic of the Calhoun silt loam, occurs between the soil and subsoil of this type. These are too small and unimportant to be mapped separately. They have a lower agricultural value than the typical soil.

The Buckner silt loam occurs in extensive areas in the vicinity of West Liberty, Nichols, and Atalissa. It occupies a terrace position along present drainage ways, and the topography is generally level. Where the type adjoins the upland bluffs there is a slope away from the bluffs. Over this type are scattered the characteristic mounds and ridges of the Knox fine sand and fine sandy loam. These constitute the only relief in the otherwise flat topography. Slightly depressed areas of small extent occur in which the soil is heavier, approaching a silty clay loam.

The natural drainage of the greater part of the type is only fair, and in the lower lying areas it is supplemented by laterals to the main drainage ditches.

Except for the forest growth along the streams and on the terraces, the type was originally prairie. The timber consists largely of oak, elm, and soft maple, with some sycamore, cottonwood, and willow nearer the streams.

The friable nature of the soil renders cultivation and the maintenance of a good tilth comparatively easy. A heavy type of farm equipment is used, but considerably less draft power is required than on the Bremer soils. Cultivation is especially easy where the percentage of very fine sand is high.

A high grade of farming is generally conducted on this type. Crop rotations, including corn, the small grains, and meadow or pasture, and extending over a 4 or 5 year period, are practiced. Manure is applied at rates varying from 4 to 8 tons per acre. Considerable grazing and stock feeding is practiced, together with hog raising, and a large supply of manure is obtained from this source. The farm dwellings, outbuildings, and farm equipment indicate a progressive type of farming.

Corn, the main crop, yields from 40 to 50 bushels per acre, oats from 25 to 35 bushels, winter wheat about 20 bushels, rye from 15 to 18 bushels, and barley from 15 to 20 bushels per acre. Clover hay yields about 1 ton and timothy hay from 1 ton to 1½ tons per acre. A good catch of clover, as a rule, is easily obtained. The type supports a good growth of bluegrass for pasturage.

The Buckner silt loam is valued at $175 to $250 an acre, depending on local conditions, improvements, and location.

Buckner silt loam, colluvial phase.—The soil of this phase varies in depth from 8 to 12 inches or more and consists of a grayish-brown to dark-brown silt loam which is moderately friable and contains a moderate amount of fine sand and very fine sand. The subsoil is a light-brown, compact silty clay loam. This continues without change in places throughout the 3-foot section. Frequently it grades at about 24 inches into a light-brown, heavy, compact silt loam to heavy very fine sandy loam. In some places the sand content is sufficient to make the soil a fine sandy loam rather than a silt loam, but these areas are generally so small and occur in such intricate association with the typical soil that separation is impracticable. In some areas the soil material has a gray color, with a slightly brownish cast.

This phase of the Buckner silt loam occurs at the foot of the bluffs which extend from the uplands to the alluvial bottoms and in the wide stream valleys bounded by steep slopes from the uplands. The material is mainly colluvial, but has been modified to some extent by alluvial material. The soil is derived mainly from material composing the Memphis silt loam, with some influence from the glacial till material and alluvial material. In some instances the subsoil consists entirely of purely alluvial material, while in others such

material constitutes only the lower part of the section. Generally the purely alluvial material is dark gray to black in color and is a silty clay loam.

The surface of the phase is generally quite flat, with a slope toward the alluvial bottoms. The slope accounts in a large measure for the good drainage of the phase. Both soil and subsoil are retentive of moisture and not especially subject to drought.

All of this soil is under cultivation, and is valued highly for truck as well as for the general farm crops. Tomatoes do well, producing an average of about 9 tons per acre. Strawberries have been reported to yield as high as 7,500 to 9,000 boxes (quarts) per acre, though the average yield for normal seasons is probably between 4,000 and 5,000 boxes. Cabbage yields about 8 tons per acre. Onions and cucumbers are grown with good average results. Corn does well, and averages about 50 bushels per acre. Oats yield from 25 to 35 bushels, wheat from 20 to 25 bushels, or slightly more, and barley from 25 to 35 bushels per acre. Very little rye is grown.

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

Mechanical analyses of Buckner silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
330623	Soil	0.2	0.6	0.9	4.2	6.7	65.6	21.0
330624	Subsoil	.2	.8	.5	3.0	6.2	72.1	16.9

BREMER SERIES.

The soils of the Bremer series are black and overlie black, brown, or grayish mottled subsoils. They occur on stream terraces and in very gently undulating upland valley basins.

BREMER SILTY CLAY LOAM.

The soil of the Bremer silty clay loam to a depth of 8 to 12 inches consists of an intensely black, generally plastic silty clay loam, the upper 2 or 3 inches in some instances consisting of fine-textured black loam. The subsoil consists of a heavy, tough, plastic, black silty clay, which grades at about 20 to 30 inches into a dark-drab to drab silty clay to clay. Brown to yellowish-brown mottlings are generally quite common below 24 to 30 inches, and in some places the subsoil at 20 to 24 inches is drab and yellowish-brown or yellowish-mottled clay, grading below a depth of 36 inches into yellowish-brown clay. Oxide of iron concretions, both black and brown, and their attendant rusty-brown stains are common in the soil and subsoil. Both soil

and subsoil are extremely plastic and sticky when wet and are hard and compact when dry, cracks of considerable width and depth appearing during the summer season.

This type occurs in the vicinity of Nichols and southeast of West Liberty, where it is closely associated with the Buckner silt loam. Near Nichols the type is also closely associated with the Bremer clay. Only arbitrary boundaries can be drawn because of the gradual merging of these types and their close textural relationship. The total acreage of this type is only slightly greater than that of the Bremer clay.

The generally flat topography and the impervious structure of the soil and subsoil render the natural drainage poor. There is only a very slight slope to the main ditches. Even with the establishment of laterals drainage is only fair. The flat topography permits water to stand for long periods in wet seasons, necessitating late cultivation and seeding in spring. This, together with the poor drainage, causes the late maturity of crops.

The type was originally prairie, except in the immediate vicinity of drainage ways, and in depressions where it supported a growth of water-loving shrubs and some trees, mainly willow.

Heavy farm equipment is necessary for thorough and efficient cultivation of the type, and extreme care must be taken to cultivate when the soil is in proper moisture condition, for if plowed when too wet the soil puddles, forming hard, compact clods on drying. When properly cultivated a good tilth may be secured, and this as a rule is easily maintained.

Manure is applied in fairly large quantities, but since the soil is already well supplied with organic matter this serves merely to increase the loaminess of the soil. No system of rotation is practiced; corn is the chief crop grown, and is planted successively for periods of 4 or 5 years. On account of the high state of fertility of the type, and the comparatively short time the greater part of it has been under cultivation, this practice has not as yet resulted in noticeably decreased yields. The soil is occasionally left in mowings or pasture in rotation with corn to "rest" the land. The yield of small grains is only fair, because of the tendency of such crops to a heavy growth of stalk with low yields of grain. The rank growth causes them to lodge badly. Oats are the chief small grain, but the total acreage of this crop is small. Corn yields from 40 to 50 bushels and oats from 20 to 25 bushels per acre. Some cabbage and Irish potatoes are grown, the former yielding from 8 to 9 tons per acre. Potatoes are not generally grown on a commercial scale. The low-lying, poorer drained areas are used for pasture. A large part of the type is in grass. Cattle raising and feeding is conducted rather extensively on this type.

Thorough cultivation and proper drainage are the main needs of this type. A good system of crop rotation should be followed to maintain its productiveness. The type generally is not acid. A good type of farming prevails on this soil, and good dwellings, buildings, and equipment are the rule.

The Bremer silty clay loam is valued at $150 to $225 an acre, depending on local conditions, mainly drainage, improvements, and location with respect to market and shipping facilities.

Following are the results of mechanical analyses of samples of the soil and subsoil of the Bremer silty clay loam:

Mechanical analyses of Bremer silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
330633	Soil	0.2	1.0	1.4	6.2	5.0	57.4	28.7
330634	Subsoil	.4	.6	.6	3.0	6.4	61.2	27.6

BREMER CLAY.

The soil of the Bremer clay to a depth of 18 to 20 inches consists of an intensely black, heavy clay to silty clay. It is plastic, tenacious, and impervious, and is underlain by an intensely black heavy clay to silty clay which is tough and tenacious. This grades at depths varying from 24 to 33 inches into a dark-drab to drab clay of corresponding structure, though in some instances the black color continues throughout the 3-foot section. Brown and yellowish brown, with some gray mottling is generally present in the lower part of the subsoil. Black oxide of iron concretions, and brownish stains due to the presence of these concretions, are present in places. When wet both soil and subsoil are extremely sticky, and on drying they harden and crack.

The Bremer clay is developed on the West Liberty Plain. It is closely associated with the silty clay loam of the same series, and on account of the gradation from one type to the other, the boundaries between the two are largely arbitrary. The clay occupies the lower positions on the plain, and until an extensive drainage system was constructed in 1906–1907,[1] the greater part of the type was constantly inundated, occupying the bottoms of "Elephant Swamp" and "Goose Lake." Only one area of the type occurs; this is in the vicinity of Nichols. It is almost 10 miles in length, and seldom exceeds one-half to three-fourths mile in width, the general outline be-

[1] The ditch connecting Big Slough with Wapsinonoc Creek was built considerably prior to this time, the original channel of the slough having been deepened and straightened.

ing that of a number of narrow, depressed areas, parallel with one another and connected by narrow necks.

The topography of the Bremer clay is mainly flat, with a very slight slope toward the center of the depression, where the main ditches have been constructed. The natural drainage is poor on account of the impervious nature of the soil and subsoil, the flat topography, and low position. The establishment of the main ditches, with a large number of laterals, has provided fairly adequate drainage. In seasons of excessive rainfall water stands on the surface for long periods.

The Bremer clay originally was not forested except for a growth of shrubs and trees along the edges of the ponds and drainage ways, these being generally of the water-loving species. The plant growth was mainly water-loving grasses and weeds. Smartweed is common on the type.

The type can be successfully cultivated only within a narrow range of moisture conditions, for the material puddles if worked when wet, and on drying compacts and forms hard, unbreakable clods. The heaviest type of farm machinery is required, and thorough cultivation is necessary to provide a good tilth, which, however, when once established is easily maintained. Both soil and subsoil are retentive of moisture, but on drying they crack badly to considerable depths, and roots of crops are injured.

The lowest lying, poorest drained areas are devoted to hay production and pasture, while the better drained areas are cultivated, corn being the chief crop grown. Oats is the principal small-grain crop. Owing to the rich, heavy soil, there is a tendency for the small grains to lodge badly, and to produce straw rather than seed. Oats yield from 15 to 25 bushels per acre. Corn yields from 40 to 50 bushels, though maximum yields of 80 and even 100 bushels per acre have been reported. Clover and timothy hay yields from 1 ton to 1½ tons per acre. The type produces good bluegrass pasturage, and in the low-lying areas, where pasturage is the chief asset, considerable stock feeding and raising is practiced. A small acreage is devoted to cabbage, and yields of 8 to 10 tons per acre are obtained.

This is the strongest, most productive soil in the county, and it is not uncommon to grow corn 4 or 5 years in succession without decrease in yields. The greater part of the type has been in cultivation for too short a time to permit its original fertility to be seriously affected. No crop rotation is practiced, except that in some cases a crop of oats is grown once in 4 or 5 years, and the land left for a year in grass. Manure is applied to the type, and this aids chiefly in giving the material a more loamy structure, since the soil is naturally well supplied with organic matter. The type is retentive of moisture, and crops suffer only from prolonged droughts.

The maturity of crops is late on this type on account of the poor drainage conditions, and the fact that tillage operations and seeding can not be performed until late in the spring. The application of potash and phosphate fertilizers probably would prove beneficial as a means of promoting earlier maturity, though on account of the present high state of fertility of the soil it is doubtful whether increased crop yields would result. The type generally is not acid.

Thorough tillage and proper drainage are the main needs of the Bremer clay. A well-devised system of rotation is needed to maintain the present high state of fertility and good crop yields. The farmers are progressive and prosperous, and the farms generally have good buildings and equipment.

The type is valued at $150 to $225 or more an acre, depending on location and local conditions, mainly drainage.

Calhoun Series.

The soils of the Calhoun series are gray. They overlie heavier subsoils of gray to bluish-gray color and tenacious, plastic structure. Iron concretions are common in both soil and subsoil. The drainage is poor. The Calhoun soils occur on flat stream terraces and are covered by standing water for considerable periods of time. They are found in the Mississippi Valley region.

Calhoun silt loam.

The soil of the Calhoun silt loam to a depth of 10 to 12 inches consists of a light grayish brown to light brownish gray silt loam of mellow and friable structure. Where the soil has been exposed to the weather for some time it has an almost white color, and where small spots of the type occur in association with the darker colored soils of the Bremer series they are referred to locally as "white spots." The soil grades into a gray or ashy-gray silt layer, which varies in thickness from 6 to 10 inches. Very little coarse material occurs as a rule in either the soil or the silt stratum, and both have a smooth, velvety feel when dry. The subsoil, beginning at about 16 to 20 inches, consists of a heavy, tough, extremely compact, and impervious silty clay loam, mottled dark gray and yellowish brown in color. The subsoil is very hard when dry, but quite plastic when wet. It grades below into a heavy, compact silty clay to clay, in which the mottled gray color sometimes changes to drab. The lower subsoil is highly impervious.

In small areas the silt layer between the soil and subsoil is of very light brown or buff color rather than gray, and in some instances the soil and this silty layer make up the 3-foot section.

The Calhoun silt loam occurs on the West Liberty Plain. Its chief development is along and east of Wapsinonoc Creek, though small, detached areas occur north of Conesville. The type occupies areas of flat topography with only slight elevations and depressions. The originally flat surface has been modified to some extent by the deposition of areas of Knox fine sand and fine sandy loam. The slightly higher areas occurring through the type are generally composed of typical Buckner silt loam.

The type is poorly drained, partly on account of the flat topography and also on account of the heavy, impervious character of the subsoil material, which prohibits the downward passage of soil moisture. Ditching and tiling are resorted to in some cases to improve the drainage. Both the soil and subsoil are retentive of moisture and maintain good supplies when drained.

Originally the type was largely prairie, but along Wapsinonoc Creek and back from that stream for a short distance there is a native forest growth consisting mainly of swamp white oak, black oak, red oak, scarlet oak, and bur oak. Some elm, hard and soft maple, sycamore, hackberry, cottonwood, and occasionally birch occur, with some willow along the slope to the creek bottom.

When in the proper moisture condition the character of the soil is such that cultivation is easy, but if cultivated when wet the material puddles and becomes compact. The soil is generally deficient in organic matter, but heavy applications of manure or the plowing under of green crops would alleviate this condition to some extent at least.

Probably 70 per cent of the total area of the type is under cultivation, the remainder being forested or in prairie, pasture land, and mowings.

Corn, oats, wheat, and hay are the principal farm crops, with some rye and barley. With the exception of oats and hay, the yields are lower than on the associated Buckner silt loam. Corn yields 30 to 40 bushels, oats from 25 to 30 bushels, wheat from 15 to 20 bushels, and rye and barley from 15 to 20 bushels per acre. Hay yields from 1 ton to 1½ tons per acre.

Notwithstanding the poor drainage conditions, a high grade of farming is generally practiced on this type. Crops are grown in rotation, the land is thoroughly cultivated, and farm manure is applied at the rate of 5 to 8 tons per acre. The owners of farms on this soil are generally quite progressive, and good dwellings and farm buildings, with modern farm equipment, are common throughout the type.

The installation of tile drainage and laterals to connect with the ditches already constructed through the type in order to establish better drainage is needed, and as mentioned before, the incorporation of organic manures to prevent the soil from becoming compact or "running together" during wet seasons. Owing to the poor drainage conditions spring seeding is usually later than on the better drained soils, plant development is slower, and maturity is necessarily later. The use of fertilizers high in potash and phosphates is an effective means of hastening maturity and of increasing crop yields.

The value of the Calhoun silt loam ranges from $125 to $175 an acre, with variations due to local conditions, improvements, shipping facilities, and distance to markets.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Calhoun silt loam:

Mechanical analyses of Calhoun silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
330601	Soil	0.2	0.5	0.2	0.8	4.4	75.4	18.2
330602	Subsoil	.0	.3	.2	1.5	8.1	68.8	21.0

WABASH SERIES.

The Wabash series includes soils of dark-brown to black color and high organic-matter content, with brown, drab, or gray subsoils. The members of the series are developed typically in the first bottoms of streams of the Central Prairie States, the material being derived principally from the loessial and associated soils of this region.

WABASH SANDY LOAM.

The soil of the Wabash sandy loam, to a depth of 8 to 12 inches, consists of a black to very dark gray sandy loam. This passes into a black, heavy loam to clay loam. At a depth of 24 to 30 inches the color in places becomes dark drab or brown, depending on the drainage. In the better drained areas the subsoil at about 18 to 20 inches is dark brown or brown in color.

The type includes areas in which the soil consists of 8 to 12 inches of brown or dark-brown sandy loam or fine sandy loam, overlying a brown clay loam subsoil which is generally quite compact. The sandy substratum sometimes present in the other members of the series as mapped in Muscatine County occurs in some instances at 24 to 30 inches, but where it does not occur the subsoil at that depth is a silty clay loam rather than clay loam, the sand becoming finer and occurring in smaller quantities with depth.

The largest area of this type occurs south of the Cedar River near Simpsons Bridge. It is subject to overflow in times of high water. The type is only fairly well drained. Like the other alluvial soils it has a flat topography and it is somewhat dissected by sloughs and drainage ways.

Excepting a small acreage used for pasture, all the type is under cultivation. Corn is the principal crop grown, and wheat and oats are the principal small grains, with some rye. The yield of corn varies from 20 to 30 bushels per acre, though heavier yields are reported. Wheat yields from 15 to 20 bushels, oats from 20 to 25 bushels, and rye from 12 to 15 bushels per acre. Some hay is grown.

WABASH LOAM.

The soil of the Wabash loam to a depth of 10 to 14 inches consists of a black to dark-brown loam to fine loam. The material is generally quite friable in structure, making tillage comparatively easy. This is underlain by a black or dark-brown subsoil, of silty clay loam to clay loam texture, which in places grades into a silty clay at 20 to 24 inches. Occasionally the color of the subsoil becomes lighter in the lower part of the soil section. In some places at about 24 to 26 inches there is a sandy clay loam or loam, which grades into a sandy loam or fine sandy loam. This in turn grades into a loamy sand or loamy fine sand before the 3-foot depth is reached. This sandy substratum is rarely present. The type as mapped includes small areas of the Wabash silt loam and silty clay loam which are too small and too intricately associated with the loam soil to be mapped separately.

Sand pockets and layers of sand are found throughout the soil section, and in areas subject to frequent overflow sand patches of considerable size occur. These are moved or washed away by the streams during overflows. Iron concretions and water-rounded pebbles are generally present in the soil and subsoil, the former giving rise to rusty-brown stains.

The Wabash loam occurs in the first bottom of the Cedar River and along Muscatine Slough. The areas adjoining the streams are subject to more or less frequent overflow. The areas some distance from the streams are subject to overflow only during periods of exceptionally high water, and they are mainly under cultivation. Originally the type was largely forested and a considerable area is still in timber, the same tree growth prevailing as on the Wabash silty clay loam. The forested areas are used for pasture.

The topography is flat, with only a slight slope toward the streams. Along the streams the type is generally well dissected by old sloughs and drainage ways. This soil is associated generally with the silty

clay loam of the Wabash series, and lies slightly higher than that type. As a rule it is poorly drained, though drainage is better than on the silty clay loam.

Corn is the main crop. Some wheat, rye, oats, and hay are grown. Corn yields from 35 to 45 bushels, wheat from 20 to 25 bushels, oats from 25 to 30 bushels, and rye from 15 to 20 bushels per acre. Clover and timothy hay yield from three-fourths ton to 1¼ tons per acre.

This type is not thickly settled. Areas well away from the streams are valued at $125 to $175 an acre. The price of the land depends on local conditions, improvements, and position.

WABASH SILTY CLAY LOAM.

The surface soil of the Wabash silty clay loam has a depth of 8 to 15 inches, and consists of a black silty clay loam to clay loam, which is sticky and plastic when wet and becomes compact and hard upon drying. The subsoil consists of a black to dark-brown, heavy, compact silty clay loam to silty clay, and is generally of close, impervious structure. In some areas this continues throughout the section, while in others it passes at about 28 to 30 inches into a brownish fine sandy loam to sandy loam which grades into a loamy fine sand or loamy sand before the 3-foot depth is reached. Where this occurs the heavy material passes first into a sandy clay loam to loam, the zone of transition occupying from 2 to 6 inches. Where the heavy material continues throughout the section the color changes at 24 to 28 inches into mottled brown and gray or drab.

Brown stains due to undecomposed organic matter and oxide of iron concretions occur in the soil and the upper part of the subsoil. The iron concretions are occasionally quite abundant. In some small areas the soil contains a high percentage of sand, and layers and pockets of sand are found within the 3-foot section. Water-rounded gravel and pebbles are scattered over the surface. Where the type adjoins the Cedar River sand patches of 100 square feet or more, ranging from 2 to 6 or more inches in thickness, are scattered over the surface. These have recently been deposited by the Cedar River, and are being moved or replaced by each overflow. The type, as mapped, includes small areas of Wabash silt loam and Wabash silty clay, which are not sufficiently extensive to justify the establishment of separate types.

The Wabash silty clay loam occurs as first bottoms along the Mississippi River, Muscatine Slough, the Cedar River, and Wapsinonoc Creek, and as islands in the Mississippi River. The most extensive areas are encountered along Muscatine Slough and the Cedar River.

The topography is nearly flat, with an almost imperceptible slope toward the streams. Near the larger streams the type is frequently

well dissected by sloughs and drainage ways. The sloughs are filled by backwater from the streams during periods of high water. Pond-like depressions which are filled with water when the river overflows occur over the type. Drainage is poorly established, and on account of the slight slope ditching and tiling are hardly practicable, though employed in some instances. The included silt loam areas lie slightly higher than the silty clay loam and have somewhat better drainage. Where it adjoins the streams the type is subject to frequent overflows, but the greater part of it is sufficiently distant from the streams to be overflowed only by exceptionally high water. Where the type is subject to overflow along the Cedar River there is a constant deposition and removal of alluvial material.

This type was originally forested, and is still in that condition to a considerable extent. The principal growth is oak of the species common to the region, elm, sycamore, cottonwood, willow, birch, and soft maple, with some hard maple and hickory and some scarlet hawthorn and hackberry.

Where timbered the soil is used only for pasture. Timber is cut for posts and building material. Where it is rarely overflowed a part of the type is cleared and cultivated, mainly to corn. Wheat, oats, and rye also are grown. Corn yields from 30 to 40 bushels, wheat from 20 to 25 bushels, oats about 25 to 30 bushels, and rye from 15 to 20 bushels per acre. Some hay is grown, the yield varying from 1 ton to 1¼ tons per acre. The areas in pasture support a good growth of bluegrass, and are frequently rented to cattle feeders. The type puddles badly, and it is necessary to exercise care in cultivating the land and in permitting cattle to graze on it when it is in a wet condition.

On account of its position the type is not very thickly settled. The selling price of land of this type varies from $75 to $150 an acre, depending on improvements, condition, the acreage cleared, and position with respect to the streams.

Cass Series.

The soils of the Cass series range from brownish gray to black. Ordinarily the subsoils are distinctly lighter in texture and in color than the surface soils. These soils are alluvial and occur in the bottoms of the Mississippi and Missouri Rivers and their larger tributaries.

CASS SAND.

To a depth of 6 to 10 inches the Cass sand consists of a grayish-brown to light-brown or brownish-gray sand, of medium to coarse texture and only slightly loamy in structure. The subsoil consists

of a rusty brownish gray to grayish-brown coarse sand, containing some fine gravel. Some small, water-rounded pebbles and gravel occur on the surface and throughout the section. Where the type occurs near the streams it frequently has a covering of loamy material an inch or so in thickness.

The type occurs mainly along the first bottoms of the Cedar River, though it is encountered throughout the areas in which the river has meandered. It occurs in small, narrow strips in close association with the other members of the Cass series. Owing to their small size it was necessary to map some of these strips with other types.

The type is forested with a thin, stunted growth of elm, hackberry, birch, cottonwood, willow, and scarlet hawthorn, with some oak. It supports a sparse growth of grass. In some areas prickly pear is a characteristic growth.

The topography is flat. The type is subject to overflow, and successive overflows change the aspect of the surface by the addition or removal of soil material.

This type is not cultivated. In one or two small areas it is underlain by gravel, which is being removed and used for road building and for construction purposes.

CASS SANDY LOAM.

The surface soil of the Cass sandy loam is a grayish-brown to black sandy loam, of medium texture and generally friable structure, 8 to 15 inches deep. The subsoil is a grayish-brown sand of coarse texture and loose, incoherent, and porous structure. The subsoil closely resembles the material of Riverwash. Small areas of fine sandy loam and coarse sandy loam are included with the type. In several small areas the soil consists of a grayish-brown to brown sandy loam, and is underlain at 24 to 30 inches by a brown fine sand.

This type is formed by the deposition of alluvial sediments by the Cedar River during overflows. It has a generally flat topography, but is somewhat dissected by old sloughs and present drainage ways. It is subject to overflow. Some areas are protected by levees, and are cultivated to corn and rye. Some onions are grown.

The type is not retentive of moisture on account of the porosity of the subsoil, and crops suffer from drought. Corn particularly shows the effects of lack of moisture, the ears being small. The yield is about 10 to 15 bushels per acre. Rye yields from 8 to 12 bushels. The greater part of the type is forested and used mainly for pasturage. The characteristic vegetation is a profuse growth of scarlet hawthorn and a stunted growth of the trees common to the series. The growth of grass is generally scanty.

CASS LOAM.

The soil of the Cass loam varies in depth from 6 to 14 inches, and consists of a black to dark-gray loam to fine loam. It is generally quite friable, though it is compact and hard when dry. The subsoil consists of a grayish-brown or brownish-gray sand, medium to coarse in texture, of loose structure, and slightly loamy in some instances. The change from the soil to the subsoil is generally quite abrupt, though a transition zone of 2 to 4 inches of sandy loam sometimes occurs. Strata of sand and sand pockets are common through the soil, and patches of sand, generally coarse in texture, occur over the surface, these being deposited and removed by successive overflows. The soil is retentive of moisture, but the subsoil is porous.

The Cass loam occurs as first bottoms, mainly along the Cedar River. One area occurs along Muscatine Slough and one along the Mississippi River.

The topography is flat, and notwithstanding the porous subsoil drainage is only fair. The type is subject to overflow by high water, and is quite frequently inundated. Old slough channels and depressions occur in the type. These are usually occupied by the silty clay loam of the Cass series, and where of sufficient extent are mapped separately. The type also includes small areas of silt loam.

The type supports a forest growth similar to that on the Cass silty clay loam. Where the sandy subsoil occurs near the surface grass makes only a sparse growth, and the timber is somewhat stunted. Where the soil is deep there is a good growth of grass. The main value of the type is for pasturage and timber.

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

Mechanical analyses of Cass loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
330611	Soil	1.9	12.9	7.1	30.0	10.0	26.6	11.4
330612	Subsoil	1.4	10.9	8.9	58.0	9.2	7.6	3.7

CASS SILTY CLAY LOAM.

The soil of the Cass silty clay loam, extending to a depth of 6 to 18 inches, is a black silty clay loam. The subsoil consists of a grayish-brown to brownish-gray coarse sand to sand. In some cases a fair percentage of fine gravel is present in the subsoil material. Some water-rounded gravel and small pebbles are disseminated through the soil and subsoil, occurring chiefly in the latter. The subsoil is loose

and incoherent and is very similar to the sandy material now in course of deposition by the rivers which is mapped as Riverwash. Strata and pockets of this material are frequently found in the soil. In the immediate vicinity of small drainage ways, in the bottoms of old sloughs, and in depressed areas the soil is more nearly a silty clay or clay than a silty clay loam, but these areas are generally too small or too narrow to map separately. The soil is compact, tough, and tenacious, and generally quite impervious to water. It cracks badly when dry, and when wet is plastic and sticky and puddles easily.

The type occurs as first bottoms, mainly along Cedar River, and to a less extent along Muscatine Slough and the Mississippi River. It represents the lowest lying material of the first bottoms, with the exception of Riverwash. It occurs along drainage ways, in depressions and old slough channels, and on islands in the Cedar River. The type occupies widely scattered areas, owing to the meandering of the streams in the present bottoms.

The type has a generally flat topography, but is well dissected by old sloughs, old river channels, and drainage ways. There is hardly any slope toward the stream. The type is frequently overflowed, each overflow effecting the deposition and removal of sediments. The sloughs are filled by overflows and backwater from the river, and, although the subsoil is porous, water is retained for long periods, owing to the impervious soil material and the fact that the return of the water to the river is impossible because of the deposition of sediment in the mouths of the sloughs. Sand patches, the material of which is similar to the subsoil, are scattered over the surface near the streams, representing the most recent material deposited by overflow.

The type is poorly drained, and on account of its position is not under cultivation. It is forested with a growth of oak, generally pin oak and swamp white oak, and some red, black, and scarlet oak, elm, soft maple, sycamore, cottonwood, basswood, birch, scarlet hawthorn, and wild crabapple. In depressions and along the sloughs it suports a growth of marsh grasses, smartweed, and sorrel. The type produces a good growth of grass. Pasturage is its main use. The land is valued at $45 to $60 an acre.

Miscellaneous Material.

MARSH.

The areas mapped as Marsh consist of former ponds and shallow lakes, the aquatic growth of which has filled these depressions, or become so matted and interwoven as to present a fairly solid covering over the surface. During the wet seasons of the year water covers the greater part of the areas, and at these times it is danger-

ous to venture out on these coverings. During the dry season, however, the surface is comparatively solid, yet spongy enough to permit it to be shaken for a considerable distance.

Very little mineral matter has entered into the composition of these bogs except immediately along the shore, and the organic matter varies in depth from 8 inches to 3 feet or more. The organic matter consists of a brownish, peatlike substance, made up of the undecomposed remains of plants. The fact that it is more or less covered with water during the greater part of the year has probably prevented oxidation and decomposition into typical Peat or Muck.

Only two areas of Marsh are mapped. One occurs east of Conesville, the other southeast of Nichols. They occupy first-bottom positions at the edge of the West Liberty Plain.

The Marsh areas are of no agricultural value. Water-loving grasses and shrubs are the characteristic plant growth.

MUCK.

The surface material of Muck consists of 6 to 24 inches of intensely black, well-decomposed, and finely divided organic matter, with an admixture of mineral matter, mainly silt, derived from adjoining slopes. The underlying material consists of an intensely black to dark-drab, mucky, plastic, impervious clay, containing some coarse sand of grayish-brown to light-grayish color. In some places the clay is absent, a coarse sandy loam or coarse sand underlying the surface material at 18 to 24 inches.

The Muck areas include several patches of typical Peat, in which the surface material consists of 24 to 36 inches or more of only slightly decomposed, coarse organic matter, with only a small mineral-matter content. This is generally underlain directly by coarse sandy loam or coarse sand.

The areas of Muck are very small and unimportant. Some of the largest are found in the vicinity of Adams, Saulsbury Bridge, and southeast of Atalissa. The land is generally in a wet, boggy condition, due to seepage from the adjoining slopes. Some areas have been ditched with a view to drainage.

MEADOW.

Meadow as mapped in Muscatine County comprises areas lying along the courses of the streams and for the most part subject to overflow. Along the larger streams the material is subject to constant change, modifications taking place with each successive overflow. In texture the material varies from sands to clays, the silt loam, silty clay loam, and clay probably predominating.

Meadow may be described as occurring in two general phases. The most common of these occurs along the smaller streams which

have fairly wide bottoms and steep slopes. Here the material is not purely alluvial, but is modified to some extent by colluvial wash from the slopes. The soil is mainly a silt loam, of gray to brown or black color, overlying a subsoil of similar or heavier texture, generally of dark-dray to black color. The largest single area of this phase of Meadow is mapped along Pine Creek, and this area includes a narrow strip which apparently occupies a distinct terrace position. The greater part of the material of this area consists of a gray to dark-drab clay loam to clay, overlying a subsoil of dark-gray to dark-brown, sticky, impervious clay at depths varying from 6 to 20 inches.

Along the Mississippi the Meadow includes a narrow strip of material of heavy texture, deposited during high water, but exposed when the river is at normal stage. The surface material varies from loam to clay, with a few sandy loam spots, generally gray to brown in color, and with subsoils consisting mainly of plastic, sticky, impervious clay loams and clays of dark-gray, drab, pink, brown, and black color. This phase has no agricultural value, while that occurring mainly along the small streams is used for pasture during the summer and fall months.

The tree growth consists mainly of box elder, willow, and cottonwood. Weeds of the varieties common to the region make a flourishing growth.

RIVERWASH.

Riverwash consists of alluvial material which is in process of deposition in the river channels and along the banks. The areas mapped as Riverwash consist mainly of sand banks and sand-bar islands and comprise brown, grayish-brown, or gray sand, chiefly of medium and coarse texture, which extends to depths of more than 3 feet. Water-rounded gravel and small pebbles are present in conspicuous quantities in some areas and are entirely absent in others. During times of overflow the material is frequently covered with thin layers of clayey sediments which, as a rule, are subsequently removed. In some cases this material remains and is subsequently covered by the sandy material typical of Riverwash. In some areas there are alternate layers of sand and clay throughout the section.

All of the Riverwash is subject to overflow, a large part of it lying only slightly above the normal stage of water. It is subject to constant reworking by flood waters.

Riverwash occurs mainly as islands and sand bars in Cedar River, and to some extent as islands, or parts of islands, in the Mississippi. It occurs along the channel of the Cedar River, and is mapped also in and along abandoned channels of this stream. Soon after deposition a growth of willows and cottonwoods appears on this material,

together with various water-loving grasses and weeds. On the Mississippi the willows are gathered and the branches woven into matting for protecting the river banks.

SUMMARY.

Muscatine County is situated in the southeastern part of Iowa and comprises an area of 276,480 acres, or 432 square miles. It lies in two soil provinces, the Glacial and Loessial and the River Flood Plain. The topography is mainly level to gently rolling, with some hills and ridges. The elevation of the greater part of the county is between 700 and 725 feet above sea level, but the elevations vary from 546 to 800 feet.

The county is fairly thickly settled, the population being reported in the 1910 census as 29,505. Nearly 94 per cent of the area is reported in farms, and the average size of the farms is given as 142.3 acres. Of the land in farms, about 82 per cent is improved.

A high class of general farming prevails. Crop rotation is practiced, and large quantities of manure are used. The use of lime to correct acidity is becoming general. Commercial fertilizers have not proved profitable. Corn is the principal crop grown. Oats, wheat, rye, barley, and hay are the other staple crops. The raising and feeding of live stock is an important industry. Dairying receives but little attention. Considerable trucking is carried on, particularly on Muscatine Island. Irrigation is practiced, mainly in connection with trucking.

There is a large diversity of soils in the county, a total of 28 types, including Marsh, Muck, Meadow, and Riverwash, being recognized. The silt loam class of soil predominates.

The soils of the Muscatine series are the most extensive in the county. This series includes the dark-colored soils with brown and gray mottled subsoils of the loessial uplands. The soils are fairly well drained and well adapted to general farming.

The light-brown to grayish-brown soils of the uplands are included in the Knox and Memphis series. The Memphis predominates, and is well adapted to the production of tomatoes, cabbage, and other vegetables.

The Lindley series is represented only by the silt loam type. It includes soils mainly of light-brown to grayish-brown color, occurring in areas of rough, gullied topography, the subsoil consisting of material of the underlying glacial drift.

The Buckner soils occur as terraces of the Mississippi River and the Cedar River, and on the West Liberty Plain. The greater part of Muscatine Island is included in this series. The soils are espe-

cially adapted to watermelons, cantaloupes, sweet potatoes, asparagus, and other vegetables.

The Bremer soils are of alluvial origin, occurring as terraces along the Mississippi and Cedar Rivers, and on the West Liberty Plain. This series includes the heaviest types in the county. They are mainly adapted to general farming.

The Calhoun silt loam is the only representative of its series in Muscatine County. The soil is light grayish brown to light brownish gray, with a distinctive ashy-gray silt layer between the soil and subsoil. It is alluvial in origin and occurs on the West Liberty Plain.

The Wabash series, with its dark-brown to black soils, predominates in the first bottoms of the Mississippi and Cedar Rivers. The soils are of alluvial origin and mainly subject to overflow during high water.

The Cass series includes the remainder of the alluvial first bottoms. The soils vary from light gray to black, with subsoils of lighter texture than the surface material. They are subject to overflow.

The miscellaneous material mapped as Marsh, Muck, Meadow, and Riverwash are inextensive and are unimportant in the agriculture of the county.

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