U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

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

SOIL SURVEY OF LINN COUNTY, IOWA.

BY

FRANK B. HOWE, IN CHARGE, AND T. H. BENTON, OF THE IOWA AGRICULTURAL EXPERIMENT STATION, AND M. Y. LONGACRE AND A. H. MEYER, OF THE U. S. DEPARTMENT OF AGRICULTURE.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1917.]

WASHINGTON:
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., April 15, 1919.

SIR: I have the honor to transmit herewith the manuscript report and map covering the survey of Linn County, Iowa, and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1917, as authorized by law. This work was done in cooperation with the Iowa Agricultural Experiment Station.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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SOIL SURVEY OF LINN COUNTY, IOWA.

By FRANK B. HOWE, In Charge, and T. H. BENTON, of the Iowa Agricultural Experiment Station, and M. Y. LONGACRE and A. H. MEYER, of the U. S. Department of Agriculture.—Area Inspected by THOMAS D. RICE.

DESCRIPTION OF THE AREA.

Linn County, Iowa, is situated in the east-central part of the State, in the third tier of counties west of the Mississippi River. It is 30 miles in length, from north to south, and 24 miles in width, from east to west, and contains 709 square miles, or 453,760 acres.

Linn County is part of a drift-covered plain in which the constructional topography has been modified to some extent by stream erosion. Three principal streams, the Cedar and Wapsipinicon Rivers and Buffalo Creek, flow across the area in a northwest to southeast direction, in valleys 200 to 300 feet below the intervening divides. The central part of the county, between the Cedar and Wapsipinicon Rivers, is occupied by a broad, gently rolling drift plain, which lies 800 to 900 feet above sea level and has a gentle slope toward the southeast. The local valleys, with their long, rounded slopes, have the appearance of preglacial valleys whose outlines have been smoothed by partial filling with glacial débris. In Spring Grove and Otter Creek Townships, particularly in the vicinity of Alburnett, the surface is gently rolling, with long stretches that are almost flat. Southeast of Springville, near Mount Vernon, the plain is divided by a belt of hilly country, having on each side an undulating prairie 3 to 4 miles wide.

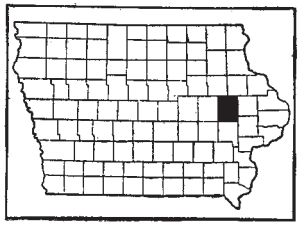

FIG. 1.—Sketch map showing location of the Linn County area, Iowa.

The central drift plain is bordered along the large stream courses by a topography peculiar to this part of Iowa, consisting of a succession of lenticular hills and smooth, elongated ridges with their longer axes in the direction of the ice flow. These hills are made up of glacial drift, covered in most cases with a thin veneer of loessial material. Hills of this character have been given the name of "paha." The exact manner of their deposition by the ice is a cause of conjecture by geologists. The southern or Cedar River belt of pahas consists of irregular ridges or ranges of hills, several of which are on the right bank of the river. On the left bank of the river paha ridges occur south and southeast of Marion, and others extend north-

ward to the northern boundary of the county. The Wapsipinicon paha belt may be considered as one ridge whose axis is cleft by the Wapsipinicon River. At Waubeek the hills reach the height of 1,040 feet above sea level, or 200 feet above the drift plain to the south.[1]

The general elevation of the drift plain between the Cedar and Wapsipinicon Rivers is between 800 and 900 feet above tide level. Data given by the U. S. Geological Survey sheets indicate an elevation of 820 feet for Center Point, 840 feet for Marion, and 840 feet for Springville. Approaching the valley of the Cedar, there is a gentle slope beginning on what might be termed a drainage divide between the Cedar and Wapsipinicon Rivers. This divide traverses the county from northwest to southeast, parallel to the Wapsipinicon River, and only 2 to 3 miles distant from it. The descent from this divide to the channel of the Wapsipinicon is more abrupt. The rivers have cut to levels as low as 685 feet above tide. The elevation of Cedar Rapids, taken from city datum, is 708 feet, and the elevations of Bertram and Palo 720 feet and 751 feet, respectively. All three towns, or at least parts of each, are situated on an ancient flood plain of the Cedar River. The low loess-capped ridges, which border on the streams and break the continuity of the slope from the drift plain to the streams, rise to a maximum height of 1,240 feet and form a conspicuous feature of the landscape. South of the Cedar River the gentle slope from northeast to southwest is continuous, the elevations of Ely and Fairfax being 741 and 773 feet, respectively.

Alluvial plains, 1 to 2 miles wide, occur along the larger streams in many places, but in many the upland loess ridges close in on the river from each side, leaving but a narrow passage or rock-bound gorge. The presence of these ridges near the rivers, together with the more active erosion at these points, gives a much more rugged topography along the streams than in the plains areas.

All of Linn County except a small area in the southwestern part is drained by the Cedar River, the Wapsipinicon River, and Buffalo Creek, which traverse the county in a strikingly parallel northwest to southeast direction. Practically all the smaller tributaries as well have a general southeastward flow. The corrugations of the drift surface determine the positions of the sloughs and the direction of the smaller streams lead to that parallelism which is perhaps the most striking feature of the drainage map. In general, the areas of ridge topography are well drained. Only in Spring Grove and Otter Creek Townships is there a radical departure from this condition of drainage. Here there is a divide that stands midway between a slough and an upland prairie, and owing to the scarcity of small tributaries flat areas and sloughs are common.

[1] Iowa Geological Survey, Vol. IV.

A feature of the prominent streams in the county is their great length as compared with their volume. The basins of the main streams are relatively narrow. The Cedar and Wapsipinicon Rivers, instead of consistently following low plains or natural courses, appear to seek eminences, even going to the extent of carving canyons in the conspicuous loess elevations.

The greater part of the county lies in the catchment basin of the Cedar River. In the northern part of the county the basin of the Cedar extends to within 1 to 3 miles of the Wapsipinicon River and is drained by several large creeks flowing nearly due south in parallel courses.

The drainage basin of the Wapsipinicon River is very narrow. Conspicuous ridges adjacent to the stream follow its course across the county. In places the river is flanked by a broad alluvial belt, as at Troy Mills and at Central City; again it narrows and is closed in by loess and sand bluffs, the river itself occupying but a very narrow strip of bottom. The elevations adjacent to the streams are carved with a dendritic sculpture. Small streams originating in the smoother parts of the prairie flow through gorges across the remnants of the loess ridges into the main streams.

The drainage basin of Buffalo Creek is also very narrow. From the divide in the northeastern part of Boulder Township there flow several small sluggish streams which occasionally cleave the line of bluffs to gain entrance to the main stream. Extending from Coggon to where Boulder Creek enters Buffalo Creek, considerable areas of alluvial sediments, some above overflow, are found. South of Hills Mill, Buffalo Creek carves through a loess elevation to emerge again upon a flood plain, separated from the drainage basin of the Wapsipinicon River by a loess ridge.

The wide and ancient channel of Prairie Creek appears to be the work of a larger stream than the present. The wide areas of heavy black soils occupying a position above overflow adjacent to the stream indicate a drainage restricted by some means permitting sedimentation of material of uniform and fine texture.

The water supply for farm use is generally obtained by open or drilled wells. In the broad flood plain of the Cedar River open and driven wells, 15 to 30 feet deep, reach an abundant supply of water in river-laid sands and gravels. On the interstream areas composed of Iowan drift the ground water stands high wherever porous beds capable of storing and transmitting water are found near the surface, but even here thick impervious beds of stony clay may compel deep drilling into interglacial and preglacial sands or into the underlying rock to find water in adequate amounts. On the uplands of the loess and Kansan drift in the immediate vicinity of the rivers the groundwater surface approaches the level of its outlets at the water level of

the streams, and wells are necessarily deep. The well water is generally wholesome and suitable for all farm purposes. Nearly all of the farms are equipped with windmills or gasoline engines for pumping water for stock.

Numerous springs are found in Linn County. The city of Marion obtains a bountiful and excellent supply of water from four large springs near the base of the Wapsipinicon limestone, which flow 3,000,000 gallons a day. Several springs are found north of Cedar Rapids and in Marion and Brown Townships. In a few cases springs furnish water for farm use, and on some farms it is piped into the house. Springs and seepage places occur in large numbers where the valleys cut across the porous sands and gravels of the drift.

Linn County was established by an act of the legislature of the Territory of Wisconsin, in 1837, and the boundaries established at that time have not been altered. The southeastern and eastern parts of the county were settled first. The early settlers followed the course of the rivers, where timber for building and for fuel was available. Linn County lands did not come into the market until March, 1843, and not till then did settlers come in in large numbers. Most of the immigrants were of Southern origin. The population of the county in 1840 was 1,342, in 1850, 5,444, and in 1860, 18,947. With the entrance of the first railroad into Cedar Rapids, in 1859, the population increased rapidly. The present population is more than 87 per cent native born. The foreign nationalities represented in a small way are mainly English, Bohemian, Danish, Irish, German, Norwegian, Swede, and Austrian. By far the largest foreign element is Bohemian. Parts of College, Putnam, Franklin, and neighboring townships are populated by foreign-born Bohemians and their descendants. The early settlers of Fairfax Township were mainly of Scotch and Irish descent.

Of the total population of Linn County, which amounted to 70,153 in 1915, 42,443 are native born of native parents, 18,059 are native born of foreign or mixed parentage, and 9,169 are foreign born. Returns of the Federal census for 1910, showed somewhat more than one-third of the population to be rural.

Cedar Rapids, with 32,811 inhabitants in 1910, is the business center of the county. Marion, the county seat, had a population of 4,400 in 1910. Other important towns are Mount Vernon, Center Point, Walker, Coggon, Central City, Lisbon, Springville, and Fairfax. All these towns are incorporated.

Linn County has excellent transportation facilities. Two trunk lines cross the county. The Chicago & North Western Railway passes through Mount Vernon, Cedar Rapids, and Fairfax. The Chicago, Milwaukee & St. Paul Railway passes through Marion, crossing the Cedar River northeast of Covington. The Chicago, Rock Island &

Pacific Railway and the Illinois Central Railway have lines running north and south. Interurban lines extend from Cedar Rapids to Waterloo and Cedar Falls and to Iowa City.

The public roads of the county usually follow section lines. The early Territorial or State roads and the military roads disregarded land lines and frequently took the most direct or easiest line of communication. In the vicinity of the rivers the roads usually followed the ridges adjacent to the streams. The dirt roads are kept in fair condition by the use of drags. Gravel is used extensively for surfacing, especially in the northern and eastern part of the county. The transcontinental Lincoln Highway enters the county at Lisbon and crosses it from east to west.

All parts of the county are supplied with rural mail delivery service, and the telephone is in general use. Rural schools and churches are conveniently located throughout the county, and consolidated schools are maintained in several places. Several electric transmission lines extend through various parts of the county and supply current for both light and power.

Cedar Rapids is the principal market for general farm crops, truck crops, and dairy products. Chicago is the most important outside market for stock and general farm crops.

CLIMATE.

In general, the climate of Linn County is favorable for the production of the staple farm crops, particularly corn, and total crop failures are unknown. Droughts of a month's duration may occur in the growing season, but the retentive character of the principal soils prevents great injury. In late years there has been more likelihood of damage to crops by excess of moisture than from any deficiency. The lowest annual precipitation recorded at Cedar Rapids is 18.74 inches, in 1910. In that year the rainfall for the most critical crop months, May to August, inclusive, was 9.68 inches. The highest annual precipitation recorded at Cedar Rapids was 44.89 inches, in 1885, in which year the rainfall for the most critical crop months, May to August, inclusive, was 24.92 inches.

Nearly two-thirds of the rainfall occurs in the months of April to August, inclusive, when it is most needed for crop growth. It is generally well distributed and occurs as local showers or slow and moderate rains. The average precipitation for the fall months is low, making conditions for harvesting favorable. There is considerable snow in the winter. Sudden thaws in the spring often cause the dirt roads to become impassable. Spring rains have in the past caused considerable damage to roads and bridges, but this condition is being remedied by improved construction.

The mean temperature for the winter months, as shown by the records at Cedar Rapids, is 20.3° F. A minimum of 32° below zero has been recorded. The prairies are often swept by cold northwest winds, so that protection must be afforded stock, and it is for this reason that the timbered areas in the vicinity of the rivers were usually chosen by the early settlers for homes.

The mean summer temperature is 73° F., so that there is a range between the winter and summer means of 52.7 degrees. However, during the growing season the range in temperature is not great, and sudden changes are infrequent. The mean annual temperature is reported at Cedar Rapids as 47.7° F.

The latest date of killing frost in the spring recorded at Cedar Rapids is May 14, and the earliest date recorded in the fall, September 20. The average date of the last killing frost in the spring for a period of 21 years is April 22, and that of the first in the fall, October 12. The normal growing season is thus 173 days in length.

Following is a table showing the normal monthly, seasonal, and annual temperature and precipitation, as recorded by the Weather Bureau station at Cedar Rapids:

Normal monthly, seasonal, and annual temperature and precipitation at Cedar Rapids.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1885).
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	−4.0	64	−20	1.40	0.33	1.48
January	17.2	63	−32	1.32	1.35	2.15
February	19.8	68	−27	1.42	.38	1.79
Winter	20.3	68	−32	4.14	2.06	5.42
March	32.7	87	−13	1.96	.00	.74
April	48.8	94	9	2.90	2.51	7.82
May	61.3	100	25	4.49	2.51	5.92
Spring	47.6	100	−13	9.35	5.02	14.48
June	70.6	103	34	3.73	.63	3.46
July	75.6	110	43	3.69	.44	6.35
August	72.8	104	41	3.51	6.10	9.19
Summer	73.0	110	34	10.93	7.17	19.00
September	64.0	102	22	3.03	3.21	2.84
October	50.9	90	11	2.43	.79	2.50
November	35.0	79	−14	1.41	.49	.65
Fall	50.0	102	−14	6.87	4.49	5.99
Year	47.8	110	−32	31.29	18.74	44.89

AGRICULTURE.

Corn and wheat were the leading crops in the early agricultural history of Linn County, with oats next in importance. Barley and rye were grown to a small extent. The luxuriant native pasturage encouraged the introduction of stock, and the raising and feeding of cattle became an important industry. In 1856, 24,251 acres were devoted to corn, 14,739 acres to spring wheat, and 249 acres to winter wheat. The subsequent decline in the wheat acreage was due in part to attacks by pests, the high costs of seed and of harvesting, and the frequent occurrence of rains at the time of wheat harvest. Oats were grown on 5,854 acres in 1856. A total of 16,905 hogs were sold in that year, their value being $127,942.

A steady agricultural progress has accompanied the introduction of improved implements. The ground is more thoroughly prepared than formerly, and larger acreages can be safely planted. With artificial drainage and resulting increased land values, the extent of native pasture and wild-hay land has been greatly reduced, and the growing of tame hay, principally timothy and clover, has become a regular part of the operations on a majority of the farms. Gradual changes have been brought about in the farming practices as the population has increased, as railway facilities have been improved, and as land values have advanced. The rural population has not increased to any great degree, however, since 1880, while the percentage of farms operated by tenants has gradually increased from 20 in 1880 to 30.3 in 1910.

At the present time the agriculture of Linn County consists mainly of two types, in one of which the raising of grain is the main object, with the raising and feeding of hogs and cattle of secondary importance; and in the other of which the raising and feeding of live stock is of first importance.

Corn is the principal crop in Linn County and has by far the largest acreage. In 1916[1] corn was grown on a total of 103,347 acres. In 1880 the area in corn was reported as 120,872 acres, and in 1900 as 124,351 acres. The number of silos in the county as reported for the year 1915 was 335, and more were constructed during 1916. Silos enable the utilization of much of the soft corn. A considerable part of the corn produced is sold. Tenant farmers as a rule keep little stock and sell a greater proportion of the grain than farm owners.

Oats rank next to corn in importance. This crop has been grown since the early settlement of the county, and the acreage has steadily increased. Oats fit in well with the growing of corn, both as a rotation crop and in the distribution of labor. The crop was grown on

[1] Agricultural statistics for 1916 are taken from the Iowa Yearbook.

54,719 acres in 1916. Both climate and soil are favorable for this crop, and of late years the yields have been good. In 1916 an average of 40.2 bushels to the acre is reported for the county. The prevailing high prices and the large yields have made oats a good money crop, and a large part of the grain is sold from the farm. Some of the straw is baled and sold, but most of it is used for roughage.

Rye is a comparatively unimportant crop in Linn County. It was grown on 1,070 acres in 1916. Rye does better than most grains on light, sandy soil, and is grown largely on such types. Barley was grown in 1916 on 1,561 acres. The 1910 census reports 4,420 acres in this crop in 1909. Buckwheat and flax are produced in a small way, the former principally on small areas of new, low-lying land.

The acreage in wheat, which ranked next to corn in importance up to 1880, decreased from 20,000 acres in 1860 to 777 acres in 1890. The production in 1915 was 25,700 bushels, from 1,370 acres. In 1916 there were 679 acres in spring wheat and 676 acres in winter wheat. During the early fifties and sixties a large acreage in the southwestern part of the county, particularly in Clinton Township, was devoted to spring wheat. In 1859 the yields averaged about 38 bushels to the acre. The average yield of spring wheat in 1916 was 17.9 bushels per acre, and of winter wheat, 17.3 bushels. The strong demand for cereals the past year, and the general distribution of new and hardier varieties of winter wheat, with consequent reduction of loss from winter killing, has resulted in an increase in the acreage of this cereal. Winter wheat makes possible a more uniform distribution of farm labor. It is used to some extent as a nurse crop for grasses and legumes. Winter wheat is sometimes grown on light, sandy soils, as it prevents washing and blowing of the soil during the winter and spring months. Turkey is the principal variety of winter wheat grown.

Sweet corn and pop corn are grown to a small extent in Linn County. In 1916, according to data collected by township assessors, 483 acres were devoted to sweet corn, producing 787 tons of green corn, which is gathered for canning. Pop corn was grown on 44 acres and produced 19,230 pounds.

The census reports 61,881 acres in tame or cultivated grasses in 1909, with a production of 99,417 tons of hay. Timothy and clover mixed constitute the chief hay crop. In 1909, 25,024 acres were devoted to timothy alone, and 1,442 acres to clover. Wild hay was cut from 4,442 acres in 1909, producing 6,432 tons. Coarse forage was cut from 3,660 acres and produced about 10,199 tons. Millet or Hungarian grass is grown to only a small extent, the 1910 census reporting about 214 acres devoted to this crop. During the last 10 years the acreage in wild hay has decreased, and the native prairie grasses have been displaced by cultivated hay and forage crops.

Timothy and clover are sown in the spring, usually with oats, and to a great extent they form a part of the rotation scheme. Red clover is well adapted to the soils of the county. Alfalfa is grown to a small extent, occupying 64 acres in 1909. Many failures have been recorded with this crop, but in a number of cases satisfactory yields have been obtained. Most of the soils need an application of lime or crushed limestone to insure best results with alfalfa, and inoculation also is advisable in most cases. The apparent adaptation of the soils to red clover has had some effect in retarding the introduction of alfalfa.

The acreage of grasses grown for seed is comparatively small. In 1916 timothy was grown for seed on 1,831 acres, producing 9,702 bushels. Clover was grown for seed on 1,358 acres, and the total production was 1,567 bushels.

In 1916, a total of 1,517 acres were devoted to potatoes, with a production of approximately 84,462 bushels. The 1910 census shows 243,111 bushels of potatoes produced in 1909 on 2,630 acres. Near Cedar Rapids, particularly east of town, trucking is carried on extensively, as the soils are sandy and naturally adapted for garden crops. The acreage devoted to vegetables in 1909, according to the census, amounted to 2,181 acres.

Apples and cherries are the principal fruits grown in the county. Small apple orchards are frequently found on farms, but there are none of commercial importance. Plums, peaches, and cherries are grown to a small extent. Various kinds of berries and grapes are grown by most farmers.

Live-stock raising has always been an important industry. Hogs and cattle are raised on nearly every farm and are one of the chief sources of income. According to the State census of 1915, the work stock, including horses and mules, ranks first in value among the live stock. In that year there were a total of 18,772 horses and mules, with a total value of $1,644,832. The horses are nearly all of the draft type, weighing 1,200 to 1,600 pounds, and all the principal draft breeds are well represented. The 1915 census reports a total of 37,158 cattle, having a value of $1,144,974. Milch cows numbered 17,029, with a total value of $711,029. Most of the cattle are Shorthorn, although there are many herds of Hereford and Angus. There are several pure-bred beef herds in the county, but most of the cattle are grades. There are several dairy herds, principally Jersey and Holstein, and dairying is recognized as an important industry. The cream is generally separated on the farm, and most of it is sold at creameries. According to the census, the dairy products produced in 1909 amounted in value to $566,871.

Hog raising is one of the most important industries in the county. The increase in the acreage of corn and the reduction in the extent

of pasture have made the raising of hogs a popular and profitable business. The ravages of cholera served to discourage hog raising for a time, but since systematic measures of prevention have been taken the disease has come under control. Crop and market conditions influence very materially the number of hogs raised. The past year (1916) was a favorable year for the raising of hogs for the market. According to the State census, there were 92,371 hogs in the county in 1915, with a total value of $728,672. Nearly every standard breed of hogs is represented, Duroc-Jersey, Chester White, and Poland-China being the most popular. There are several herds of pure-bred hogs in the county.

Sheep are kept on a few farms. In 1915, according to the State census, there were 6,329 sheep in the county, of a total value of $31,992. About 25,000 pounds of wool were produced that year, valued at $5,085.

Although poultry raising is not conducted as a separate industry, it has an important place in the agriculture of the county. Practically every farm produces poultry and eggs for home use and for sale. The income from poultry sold in 1914 amounted to $199,168 and that from eggs sold to $269,250.

Farming operations in Linn County do not appear to be materially influenced by topographic or physiographic differences. There are no marked variations in the crops grown in different parts of the county. Farmers, however, recognize the adaptation of certain soils to certain crops. Corn is probably grown more extensively on the Carrington silt loam, the Tama silt loam, and the Bremer soils than on the light-colored loess soils and drift soils usually found in the vicinity of the rivers. The rough, dissected areas adjacent to the streams are largely used for pastures. Large areas of Clinton silt loam, where not subject to excessive erosion, appear to be well suited to corn. The soils are excellent grass soils, and clover grows without difficulty. In years where the growing season is shortened by a backward spring or early fall frosts, somewhat better yields of corn are obtained on the light-colored sandier soils of the Lindley series than on the dark prairie soils. In years when the growing season is long enough, good yields of corn are obtained on the low-lying black soils of the Clyde series. These have to be drained, however, before they reach their highest state of productiveness. The sandy soils of the Lindley series warm up readily in the spring and are used quite extensively for truck crops, especially where near markets. Corn is grown extensively on the Buckner soils, which in normal years give better yields of corn than can be expected of small grains. The continuous cropping of these soils to corn, however, has resulted in decreased yields where remedial measures have not been taken, owing to their open, porous subsoils. The soils of the Wabash, Sarpy, and

Cass series are mainly used for pasture, especially where subject to frequent overflows.

Farming methods apparently are not influenced to any marked degree by local soil conditions. The most up-to-date methods, indicative of progressive agriculture, are practiced in all parts of the county. Much attention is paid to the improvement of the stock, and cow-testing associations are active in an effort to make the dairy industry more profitable. Inoculation against hog cholera is practiced. Seed corn and other seed are carefully selected, and germination tests are made in some instances before planting. Danger from smut is lessened by treatment of oats with a formaldehyde solution. The value of tile drainage in the flat areas is appreciated, and large areas have been reclaimed and put in a more productive condition. The rough, dissected areas adjacent to the rivers are generally kept seeded to cover crops or left in pasture to prevent erosion.

Modern farm machinery is used on all farms. The buildings are substantially constructed and kept in a good state of repair. The barns are large, with ample space for the storage of farm products and machinery, and provision is made for the protection of cattle and work stock from severe winter weather. The farm houses are usually well built and often have many modern conveniences. The automobile has become an important adjunct of the farm. Power machinery is used quite extensively. The work stock consists mainly of heavy draft horses, with some mules.

The cultural methods followed are thorough and well suited to maintaining the various soils in good condition. The land is usually plowed 6 to 7 inches deep, and a large proportion of the land intended for spring crops is plowed in the fall. Corn is planted early in May. Practically all of the crop is checked, with the rows usually about 40 inches apart. Both single and two row cultivators are in use. The crop is cultivated three to five times, depending on the season and the labor available. Most of the crop is gathered from the standing stalks, cattle being allowed to forage in the fields afterwards. Part of the corn is cut and shocked in the fields and then either fed whole or shredded. Considerable corn is grown for ensilage, and the number of silos is increasing from year to year. Hogging down corn is a common practice, and one which is gaining in favor of late. Rape is often sown in the corn at the time of the last cultivation. Small grains are sown with the drill or broadcast seeder on corn stubble prepared by disking. Seeding is done throughout April. Most of the crop is thrashed from the field, only a small part being stacked.

Crop rotations are generally recognized as essential in maintaining the productiveness of the soils. No particular rotation is followed, the cropping system varying with the kind of farming car-

ried on. A popular system is one covering five years, corn being grown for two years; a small grain, seeded with grass, one year; followed by hay and pasture for two years.

Stable and barnyard manure constitutes almost the only fertilizer used in the county. On most farms the manure is distributed with a spreader on land to be put in corn. The use of crushed limestone as a soil amendment is becoming quite general. Soils that are acid are invariably improved by an application of lime, especially when clover or alfalfa is to be sown. The application is generally from 2 to 4 tons of crushed limestone to the acre.

The demand for farm labor is supplied locally, and in normal times it is possible to get efficient help without difficulty. The average wage paid farm help in the summer of 1916 was $31.43 a month. The average wage paid the farm help in the winter months is reported as $24.80. Efficient farm help has been very scarce the last year, and wages have advanced. Most of the farm laborers are American-born white persons.

The average size of the farms in 1910 is reported as 119.1 acres, and in 1916 as 128.1 acres. According to the 1915 State census, of a total of 413,840 acres in farms, 230,365 acres are farmed by the owner, 131,515 acres are rented for cash, and 51,960 acres are rented on a share basis. There has been a constant and growing demand for farms to be operated on a rental basis. The cash rental of farms with average improvements varies from $6 to $6.50 or sometimes more per acre. The tenants as a rule are good farmers and carry on farming operations in much the same way as owners. In many leases it is stipulated that no roughage be hauled away but that it be fed on the farm and returned to the land in the form of manure.

Land values are high and increasing. The selling price of land varies considerably over the county, depending upon the improvements, character of the soil, and location with respect to railways and markets. In 1900, according to the census, the average assessed land value was $44.37 an acre, and in 1910, $92.47. The increase in land values has been rapid during the last few years. The 1915 State census gives the average value of farm lands as $142.30 an acre. Present (1917) selling prices range from $100 to $200 per acre.

SOILS.

Linn County is a part of the vast region covered during the Pleistocene period by the invasion of the great continental ice sheets. Two distinct advances, widely separated in time, moved down from the north and covered the area with transported material. This glacial débris, consisting of ground-up rock of many kinds in various stages of fineness, is the parent material of the soils over the greater part of the county. The older drift, known

as the Kansan, is deeply buried over the greater part of the area and is exposed only in the deeper stream channels.[1] The younger or Iowan drift is the principal soil-forming material.

The unweathered till is a yellow or brown calcareous clay or sandy clay, with occasional pockets or beds of sand and gravel. These occur at the base of the till, and they affect the drainage and furnish the water supply of the region.

The changes that have taken place in the drift in bringing it to its present condition as a productive soil have been produced mainly by the leaching of the soluble constituents within a few feet of the surface and by the accumulation of black organic matter, which has imparted the dark-brown to almost black color in the surface soil to depths of 8 to 18 inches. Below this to a depth of several feet oxidation, aeration, and leaching have given a uniform yellowish-brown color. There has been a concentration of clay particles in the subsoil, so that in most places it is heavier in texture than the surface soil, but in no case is the subsoil extremely compact and impervious. The dark-colored upland prairie soils with uniform brown subsoils, which indicate formation under conditions of good drainage, are classed with the Carrington series. The light-colored upland soils of glacial origin are found on the rolling timbered areas along stream slopes. The forested condition, and probably differences in the original composition of the material itself, have not favored the accumulation of much organic matter, but the subsoils do not differ greatly from those of the Carrington series. The light-colored glacial-drift soils are classed with the Lindley series. The sandy and gravelly drift occurring in beds and pockets in the glacial till has produced the sandy and gravelly soils of the Carrington and Lindley series. In some places, particularly in areas of the Lindley series, it has been difficult to determine, without investigation into purely geological processes, the origin of these soils. The sands and gravel may be outwash from the glacier, or in some cases the sands may have been deposited by wind action. No fine separation, therefore, has been attempted upon the basis of origin.

A deposit of loess overlies the drift in some parts of the county, but is not continuous over any large areas. It is the parent material of the soils over considerable areas in the central part of the county along the valley of Cedar River. In its unweathered condition the loess consists of a loosely consolidated material, ranging in texture from a silt loam to a heavy silt loam and in color from brownish yellow to light gray. Processes of oxidation, aeration, and leaching similar to those that have changed the glacial till to productive soils have produced similar changes in the loess, but these processes are

[1] Iowa Geological Survey, Vol. IV.

not so far advanced in the loess, as it is a younger formation. Two general classes of loessial soils have been formed. The prairie type, called the Tama silt loam, has a dark-brown to black surface soil, due to the large accumulations of black organic matter, and a uniform brown subsoil, a consequent of good drainage. The light-colored loessial soil, the Clinton silt loam, occurs on the rolling stream slopes. The soil is dark gray to light grayish brown, and the subsoil is yellowish brown. The accumulation of clay in the subsoil has produced a heavy, compact structure.

The underlying rocks of the area are limestones and shales of Paleozoic age. Limestone is exposed at many places, but the outcrops are very small and no soils of any importance have been derived from it. The limestone, when found at a depth of a few feet, has no appreciable influence on the composition of the surface soil. Cliffs composed of limestone are found along the Cedar and Wapsipinicon Rivers wherever these streams have cut into the rock formations on the outer edges of their flood plains. Such areas of limestone outcrops adjacent to prominent drainage ways really constitute Rough stony land, but it is considered impracticable to show these narrow areas on the soil map.

The soils of the Carrington series are dark brown to black, and the subsoils yellow to light brown. Although these soils are derived through the weathering of the glacial till, the silty members are modified to some extent by loess. The topography is gently undulating to rolling. Neither soil nor subsoil is highly calcareous.

The soils of the Lindley series are characterized by gray or grayish-brown soils and light-brown or yellowish-brown subsoils. Neither soil nor subsoil is calcareous. The topography is rolling to broken, and drainage is well established. Limestone outcrops are frequent.

The Clyde soils occupy the depressed areas in the uplands. The surface soils are dark gray, dark brown, or black, and the subsoils are gray or yellow, mottled in practically all cases with gray or yellow. The topography is level or very nearly so. The Clyde soils are not calcareous in either soil or subsoil. They are naturally poorly drained, but when reclaimed are highly productive.

The Clinton series is characterized by gray or dark-gray soils and by light-brown or yellowish-brown compact subsoils. The topography is rolling to broken, and drainage is well established. The Clinton soils are derived by weathering from loess.

The soils of the Tama series are dark brown to black and overlie light-brown to yellowish-brown friable upper subsoils. At 18 to 24 inches the subsoil becomes slightly more compact. Both soil and subsoil are neutral or acid. The Tama soils occupy level to smooth rolling upland of the characteristic paha type.

Sharply separated from the upland proper are the alluvial soils, comprising both the frequently overflowed first-bottom soils and the old alluvial or second-bottom soils lying above normal overflow. The alluvial soils have been derived to a very large extent, if not wholly, from the uplands and represent wash material transported by the streams and deposited in their flood plains. The soil of the first bottoms is of recent formation, and the process of deposition is still going on, but the terrace soils are much older, some probably dating back to glacial times or before, with the result that through weathering the surface has come to be more like that of the uplands than that of the first bottoms.

Closely related to the terrace soils, and occupying a similar position, are areas mainly derived from colluvial material. The soils here are classed in the Judson series.

The Judson series comprises soils of alluvial and colluvial origin. The surface soils are dark brown to almost black, and the subsoils are lighter brown. Neither soil nor subsoil is highly calcareous. The Judson are found on terraces above overflow and on colluvial slopes along the foot of bluffs. The material mainly consists of wash from loess or silty drift soils.

Distinct terraces are developed along the principal streams. The terraces along the Cedar and Wapsipinicon Rivers and Buffalo Creek are mainly occupied by the Buckner series of soils, and those along their larger tributaries by soils of the Bremer and Calhoun series.

The Buckner series consists of brown to dark-brown soils, with lighter colored friable subsoils. The soil is composed principally of reworked loessial material, frequently mixed with sediments from glacial and residual soils. The surface is level, but drainage is good.

The soils of the Bremer series are black, and the subsoils are dark gray to almost black or drab, mottled with yellowish-brown and black iron stains. The subsoil is as heavy as, or heavier than, the soil to a depth of 3 feet or more, and in the heavier members it is tough and plastic. The series is confined to terraces above overflow. Drainage is good in some cases but very poor in others.

The Calhoun soils range in color from dark gray to brown. The upper subsoil is usually an ashy-gray silt loam to silty clay loam, about 6 inches in thickness. The lower subsoil is a mottled brown and drab compact silty clay loam or clay. These soils occur on old terraces above the present flood plains of the streams.

The soils of the first bottoms, subject to overflows, are classed in the Wabash, Cass, and Sarpy series.

The Wabash series includes dark-brown to black soils, high in organic matter, with dark-drab to gray heavy subsoils. Both soil

and subsoil have a low lime content. The series is typically developed in the first bottoms of streams in the Central Prairie States, the material being derived principally from the loessial and silty glacial uplands. The natural drainage is well established in some areas.

The Cass series includes dark-brown to black soils underlain by lighter textured subsoils which frequently pass within the 3-foot section into loose sand and gravel. These soils drain off rapidly when the floods have subsided.

The Sarpy series includes brown soils underlain by subsoils of lighter texture, frequently passing within the 3-foot limit into loose sand and gravel.

A few low-lying areas occur in the upland in which the soil consists of decomposed organic matter mixed with various amounts of mineral matter. This soil is mapped as Muck.

The following table gives the name and actual and relative extent of each of the soils mapped:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Carrington silt loam	225,664	49.7	Cass loam	3,520	0.8
Carrington loam	45,504	10.0	Lindley loam	3,264	.7
Clinton silt loam	40,128	8.8	Cass silt loam	2,752	.6
Clyde silt loam	31,680	7.0	Cass fine sandy loam	2,688	.6
Wabash silt loam	15,808	3.5	Lindley fine sand	2,112	.5
Tama silt loam	15,552	3.4	Lindley very fine sandy loam	1,600	.4
Carrington fine sandy loam	11,776	2.6	Sarpy fine sand	1,280	.3
Lindley silt loam	10,176	2.2	Buckner sandy loam	1,216	.3
Buckner silt loam	9,536	2.1	Bremer silty clay loam	1,152	.3
Lindley fine sandy loam	9,344	2.1	Clyde silty clay loam	1,024	.2
Bremer silt loam	4,928	1.0	Carrington very fine sandy loam	576	.1
Judson silt loam	3,712	.9	Muck	384	.1
Light-colored phase	512		Calhoun silt loam	192	.1
Buckner loam	3,968	.9	Total	453,760	
Buckner fine sandy loam	3,712	.8			

CARRINGTON FINE SANDY LOAM.

The soil of the Carrington fine sandy loam consists of a brown or dark grayish brown loose, friable fine sandy loam, 10 to 15 inches deep. There is a slight change to a lighter color with increase in depth, due to a deficiency of organic matter, but no change in texture is apparent to a depth of 20 to 24 inches, where the subsoil is a grayish-yellow or brown fine sandy loam, somewhat higher in silt and clay than the surface soil and having somewhat more coherency. At 24 inches the subsoil grades into a yellowish-brown to light-brown fine sandy loam or loamy fine sand which becomes lighter in color

and texture with depth. The subsoil at 24 to 36 inches consists of angular material of rather unweathered appearance.

The Carrington fine sandy loam occurs mainly in association with the Carrington loam, but a few small areas are associated with the Tama silt loam. It is frequently found adjacent to streams, where its position would permit of ready modification by wind action. It usually occupies ridges, and drainage is excessive in most cases. There are many places, however, especially on slopes, where seepage water collects, and where tiling is resorted to in order to improve the drainage.

Large areas of this type are forested. The growth consists principally of oak and hickory, with an undergrowth of blackberry, sumac, and other shrubs. Areas that have supported a growth of timber are naturally lighter in color than typical. The addition of organic matter is generally necessary on this soil to maintain its productiveness, increase its moisture-holding capacity, and make it less subject to wind action. Small areas of fine sand, which has been reworked by the wind in the form of "blow-outs", are frequently included with the type.

The staple crops of the county are grown on this soil, which is generally farmed in connection with the Carrington loam and silt loam. Cultivated areas are especially subject to wind action, which frequently removes the soil from the roots of plants, while in the spring the seed bed is so disturbed at times that the seed is left exposed. Owing to its tendency to drift, the type is best left in mowing or pasture, and much of it, especially the rougher areas adjacent to the streams, is used for these purposes.

CARRINGTON VERY FINE SANDY LOAM.

To a depth of about 22 inches the Carrington very fine sandy loam consists of a brown or dark-brown very fine sandy loam or fine sandy loam. This grades into a light-brown or yellowish-brown fine sand or loamy fine sand. The type is apparently weathered from glacial drift, with perhaps a modification brought about by wind action.

The Carrington very fine sandy loam is not extensive. Areas are mapped southeast of Troy Mills and elsewhere on the Iowan drift plain. Southeast of Troy Mills the type forms part of a conspicuous ridge which represents an area of drift soil apparently devoid of any loessial covering. Southeast of Robins a small area is recognized which has a northwest-southeast trend. The soil here has a position smiliar to that of the area southeast of Troy Mills. On account of its close association with the glacial soils it is classified as Carrington very fine sandy loam.

Most of the type is under cultivation, but it is subject to erosion, and unless it is seeded down frequently considerable damage is done. Although there is indication that the type has been modified by wind action, conditions do not appear to have been favorable for the formation of blow-outs. The slopes occupied by the type are quite steep. The addition of organic matter is essential to maintain the productiveness of the soil and make it less subject to wind erosion.

CARRINGTON LOAM.

The surface soil of the Carrington loam consists of 10 to 12 inches of dark-brown or nearly grayish-brown loam or fine loam. The relatively small amount of sand present is medium or fine in texture. The soil is friable and easily cultivated. With increase in depth the subsoil becomes somewhat heavier and more compact, and at 20 inches it grades into a brown, light-brown, or nearly yellowish-brown fine loam or fine sandy loam. At 30 to 36 inches the subsoil is a yellowish-brown or light-brown fine sandy loam to yellow fine sand. Angular coarse sand and frequently glacial pebbles are contained in the subsoil. Bowlders, mainly granite, occur on the surface of the type, but rarely in large quantities, and they are usually much weathered and disintegrated. Where exposed in road sections or in other places, the granite bowlders rapidly crumble away, and the coarse-grained ones upon disintegration add to the sandy nature of the type. Small areas of darker brown loam overlying a yellowish-brown gritty clay loam or silty clay loam are included in this type as mapped.

A sandy loam variation of this type occurs in small, scattered areas in the Iowan drift plain. It occupies rounded ridges within areas of the Carrington loam, and on account of its small extent it is included with that type. It does not differ essentially except for its slightly higher content of medium sand.

The Carrington loam is closely associated with the Carrington silt loam. It usually occurs on low mounds or ridges, frequently at a slightly higher elevation than the silt loam. It is often encountered at the junction of two intermittent drainage ways, where conditions have favored the removal of the finer soil particles, leaving coarser grains to form the soil.

Owing to the preponderance of fine sand and coarse silt, this soil has been readily modified by the action of the wind. A variation found in small areas in sec. 5, T. 83 N., R. 6 W., and in several other places, consists of a fine loam with a uniform fine sandy loam or coarse silt subsoil. At first sight, the material appears to be mainly of loessial origin, but the evidence is inconclusive. Occasional bowlders and the angularity of the soil particles, together with the

position of the areas, favor the inclusion of this variation in the Carrington loam.

The largest areas of Carrington loam are found in the northern part of the county, in proximity to the drainage systems. The type is conspicuously lacking on the drift plain in Fairfax and College Townships. Here the glacial drift soils lack the preponderance of sand, the subsoils are heavier, and the soil material is in a less advanced stage of decomposition and disintegration than is the case of the Carrington loam in the northern part of the county. The topography of the larger areas is generally rolling to slightly undulating, while the slopes of the individual mound and ridge areas are usually gentle. There is a striking similarity of form between the areas of Carrington loam on the right bank of the Wapsipinicon River, extending from the region of Troy Mills southeastward toward Paris, and the loess ridges commonly found adjacent to the major stream areas. This large area of Carrington loam is entirely devoid of loess and rises boldly above the drift plain and the river. Numerous bowlders are present on the highest elevations, and the character of the drift material is such that it is utilized for road making in the surrounding neighborhood.

The drainage over the Carrington loam is generally fair or good. Occasionally tiling is necessary, largely where the type reaches well down the slope, bordering on the heavier, more poorly drained areas. Both soil and subsoil are fairly retentive of moisture, and the soil warms up readily in the spring, hastening the maturity of crops. In years of average rainfall yields are very satisfactory, but they are somewhat reduced in seasons of severe drought. The good drainage, favorable tillage properties, and the absence of waste land render this a highly desirable type. It is very responsive to manuring and other methods of improvement. No commercial fertilizer is used.

This soil is used almost exclusively for the staple crops of corn, oats, and hay. The farming practices are those common to the county as a whole. The greatest acreage on individual farms is devoted to corn and the next largest acreage to oats. The yields of corn average 40 bushels per acre under the common methods of cultivation and where the fields have been tilled for several years. Where the land is heavily manured, or where especially careful cultivation is practiced, higher yields are obtained. Oats do well, averaging 30 to 35 bushels per acre, and in some years giving considerably higher yields. Clover and timothy, the chief hay crops, yield from 1 to 1½ tons per acre. Wheat and barley are grown to a very small extent. Ordinarily the small grains and corn mature several days earlier than on the heavier textured prairie soils, and corn is less likely to be injured by early fall frosts.

Improved farms of this type at this time (1917) have a value of $100 to $175 an acre, depending upon the improvements and the proximity to markets.

CARRINGTON SILT LOAM.

The Carrington silt loam, to a depth of 8 to 12 inches, consists of a dark grayish-brown or nearly black, friable and generally mellow, silt loam to fine loam. The soil is underlain by a dark-brown heavy silt loam, which passes abruptly at about 22 inches into a yellowish-brown or light-brown gritty clay loam or silty clay loam. Considerable coarse material is usually incorporated in the lower subsoil. Huge drift bowlders are commonly found on this type, especially in the region of Walker and southward toward Center Point. Greenstone and other glacial pebbles are frequently encountered in the subsoil.

A variation of the type is found in the northern part of the county, especially in Maine, Marion, Brown, and Boulder Townships. It is characterized by a relatively high percentage of sand throughout the soil section, and especially in the subsoil. Another variation occurs in the region of Alburnett, particularly north of the town. Here the soil is somewhat deeper than typical, and the subsoil tends toward a dark-gray or yellowish-gray silty clay, mottled with brown. It is so compact as to restrict drainage, and in wet seasons crops may be injured.

The largest areas of typical Carrington silt loam are found in Fairfax and adjoining townships, south of the Cedar River, where the loam type is almost entirely lacking. The soil here is practically uniform except for the heavy black areas in the wide channel of Prairie Creek. In Grant Township the Carrington silt loam is typically developed. The ridges, which in other parts of the county would give rise to the loam member of the series, are here usually occupied by the Carrington silt loam. In general, this is the predominant soil type in the drift areas between the Cedar and Wapsipinicon Rivers.

The type was originally prairie, and the decay of the heavy growth of prairie grasses accounts for the high content of organic matter. The topography is general is undulating to rolling, with a few nearly flat or level areas.

The surface drainage of the Carrington silt loam is good except in a few areas, as in the region of Alburnett, where the surface is undulating to nearly flat. Tiling remedies this condition, the subsoil permitting the satisfactory escape of the excess water.

The Carrington silt loam is one of the most important soils, and it is practically all under cultivation. The soil is easily cultivated

and maintained in good tilth. A progressive type of farming is practiced, and the improvements are good and well cared for.

Corn is the chief grain crop. It averages from 40 to 50 bushels per acre, and where the land has been heavily manured, or where especially careful cultivation has been practiced, considerable higher yields have been obtained. The next largest acreage is devoted to oats. This crop does well, and exceptional yields have been reported of late years, owing in part to favorable growing seasons. Very little rye and barley are grown. Clover and timothy do very well. Alfalfa is grown to a small extent. Inoculation of the soil and liming to correct the acidity are practices that insure the more certain catch of the crop.

This soil is very responsive to the application of manure, and its natural productiveness is maintained and often increased by the application of manure and the adoption of a satisfactory crop rotation. A system of live-stock farming is very general on this soil. This type of agriculture serves to keep up the natural fertility of the soil. Much high-grade stock is found on farms on this soil throughout the county. The cattle industry is confined mainly to beef production, except in a few localities where dairying is of considerable importance.

In the vicinity of Mount Vernon and Lisbon a very silty variation of this type is found, resembling the Tama silt loam. It consists of a dark-brown or nearly black, mellow, friable, rather heavy silt loam to a depth of 15 inches, underlain by a dark-brown heavy silt loam to silty clay loam. The subsoil is friable and drainage is apparently not restricted. This soil is apparently a product of the unstratified glacial drift, with perhaps a modification by a thin covering of loess. Glacial bowlders are present on the surface, but are not abundant. The topography is undulating to rolling. This soil occupies a position between the loess ridges that are common in the region surrounding Mount Vernon. It is very productive and supports a prosperous agriculture.

LINDLEY FINE SAND.

The Lindley fine sand to a depth of 18 or 20 inches is a light grayish brown fine sand. The subsoil is a light-brown fine sand. Angular and subangular pebbles and small gravel are generally scattered over the surface.

This type is mapped in small scattered areas on the upland ridges adjacent to the Wapsipinicon and Cedar Rivers. These ridges have gentle slopes, but drainage is excessive and the type is droughty. Some small depressions within the type, however, are occupied by a somewhat heavier soil which frequently has inadequate drainage.

The Lindley fine sand is derived from glacial material. It is subject to drifting, and the surface has been considerably modified by the action of the wind.

Some of this type is cultivated, but the greater part is kept in pasture, since cultivation renders it subject to drifting. Much of the type is forested. Oak is the chief tree growth, with some elm and hickory. The best use of this soil is for pasture. Truck crops are grown to a small extent. The incorporation of large quantities of organic matter makes this soil more loamy, prevents blowing to some extent, and serves also to increase the moisture-holding capacity. Such treatment is necessary for best crop yields.

A variation of this type is found in the northern part of the county, in small, scattered areas. It consists of a grayish-brown to dark-brown slightly loamy fine sand with a depth of about 10 to 15 inches. The subsoil is a brown or light-brown loamy fine sand or very fine sand, grading at 36 inches into a light-brown fine sand. In places the soil may have a texture coarser than fine sand and contain some small gravel. This variation occurs on mounds and ridges.

Southeast of Troy Mills an area 1½ miles long and less than a quarter of a mile wide, in which the soil is not typical, has also been included with the Lindley fine sand. It extends in a northwest-southeast direction, suggesting a modification by the prevailing winds. The soil is commonly referred to as "blow sand", since it is subject to shifting. Owing to its porous character, it is over-absorptive of moisture, and there is little run-off. Part of the soil is cultivated, generally in association with some of the heavier members of the Carrington series. The greater part of the type, however, is kept in pasture or meadow, as the soil drifts where the land is plowed. A few of the areas are timbered, mainly with oak and hickory. Crop yields are naturally low. The variation does not occur in areas sufficiently large to comprise individual farms, and it lowers the value of farms on which it occurs.

LINDLEY FINE SANDY LOAM.

The Lindley fine sandy loam, to an average depth of 18 inches, consists of a grayish-brown fine sandy loam or fine loam. This is underlain by a brown to light grayish brown fine sandy loam or loamy fine sand, giving way at about 30 inches to a light brownish gray loamy fine sand. Pebbles and small gravel, mainly subangular, occur on the surface and throughout the soil section. The subsoil is variable. In the slight depressions it is usually a gritty or sandy, dark-brown or yellowish-brown silty clay loam. Occasionally the limestone outcrops on the slope, the overlying soil stratum being very thin.

This type occurs mainly in close association with the soils of the river ridges, which are forested or originally were forested. Small scattered areas are closely associated with the Carrington series, and the type resembles the Carrington fine sandy loam except for the color of the surface soil. The Lindley fine sand loam is apparently a result of the weathering of the glacial drift with perhaps considerable later modification. The forest growth resulting from the proximity to streams has caused the formation of a lighter colored soil than is found in the areas farther back from the streams.

The surface drainage of the type is for the most part adequate, and sometimes excessive, but shallow basins or depressions underlain by a heavy subsoil are benefited by artificial drainage. Owing to its porous character the type is absorptive of moisture. In many places the shallow basins are occupied by material of a cumulose nature. The basins occur more or less independently of topography and may be found on hillsides or even on hilltops.

Most of the type is under cultivation. The more dissected areas have been allowed to remain in forest and are used as pastures. The Lindley fine sandy loam bears evidence of originally being heavily timbered. The present stand consists mainly of white oak and hickory, with an undergrowth of sumac and other brushy and shrubby vegetation.

Small grain and corn are grown on this type, but the average yields are low. When plenty of manure is applied good yields of corn have been reported. The occasional plowing under of a crop of clover gives good results. The incorporation of large quantities of organic matter in the soil is essential for the best yields. Mammoth clover is reported to grow well on this soil, and its large root system opens up the subsoil and permits it to be aerated—a benefit which is often overlooked as being unnecessary on sandy soil. The type where located in proximity to suitable markets is well adapted to growing truck crops.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Lindley fine sandy loam:

Mechanical analyses of Lindley 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.*
332134, 332188...	Soil.....	0.1	6.3	14.4	52.9	8.3	14.3	3.5
332135,332189...	Subsoil.....	.1	6.6	15.7	56.2	5.9	12.7	2.5
332136,332190...	Lower subsoil.	.2	10.6	15.1	56.4	7.3	7.9	2.3

LINDLEY VERY FINE SANDY LOAM.

The soil of the Lindley very fine sandy loam consists of a grayish-brown very fine sandy loam about 12 inches deep. The subsoil is a light grayish brown coarse silt loam which becomes heavier with depth, grading at 36 inches into a brown or light-brown, gritty, heavy silt loam or silty clay loam.

This type is of minor importance. It is most extensively developed on rather steep slopes or ridges. Southeast of Cedar Rapids it lies lower than the associated Lindley fine sandy loam, from which in great part it has been derived. The drainage is good to excessive except in small depressions, which are often benefited by artificial drainage. The type is fairly retentive of moisture.

The greater part of the Lindley very fine sandy loam is cultivated. Small scattered areas throughout the county are forested. Truck gardens are numerous on this soil, especially to the southeast of Cedar Rapids. The selling price of this land is high wherever the proximity to market favors the trucking industry.

LINDLEY LOAM.

The surface soil of the Lindley loam is 8 to 10 inches deep. It is a light grayish brown or light-brown coarse silt loam or fine loam, containing a noticeable amount of sand and fine sand. The subsoil becomes somewhat heavier with depth, changing to a brown or light-brown heavy silt loam at about 20 inches, and below into a brown sandy or silty clay loam, which becomes lighter in color and coarser in texture with depth. At about 26 inches the subsoil passes into a sandy or gritty brown or yellowish-brown clay or till.

Stones and bowlders are scattered over the surface of this soil in places. Limestone outcrops are frequent, especially near the streams, but limestone does not appear to have had any influence on the type. Large areas of brown or light grayish brown fine loam are included with the type, especially in scattered areas adjacent to streams.

A characteristic feature of the Lindley loam as compared with the Lindley silt loam is its more open and porous subsoil. Like the Carrington loam, the Lindley loam is a product of the weathering of unstratified glacial till. The difference between the two soils is principally in organic content. The Lindley loam is, or originally was, forested, while the Carrington loam was mainly prairie.

The Lindley loam ordinarily is well drained, except in some areas back from the drainage systems where the subsoil is more compact and the underdrainage is less adequate. A large part of the type is under cultivation. Although the type often occurs near limestone, it is not calcareous. Owing to its low organic content it needs liberal manuring to maintain the productiveness. Although this soil is

usually deficient in lime, laboratory tests do not show as large a deficiency as is usually the case with the dark prairie soils. The more systematic growing of legumes on this type materially benefits its structure and makes it more productive. Red clover appears to do well, especially where the soil has been limed.

Below are given the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Lindley loam:

Mechanical analyses of Lindley 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.*
332129	Soil	1.0	9.9	9.7	17.9	10.7	41.6	8.7
332130	Subsoil	.8	9.7	8.6	17.1	5.1	45.7	13.0
332131	Lower subsoil	2.0	14.0	13.7	28.7	6.6	21.2	13.6

LINDLEY SILT LOAM.

The soil of the Lindley silt loam is a light grayish brown or gray, rather compact, silt loam, 8 to 10 inches deep. The soil changes abruptly into a light-brown or light yellowish-brown compact silty clay loam subsoil, which becomes somewhat lighter in color and heavier in texture with depth, and at 24 inches passes into a compact, tough, and impervious, light-brown to yellowish-brown silty clay loam or silty clay. At 30 inches a gritty yellowish-brown clay loam occurs and at 36 inches a light yellowish-brown sandy loam. A substratum of sand is often encountered at lower depths. The surface soil is characteristically light gray when dry, but darker when wet. In some places the compact subsoil continues to a depth of more than 3 feet. The substratum of sand is most likely to occur in areas adjacent to streams.

The Lindley silt loam is confined to small areas or strips of upland bordering some of the important streams. It is often closely associated with the Clinton silt loam, which always occupies a higher position, and also with the Carrington silt loam, into which it may grade almost imperceptibly. In places arbitrary lines are drawn separating it from these soils.

On account of the nearness of the Lindley silt loam to streams and to the higher lying loess areas, it is subject to erosion, and in some places is much dissected. Surface drainage is in most places adequate. In a few local areas the underdrainage is not free, owing to the compactness of the subsoil.

A large part of this type originally supported a heavy growth of hardwood trees. Much of it has been cleared and placed under

cultivation. The surface soil becomes rather compact and hard in dry weather, and a good tilth is not quite so easily maintained as on the prairie soils. The peculiar properties of the subsoil are recognized by farmers. The type is not highly productive, the average yields of corn being somewhat lower than on the prairie soils. The liberal use of manure improves the productiveness and tilth.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower 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.*
332126	Soil	0.0	1.7	2.0	5.2	7.0	73.9	9.7
332127	Subsoil	.0	.5	.8	3.3	12.1	64.0	18.6
332128	Lower subsoil	.1	9.7	15.5	37.9	7.1	20.5	9.0

CLYDE SILT LOAM.

To a depth of 6 inches the Clyde silt loam consists of a black heavy silt loam containing considerable raw, undecomposed organic matter. It is underlain by a black or nearly black heavy silty clay loam or silty clay to about 24 inches, where the material is a yellowish-gray plastic silty clay, slightly mottled with brown and light brown.

The position of this type in depressions has permitted considerable sand to be washed down and incorporated with the surface soil. Small pebbles and gritty material are abundant in the subsoil, giving it a rather open, porous structure, and pockets or streaks of sand, in some places clean and well assorted and in others iron stained, occur in many places in the lower part of the subsoil. Examination of the coarse material does not indicate any limestone or calcareous material in the subsoil.

The Clyde silt loam is developed throughout the drift region. Quite extensive areas of the type lie south of Center Point, and also in Spring Grove Township. In many places it occupies small draws and extends will up the slopes. These draws are often filled with granite bowlders.

The larger areas of the Clyde silt loam are flat, while the smaller ones are depressions. In all cases the areas lie lower than the adjoining soils, and the drainage is usually poor. In many places the type has been tile drained. Efficient drainage naturally changes the character of the soil by causing thorough oxidation and more complete decomposition of the soil material, and with time it will closely approach the Carrington silt loam in character.

Many of the larger areas of Clyde silt loam are cultivated, but much of the type is still used for the production of hay and for pastures. Corn is the most important crop. Where the land is well drained good yields of corn are obtained in favorable years. Small grains are grown to a considerable extent. The type supports a good growth of bluegrass.

A variation in the Clyde silt loam consists of a grayish-black or black heavy silt loam (nearly a silty clay loam in places) with a depth of about 15 inches. This zone contains a high percentage of organic matter. A transition zone, extending from 15 to 22 inches, consists of a dark-gray heavy silt loam or silty clay loam with faint mottling of brown or grayish brown. At 22 to 30 inches the subsoil is a very compact, impervious, gray or grayish-yellow, heavy silty clay, with abundant mottlings of brown and reddish brown, which have an influence on the color. The subsoil becomes less compact and impervious with increase in depth. At 30 inches it grades into a yellow or light-yellow silty clay loam, tinged with gray. Reddish-brown and dark-brown mottlings are present here, but are not so pronounced as in the upper portion of the 3-foot profile. In many places grit and coarse pebbles are encountered in the subsoil. These areas are the product of the weathering of unstratified glacial drift. Owing to the level topography, the drainage is poor. In many places the texture is somewhat heavier than a silt loam, but when thoroughly drained and moderately dry the soil is friable and, with proper cultivation, works up into good tilth.

CLYDE SILTY CLAY LOAM.

The Clyde silty clay loam consists of a black friable silty clay loam to a depth of 10 inches, underlain by a grayish-black compact silty clay which is slightly mottled with brown. Iron concretions are frequently found in this section of the soil profile, and the soil has a peculiar "buckshot" structure. At 24 inches the subsoil grades into a gray or dark-gray plastic silty clay, mottled with brown or dark brown. The lower subsoil is quite pervious.

This type occurs in small scattered areas in close association with the Clyde silt loam. In most cases it occupies depressed areas, often at the head of or along drainage ways. The soil is usually wet, and tiling and ditching are necessary in most cases before it can be cultivated satisfactorily. The type is naturally strong and fertile, and in seasons of favorable rainfall good yields are obtained on areas that are suited to cultivation.

Only a few areas of this soil are farmed, corn being the chief crop. It supports a good growth of bluegrass and is largely used as pasture land.

CLINTON SILT LOAM.

The Clinton silt loam consists of a light brownish gray or yellowish-brown friable silt loam, about 8 inches deep, underlain by a light-brown or dark yellowish brown heavy silt loam or silty clay loam. At 18 inches the subsoil grades into a light-brown or yellowish-brown silty clay loam or silty clay. The lower part of the subsoil has a distinct granular structure, but is not compact. The type is uniform in texture, and there are only slight variations in the color of the surface soil.

The Clinton silt loam is an extensive soil. It occupies a large part of the conspicuous ridges adjacent to the principal streams, and large areas occur elsewhere in the neighborhood of streams.

A characteristic feature of the Clinton silt loam and other closely related soils is the basal sands. These deposits of sand frequently underlie large areas of loess and contribute much to the confusion that exists in satisfactorily explaining the origin of the so-called loess soils. Where the basal sands occur and are exposed, they are very easily eroded.

This type as a whole is rolling to rough. Erosion is extremely active, and some areas are considerably dissected. Both soil and subsoil are retentive of moisture.

The Clinton silt loam is an important soil, and a large part of it is under cultivation. The type was originally forested, mainly with white, red, scarlet, and bur oak. Hickory, hazel brush, and many other trees and shrubs are common to this type. The forested areas furnish excellent pasturage, the forest growth preventing the destructional work of erosion.

Much of the type is planted to corn. Oats probably rank next in acreage. Little difficulty is experienced in obtaining a good catch of clover on this type. Some trucking is done, mainly near Cedar Rapids. There are numerous orchards, but none of commercial importance.

Owing to its friable, mellow character, this soil is easily cultivated and maintained in good tilth, and it warms up readily in the spring. Where manure has been applied excellent yields of corn are obtained. The control of erosion and the maintenance of the organic content are the most important needs in handling this soil. It appears to be well adapted to alfalfa, where proper measures are taken to insure a stand, such as liming and inoculation.

A variation of the Clinton silt loam occurs in some areas north of Waubeek and southeast of Cedar Rapids. The soil consists of a light brownish-gray mellow silt loam, 8 inches deep, underlain by a light-brown or yellowish-brown rather friable silty clay loam. At about 20 inches the subsoil passes into a yellowish-brown friable silty clay

loam. The subsoil is not especially compact, but has a good structure. This phase differs from the main body of the type in having a slightly lighter color, in its heavier growth of forest, and in the more severe dissection of the surface.

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

Mechanical analyses of Clinton silt loam.

[Fine earth.]

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.*
332180	Soil	0.3	0.6	0.3	3.2	21.0	62.6	11.6
332181	Subsoil	.0	.3	.1	2.9	22.5	57.1	16.7
332182	Lower subsoil	.0	.2	.1	4.6	22.9	55.8	15.5

TAMA SILT LOAM.

The Tama silt loam consists of a dark-brown friable silt loam, underlain at a depth of 12 inches by a dark-brown or brown, rather compact, heavy silt loam or silty clay loam, which grades at 20 inches into a light-brown or yellowish-brown friable silty clay loam. There is no change in the lower subsoil to a depth of 36 inches.

The Tama silt loam is found on the loess-mantled pahas and in scattered areas associated with the soils developed on the river ridges. In contrast with its predominance on the paha ridges, the type is strikingly lacking in the large areas of loess constituting in part the river ridges. The surface features of the Tama silt loam are distinctive. The isolated hills are elliptical, with a smooth, graceful contour, and erosion has not destroyed the gentle slopes to any extent. Drainage, however, is usually adequate. Both soil and subsoil are retentive of moisture.

The Tama silt loam, although not extensive, is an important and valuable agricultural soil. Most of the type is cultivated or used as pastures. It supports an excellent growth of bluegrass. Corn is the principal crop, and where the slopes are not too steep excellent yields are reported. The small grains grown are chiefly oats and wheat. Considerable clover and timothy are produced. Alfalfa is not grown to any important extent, but with inculation and liming the soil apparently should be well suited to this legume. Owing to its mellow, friable nature, the type is easily cultivated. Manure is depended upon to maintain the productiveness of this soil, which in some places is lowered by moderate erosion.

Below are given the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Tama silt loam:

Mechanical analyses of Tama 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.*
332101	Soil	0.2	0.2	0.4	2.9	34.9	43.9	17.1
332102	Subsoil	.0	.1	.3	2.4	17.6	60.8	18.4
332103	Lower subsoil	.0	.1	.3	4.5	27.0	59.4	8.2

JUDSON SILT LOAM.

The soil of the Judson silt loam, where typically developed, consists of a dark-brown or nearly black friable silt loam, 18 inches deep. It is underlain by a brown, friable, heavy silt loam or silty clay loam, grading into a light-brown friable silty clay loam. Both surface soil and subsoil are devoid of grit or coarse material.

This type is most extensively developed north of Palo, with several small areas in other parts of the county. It generally occurs in close association with the Clinton and Tama silt loams and occupies a modified terrace, forming a gentle slope from the adjacent loessial upland down to the flood plain of the stream. The material is mainly of colluvial origin, derived from the loessial upland. A few small areas, however, apparently bear no relationship to the loessial upland, although mainly composed of colluvial material. Their position is typical, in that they occupy modified terrace positions, but slightly more compact.

The surface of the Judson silt loam is flat, with a slight slope in the direction of adjacent streams. In places it is dissected by drainage ways issuing from the upland. It is ordinarily well drained, as the porous subsoil permits the ready absorption and movement of moisture, and crops are materially benefited in dry seasons by the capillary rise of soil moisture. In a few of the smaller areas the compact subsoil does not allow the ready percolation of moisture, but even here the drainage can not be said to be inadequate.

The Judson silt loam is practically all under cultivation, and it is recognized as a very desirable soil. Corn does exceptionally well, giving uniformly good yields from year to year. Small grains also do well. The mellow, friable nature of the soil makes tillage comparatively easy. Manure is applied to maintain the productiveness.

Areas of the Judson silt loam command a good price when sufficiently large to comprise individual farms.

Judson silt loam, light-colored phase.—The Judson silt loam, light-colored phase, consists of a light grayish brown or light-brown friable silt loam, 10 to 12 inches deep, underlain by a light-brown or dark-brown or dark yellowish brown, compact, gritty silty clay loam. The surface soil is inclined to be compact when wet. There is an abrupt change in texture between the surface soil and the subsoil. The phase is somewhat variable in color and texture.

This soil is found in small areas one-half mile north of Cedar Rapids and northwest of Bertram. It resembles the Lintonia silt loam. It is composed of recent colluvial material, derived from the adjacent loessial upland, and occupies a terrace position, being one of the better drained soils of the area. The surface is similar to that of the typical Judson silt loam, although the phase lies more directly in the path of the drainage issuing from the upland. The adjacent loessial upland is usually covered by the Clinton silt loam.

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

Mechanical analyses of Judson 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.*
332144	Soil	0.0	0.3	0.4	4.1	18.6	65.5	11.1
332145	Subsoil	.0	.1	.1	4.6	23.1	59.9	11.3

BUCKNER SANDY LOAM.

The soil of the Buckner sandy loam consists of a dark-brown friable fine sandy loam or sandy loam, 20 inches deep. It passes into a subsoil which is only slightly lighter in color, approaching a brown or light-brown fine sandy loam or loamy fine sand.

A few scattered areas of Buckner sandy loam occur on the alluvial terraces, principally along the Cedar River. The topography is nearly flat. The loose and porous nature of the subsoil insures free subsurface drainage, and in places the drainage is excessive, crops suffering in dry seasons.

In all respects except texture of the surface soil this type does not differ from the Buckner fine sandy loam. The crop adaptations and the yields are similar. The chief deficiency of the soil is in the content of organic matter, which is corrected to some extent by applications of stable manure.

BUCKNER FINE SANDY LOAM.

The soil of the Buckner fine sandy loam consists of a dark-brown friable fine sandy loam extending to a depth of about 20 inches. It is underlain by a brown or light-brown loose fine sandy loam or

loamy fine sand. Coarse gravel, much worn by the action of water, is frequently found throughout the soil section. A very fine sandy loam variation occurs in small scattered areas.

This is an extensive soil on the terraces of the Cedar River, and several scattered areas of fair size occur on the terraces of the Wapsipinicon River and Buffalo Creek. The surface in general is fairly flat, but there are places where it has been modified by the wind, and occasionally the type is dissected by drainage ways issuing from the upland. The natural drainage is good, and in places excessive, owing to the loose, porous nature of the subsoil. In seasons of prolonged drought crops are likely to suffer.

Practically all of the type is under cultivation. Corn is the principal crop. Small grains are grown to some extent, but the yields are never as satisfactory as might be expected, and the continuous cropping to corn has brought about a decline in yields in many cases. Manure is generally added to supply organic matter and maintain the productiveness of the soil.

Results of mechanical analyses of samples of the soil and subsoil follow:

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.*
332146	Soil	0.7	7.6	8.3	54.7	9.4	11.0	7.9
332147	Subsoil	.9	7.6	10.8	55.9	10.9	8.0	5.6

BUCKNER LOAM.

The Buckner loam is a dark-brown fine loam to a depth of 10 to 20 inches. This material grades into a subsoil of grayish-brown or light-brown loam. The soil grains are mainly rounded and waterworn, and only the more insoluble minerals remain. In places the subsoil is a compact fine loam, not greatly different from the soil. Considerable gravel and coarse material occurs on the surface and throughout the soil section in many places.

A few areas of this type occupy a position somewhat lower in respect to the streams than the typical Buckner loam. Southeast of Troy Mills an area is included that is only slightly above overflow and which contains much coarse gravel on the surface. South of Coggon, along Buffalo Creek, the soil is very open and porous, with much coarse material on the surface.

The Buckner loam is most extensive along the banks of the Cedar River, where it occurs in association with the Buckner silt loam and sandy loam. Narrow strips occur along the smaller streams.

The type occupies well-drained terrace positions. The subsoil is never sufficiently compact to make the type impervious to water, and in areas where the soil material is coarse and the subsoil loose and porous it is inclined to be droughty.

Practically all of this type is under cultivation. Corn is the most important crop, followed by the small grains. The type is comparatively easy to till, owing to its mellow, friable nature. It responds well to applications of barnyard manure. Owing to continued cropping to corn, which has been the custom on the alluvial soils, the natural productiveness has decreased, and it requires careful management to maintain the yields.

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

Mechanical analyses of Buckner 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.*
332121	Soil	0.8	11.8	18.5	42.1	3.8	14.0	8.4
332122	Subsoil	.6	9.1	20.3	47.0	4.4	11.1	7.2

BUCKNER SILT LOAM.

The surface soil of the Buckner silt loam consists of a dark-brown friable silt loam, 15 to 20 inches deep. The subsoil comprises two zones, an upper one of grayish-brown compact silt loam, and a lower one, beginning at about 30 inches, of light-brown or yellowish-brown gritty silty clay loam, grading into loam or fine sandy loam. Much gravel and coarse waterworn material are included in the subsoil. The substratum is sandy, and this is a characteristic feature of the type. The sand is usually more or less coherent and bears evidence of having been assorted by water.

A few areas, which seemingly were originally heavily forested, vary somewhat from the typical Buckner silt loam. In the area 3 miles southwest of Toddville, for instance, the surface soil is grayish-brown friable silt loam. Several other scattered areas of similar nature are included with the Buckner.

The Buckner silt loam occupies distinctly benchlike areas along both large and small streams. The surface is nearly level over large areas. Some of the terraces on which the type occurs are apparently remnants of ancient filled-in valleys which have been dissected and modified, and in places the ancient terrace has almost lost its identity.

The surface of the Buckner silt loam is usually flat or gently undulating. In places the surface has been dissected considerably by small streams issuing from the upland. The type has good drainage,

but crops are not likely to suffer from drought save in exceptionally dry seasons.

The Buckner silt loam is recognized as a very desirable soil for general farming. Owing to its friable nature it is easily cultivated and maintained in good tilth. Small grains give good yields. Corn is the principal crop. As on the other types of similar origin and position, the Buckner silt loam has been cropped to corn very continuously. Rotations are now practiced to some extent. Considerable grazing and stock feeding is carried on, together with hog raising, and a large supply of manure is obtained from this source. The type is very responsive to manuring. Excellent yields of corn are obtained where proper methods of maintaining the productiveness are used.

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

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.*
332158.....	Soil.....	0.0	6.5	9.8	16.4	12.4	38.0	16.0
332159.....	Subsoil.....	.4	5.5	9.4	17.1	15.1	35.8	16.1
332160.....	Lower subsoil.	.4	7.4	11.8	19.2	11.6	36 8	12.3

BREMER SILT LOAM.

The Bremer silt loam consists of a dark-brown or black heavy silt loam, 18 inches deep, underlain first by a light grayish-brown silty clay loam or silty clay, faintly mottled with brown, and then by a brown silty clay. The subsoil is quite compact and impervious.

The Bremer silt loam is most extensively developed in Fairfax and College Townships, where it occupies the wide ancient channel of Prairie Creek. The type is not subject to overflows. Small scattered areas are found throughout the county on terraces adjoining streams. The surface soil is not as deep in other places in the county as along Prairie Creek.

The type as developed along Prairie Creek has a flat surface, with a very slight slope from the adjoining upland to the stream. The compact nature of the soil and subsoil does not allow the free penetration of water, and at times the drainage is inadequate.

This is recognized as one of the most desirable soils in the county. It is a strong soil, well adapted to corn, and crop yields are invariably satisfactory, even in years of deficient rainfall.

Corn is the principal crop. Small grains are not popular on account of their tendency to lodge. Satisfactory yields of corn are

maintained by rotating crops and applying manure. Cattle and hogs are raised in considerable numbers.

This soil is easily tilled, but some attention must be paid to moisture conditions. It does not warm up in the spring as readily as the surrounding upland soils, and planting is somewhat delayed on that account.

The selling price of this land varies with that of the surrounding upland. It is generally closely associated with the upland types. Few farms are composed of the Bremer silt loam alone.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Bremer 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.*
332151	Soil	0.0	1.0	0.7	1.9	2.9	70.8	22.7
332152	Subsoil	.0	.8	.7	6.1	6.6	65.1	20.9

BREMER SILTY CLAY LOAM.

The soil of the Bremer silty clay loam consists of a black silty clay loam, about 18 inches deep, underlain by a grayish-black or black silty clay, faintly mottled with brown, Iron concretions, together with coarse material, such as small pebbles, are present in this part of the soil section. At 20 inches the subsoil passes into a grayish-yellow, heavy, compact silty clay, mottled with brown or light brown.

The Bremer silty clay loam is developed most extensively along Prairie Creek, where it occupies a position above overflow. A few small scattered areas are mapped along the minor streams, where the position of the type and its association with the surrounding upland seem to indicate a somewhat different origin or method of deposition than is the case along Prairie Creek. The type has a flat surface, relieved by a few depressions. In places it merges into the upland without any perceptible change of elevation.

The impervious structure of the soil and subsoil renders the natural drainage poor. The ditches constructed to carry away the excess water have only a moderate slope, but the drainage provided is in most cases sufficient to insure good yields. Spring seeding frequently is delayed, and crops are sometimes late in maturing, but the type in general is a desirable agricultural soil, and practically all of it is under cultivation. Corn is the most popular crop. It gives excellent yields in favorable seasons. Somewhat heavier farm machinery is needed for thorough tillage than on the surrounding soils,

and care is taken to cultivate when moisture conditions are favorable. The type is held in high esteem as a corn soil, the selling prices not being exceeded by those of any other soil in the county.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower 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.*
332153	Soil	0.5	3.1	2.0	7.9	4.6	40.3	41.2
332154	Subsoil	1.6	2.7	2.0	6.6	6.3	57.6	22.9
332155	Lower subsoil.	.4	1.5	.8	4.8	6.5	65.1	20.7

CALHOUN SILT LOAM.

The soil of the Calhoun silt loam consists of a dark-gray or brownish-gray rather compact silt loam, 8 or 10 inches deep. It passes abruptly into a light brownish gray or gray friable silt loam which approaches a silty clay loam in places. At 20 inches the material grades into a brownish-gray, light, compact silty clay, mottled with brown. The lower subsoil is very impervious.

The Calhoun silt loam is an inextensive soil. It occupies flat areas which are poorly drained, partly on account of the heavy, impervious subsoil, which prevents the downward passage of moisture.

This type was originally timbered, but at present most of it is under cultivation. It is deficient in organic matter, to remedy which condition heavy applications of manure should be made or green crops plowed under.

WABASH SILT LOAM.

The soil of the Wabash silt loam, where typically developed, consists of a black friable silt loam. At about 18 inches the material becomes slightly heavier in texture. This layer forms the upper part of the subsoil and grades without any appreciable change in color, into a heavy and compact silty clay loam which in the lower part becomes a black or dark-gray, heavy, compact silty clay. Pockets of sand occur in both soil and subsoil. Small areas of silty clay loam occurring in depressed areas are included with this type as mapped.

The Wabash silt loam is found most extensively along the smaller streams of the county. It is also found in a few scattered areas along the Cedar and Wapsipinicon Rivers. The type occupies first bottoms and is subject to overflow. It is closely associated with the Clyde silt loam and the adjoining upland types, into which it frequently merges almost imperceptibly.

The surface is practically flat, with a slight slope toward the streams. Along the Cedar and Wapsipinicon Rivers there is some slight surface relief, due to the presence of old channels, ox-bow sloughs, and depressions. These are filled by overflows and retain water for long periods.

The type is poorly drained, and it is seldom used for any other purpose than grazing. Some areas are forested, especially those along the larger streams. The type supports a good growth of bluegrass.

CASS FINE SANDY LOAM.

The soil of the Cass fine sandy loam consists of a dark-brown friable fine sandy loam, underlain at 8 inches by a brown or dark-grayish brown loamy fine sand, which in turn passes at 20 inches into a light-brown or light-grayish brown loose and incoherent fine sand. Mapped with the type are small areas of sandy loam.

The Cass fine sandy loam occurs along the Cedar and Wapsipinicon Rivers. It occupies a first-bottom position and is subject to overflow. The surface is flat, except for numerous old sloughs and depressions, but the land is well drained. In places the drainage is excessive, owing to the porous character of the subsoil.

The Cass fine sandy loam is used mainly for pasture. The tree growth is the same as that on the other soils of the alluvial bottoms. A few areas that occupy a slightly higher position than the remainder are cultivated, corn and small grains being the principal crops.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Cass fine sandy loam:

Mechanical analyses of Cass 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.*
332185	Soil	0.2	5.7	14.9	41.2	10.7	19.1	7.9
332186	Subsoil	.0	6.2	20.2	50.4	6.4	11.6	4.9
332187	Lower subsoil	.5	18.9	38.3	35.7	1.8	3.4	1.4

CASS LOAM.

The soil of the Cass loam consists of a dark-brown fine loam or loam, with a depth of 10 inches. The subsoil is a light-brown loose and incoherent sand and coarse sand.

The type is extremely variable. Pockets of fine sand, loose and incoherent, are frequently found in the soil section. Again, the depth of the surface soil may be considerably greater than typical, with an indication of a sandy subsoil at the bottom of the section.

The Cass loam occurs mainly along the Cedar and Wapsipinicon Rivers, with small areas in the bottoms of some of the smaller streams. It occupies a first-bottom position and is subject to overflow. The surface in most places is flat, but drainage is adequate, owing to the porous nature of the soil and subsoil. Old sloughs and depressions make up the only surface relief. This soil is mainly used as pasture land. The better drained areas were originally forested with soft maple, elm, ash, and birch, while the depressions or wetter areas supported a heavy growth of prairie grasses.

CASS SILT LOAM.

The soil of the Cass silt loam is a dark-brown or nearly black silt loam or fine loam. It is underlain by a grayish-brown or light-brown loamy fine sand grading into a loose and incoherent fine sand. The type is widely variable.

Fairly large areas of this type lie in the bottoms along the Cedar and Wapsipinicon Rivers. The type is subject to overflow, but a few areas, occupying a position intermediate between true first bottom and what is recognized as second bottom, though subject to overflow are better suited for crop production than the low-lying areas.

The surface of the Cass silt loam is flat. Drainage ways, old channels, ox-bow sloughs, and small mounds of sandy material afford the only relief. Most of the type is devoted to pasture. The areas least subject to overflow are cropped, principally to corn and small grain. Most of the type was originally forested, and a large part is still timbered, mainly with soft maple, elm, birch, cottonwood, scarlet hawthorn, and wild crab apple.

SARPY FINE SAND.

The soil of the Sarpy fine sand consists of a dark grayish brown or brown loose fine sand extending to a depth of 15 inches. The subsoil is a grayish-brown or light-brown incoherent fine sand.

The type is extremely variable in texture of both soil and subsoil. Considerable medium sand and coarse sand are found throughout the soil section, and a fine sandy loam variation is included with the type.

The Sarpy fine sand occurs in scattered areas in the first bottoms of the Cedar and Wapsipinicon Rivers. It is subjected to overflow and valued mainly for pasture, although the grass growth is often scanty. In the forested areas the growth consists mainly of hawthorn, elm, crab apple, birch, and willow. The type has little agricultural value.

Part of the area correlated with the Sarpy fine sand, when of sufficient extent to justify a separation, is usually mapped as Riverwash and is not given a type name.

MUCK.

Muck, as recognized in Linn County, consists of dark-brown or black well-decomposed mucky material, sometimes quite silty, grading at 8 inches into a black, compact, impervious, stiff, silty clay, which in turn passes into a yellowish-drab or gray, sticky, and very plastic silty clay, spotted with brown or reddish brown.

The largest area of muck occurs 2 miles northwest of Palo. Several small areas are found in various parts of the county. A few of the areas closely approach peat, showing a relatively high percentage of undecomposed organic matter.

Muck occurs in depressions where the restricted drainage has favored the accumulation and preservation of organic matter. This has become incorporated with more or less mineral matter derived from the surrounding slopes through wash.

Most of the areas of Muck can be reclaimed by drainage. The very small areas, which owe their origin to local seepage on a slope, are not so easily reclaimed. There are several such areas in the county which are not of sufficient size to show on the map.

Muck is very closely associated in many cases with the Clyde silt loam or silty clay loam. It is seldom used for any other purpose than pasture, but a few areas have been drained and put into crops. The natural vegetation consists mainly of marsh grass, smartweed, and other aquatic plants.

SUMMARY.

Linn County is situated in the east-central part of Iowa. It is rectangular in shape and contains about 709 square miles.

The county lies within the glaciated portion of the State, and the topography over the greater part is that of a partially eroded drift plain. A feature of the topography peculiar to this part of Iowa is the occurrence of lenticular hills and ridges known as pahas. These hills, in two principal belts, follow the two larger streams and stand above the general level of the central drift plain.

The county is drained by three principal streams that traverse it from northwest to southeast in channels 200 to 300 feet below the drift plain. Tributaries and minor drainage ways have reached every part of the area.

This county was well settled before the Civil War period. The population has steadily increased and in 1910 amounted to 60,720, of which 37,211 is classed as urban and 23,509 as rural.

Agriculture is the chief occupation, although manufacturing and other industries are important. Transportation facilities are good throughout the county. Cedar Rapids is an important business center of the State, with a population in 1910 of 32,811. Marion is the county seat.

The climate of Linn County is favorable to agriculture. The mean annual temperature is 47.8° F., as recorded at Cedar Rapids, and the mean annual precipitation 31.29 inches. A normal growing season of 173 days is reported at Cedar Rapids.

The agriculture of Linn County consists of the growing of grain and hay, with the feeding and raising of hogs and cattle as a coordinate industry. Corn is the chief crop of the county, with oats next in importance. Timothy and clover constitute the principal hay crops.

Probably as much as 90 per cent of the county is improved farm land. Land valuations are high, ranging from $100 to $300 an acre.[1] The farms are generally well improved, and the farmers throughout the county are prosperous.

The soils of the county are derived mainly from loess, glacial till, and alluvial deposits.

The loessial soils occur near the drainage ways, while the glacial soils occupy the interstream areas. The alluvial soils occur along the Cedar and Wapsipinicon Rivers and in the valleys of their larger tributaries.

The glacial soils occupy the largest area. The Carrington silt loam is the most extensive soil type in the county. It is a prairie soil and naturally productive. It is well adapted to corn and oats. The loess soils are productive, but present special problems for their satisfactory management.

The alluvial soils are grouped into two divisions on the basis of their position. Those of the terraces, lying above overflow, are desirable soils. They were the first soils used for agricultural purposes in the county. The first-bottom, or overflowed, soils are of less agricultural importance. They are valuable mainly for pastures.

[1] This was written in 1917. Prices have advanced greatly since that year.

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[PUBLIC RESOLUTION.—No. 9.]

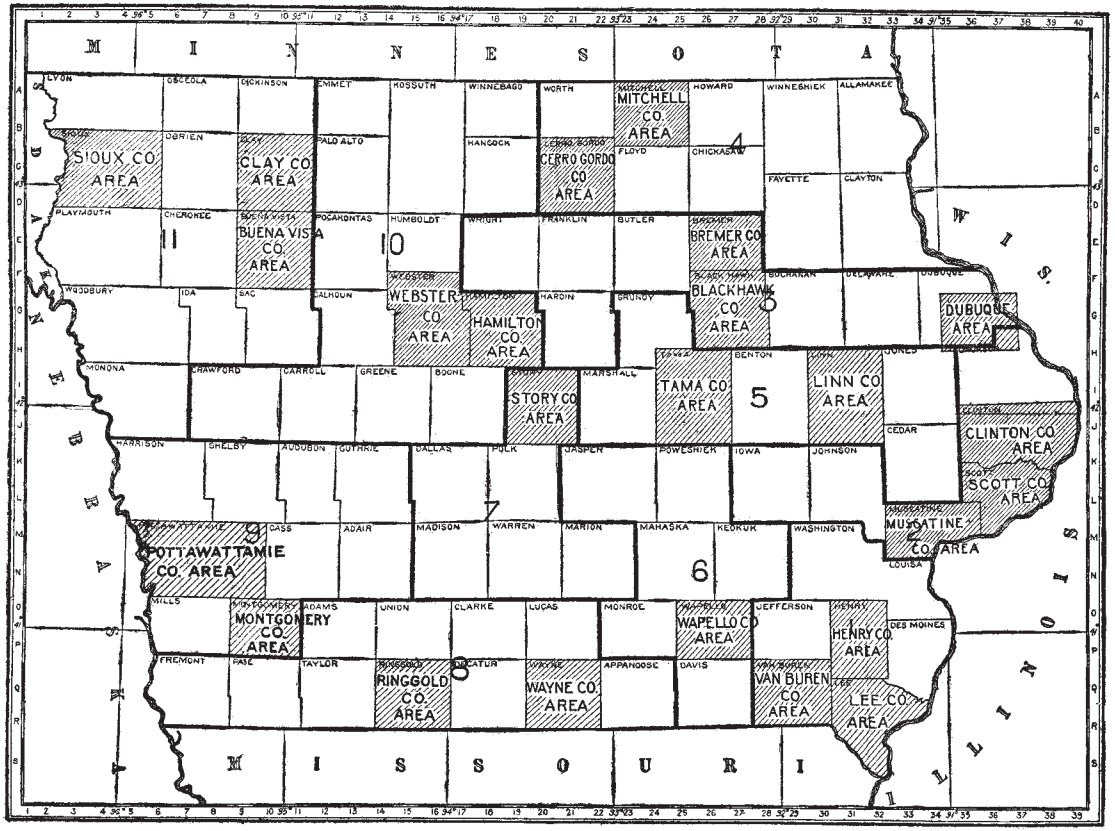
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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

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

Approved March 14, 1904.

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



Areas surveyed in Iowa.

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