Series 1956, No. 6

Issued February 1960

SOIL SURVEY

Lucas County Iowa

OUR SOIL ★ OUR STRENGTH

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
IOWA AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS REPORT is about the soils of Lucas County, Iowa. It describes each kind of soil and tells how you can use it, how to take care of it, and what yields you can expect. The soil map at the back of the report shows the location and extent of each soil.

Soils of a farm

To learn about the soils of any farm, first locate the farm on the soil map. This map shows township and section lines, towns and villages, roads, streams, and other landmarks. Remember that 2 inches on the map is equal to 1 mile on the ground.

Use the index to map sheets to locate areas on the soil map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the soil map is located. When the correct sheet is located, you will see that boundaries of the soils are outlined and that there is a symbol for each kind of soil. All areas shown by the same symbol and color tint are the same kind of soil, wherever they appear on the soil map. Suppose, for example, an area located on the soil map has the symbol Gd. The legend for the soil map shows that this symbol identifies Grundy silty clay loam, 2 to 7 percent slopes. This soil and all the others mapped in the county are described in the section, Descriptions of the Soils.

Suggestions for managing each soil are contained in the section, Management of Soils. Yields of crops that can be expected under two levels of management and corn productivity ratings are given in the section, Estimated Yields and Corn Productivity Ratings.

Soils of the county as a whole

A general idea of the soils in the county is given in the section, General Soil Areas. After reading this section, study the soil association map and notice how the different kinds of soils tend to occur in different parts of the county. These patterns are likely to be associated with well-recognized differences in types of farming, land use, and land use problems.

A newcomer to the county, especially if he considers purchasing a farm, will want to learn something about the organization and population of the county, the climate, the types of farming practices, and transportation facilities. He will find this information in the section, Additional Facts about Lucas County.

This survey was completed in 1956. Unless otherwise indicated, all statements in the report refer to conditions in the county at that time.

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SOIL SURVEY OF LUCAS COUNTY, IOWA

Report by R. C. PRILL, Iowa Agricultural Experiment Station

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United States Department of Agriculture in cooperation with Iowa Agricultural Experiment Station

Location and Extent

Lucas County is in south-central Iowa. It is bordered on the south by Wayne County, on the west by Clarke County, on the north by Warren and Marion Counties, and on the east by Monroe County (fig. 1). The county has a total area of 277,760 acres, or 434 square miles. Chariton is the county seat.

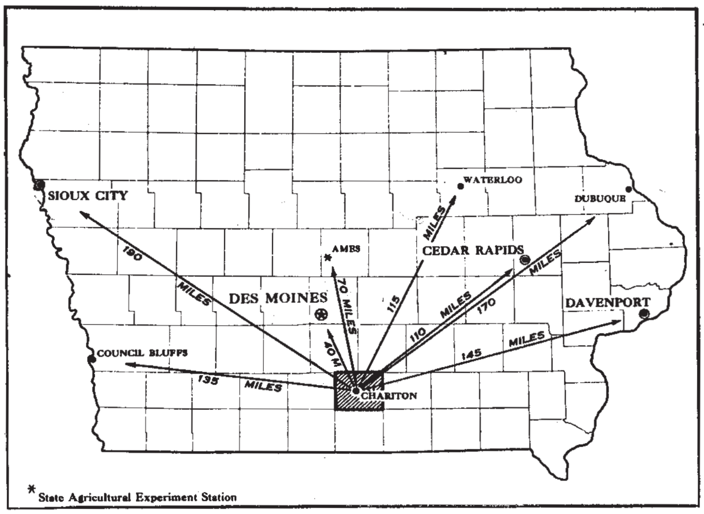

Figure 1.—**Location of Lucas County in Iowa.**

General Relationships of Soils

Twenty-seven soils were mapped in the county and are described in this report. Each of these soils is different from the others. The soils vary in their suitability for crops and other plants and in their responses to various kinds of treatment.

In mapping a county or other large area, it is fairly easy to see differences in the soils as one goes from place to place. Many differences are obvious, such as those in degree, length, and shape of the slopes; in the color and texture of the soils; and in the width of flood plains. There are also differences in the types of farming. Other differences are less easily noticed but can be seen or measured; these include the characteristics of the subsoil and material under it, the length of time that water stands on or remains in the soil, and the acidity or alkalinity of the soil layers.

The section that follows consists of three parts, each aimed to help make clear some of the differences in the soils and some of the relationships between different kinds of soils. In the first part the description and map of general soil areas suggests in a broad way some of the soils that are likely to be found on a farm in each part of the county. In the next part a sketch of a typical landscape is described. This sketch shows how certain soils occur on the ridges, others on slopes, and still others in the valleys. In the third part a profile of one of the soils, Edina silt loam, is illustrated and described.

General Soil Areas

By drawing lines around the different patterns of soils on a small map, one can map the general soil areas, or as they are sometimes called, soil associations. Such a map of Lucas County is shown in figure 2. This map is useful in locating large areas suited to a particular type of agriculture or other land use and in comparing the pattern of soils in one part of the county with that in another part.

Each soil association consists of two or more extensive soils and as a rule contains several other soils of lesser extent. Within each association, the soils occur on the landscape in a pattern that is characteristic and recurring, although of course it is not strictly uniform. Most farms contain several soils, but within a soil association the patterns of soils on different farms are likely to be somewhat similar. A description of each of the soil associations in Lucas County follows.

Dark-colored, nearly level to moderately sloping soils: Grundy-Haig-Shelby-Adair.—This soil association is on nearly level divides and on the adjacent moderate slopes. It occurs throughout the county.

The Haig soil is nearly level. It has a black or very dark gray surface soil and a dark gray, somewhat mottled subsoil. The Grundy soil is similar to the Haig soil, but it is somewhat better drained and lies on gentle slopes. The soils of the Shelby-Adair complexes that are in this association are dark colored and have moderate slopes.

The soils of this association are the most productive of the upland soils. Nearly all the areas of Grundy and

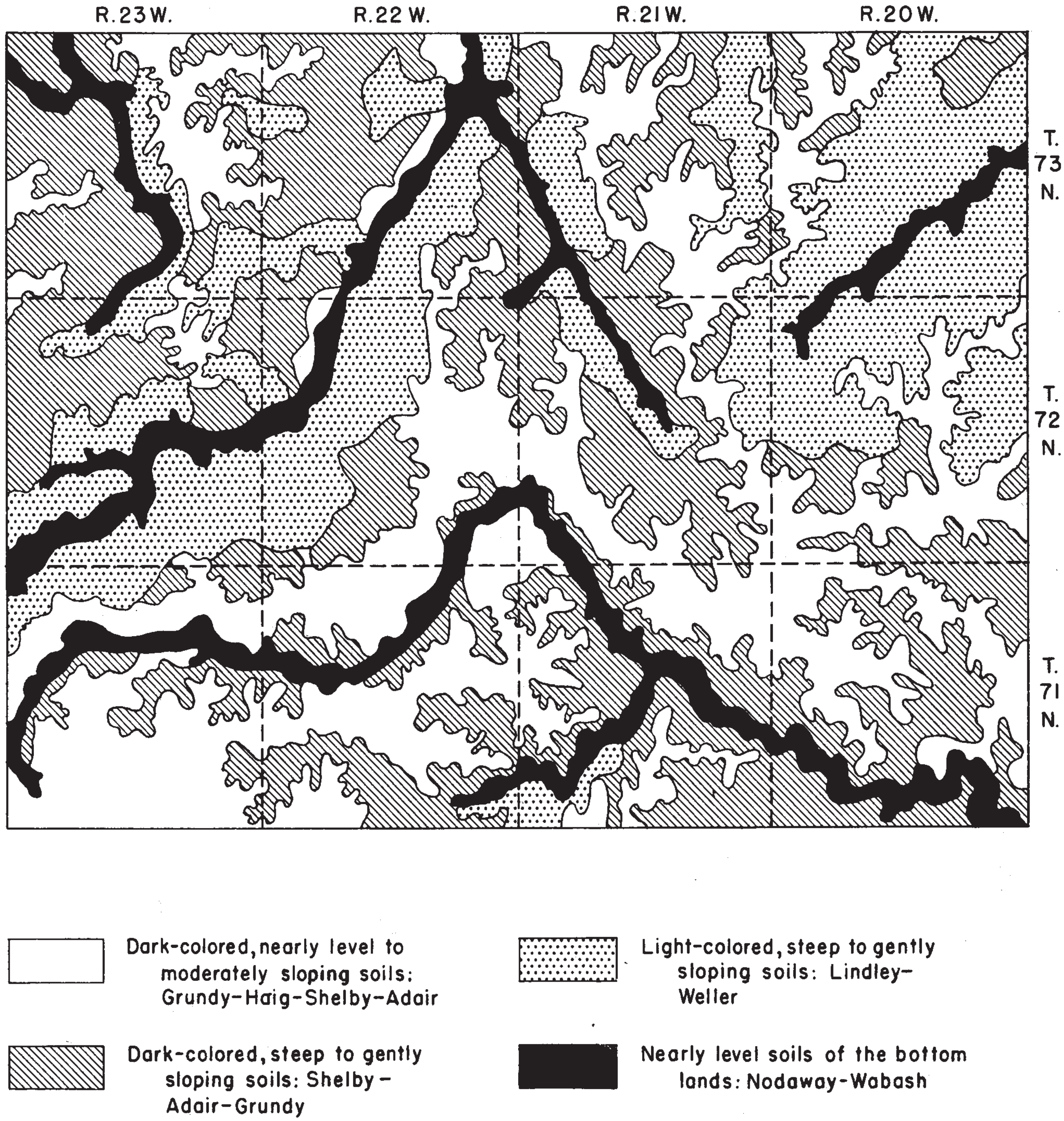

***Figure 2.*—General soil areas of Lucas County, Iowa.**

Haig soils are used for crops in a system of grain and livestock farming, and most of the Shelby-Adair soils are used for permanent pasture.

Dark-colored, steep to gently sloping soils: Shelby-Adair-Grundy.—This association is made up of the more strongly sloping areas of dark-colored soils. It contains a higher proportion of soils of the Shelby-Adair complexes than the Grundy-Haig-Shelby-Adair soil association. The areas occur throughout the county. A livestock system of farming is most common on this association, and some of the association is used for permanent pasture.

Light-colored, steep to gently sloping soils: Lindley-Weller.—This association occurs on the rougher terrain of Lucas County, mostly in the two northern tiers of townships. The Weller soil is gently sloping, and the subsoil is slowly to very slowly permeable. The Lindley soils are strongly sloping to steep and occur in areas below the Weller soil. They have developed from firm clay loam.

Minor soils in this association are the Gosport and Beckwith. The Beckwith soil is light colored and has a gray, very slowly permeable subsoil. It occurs on small

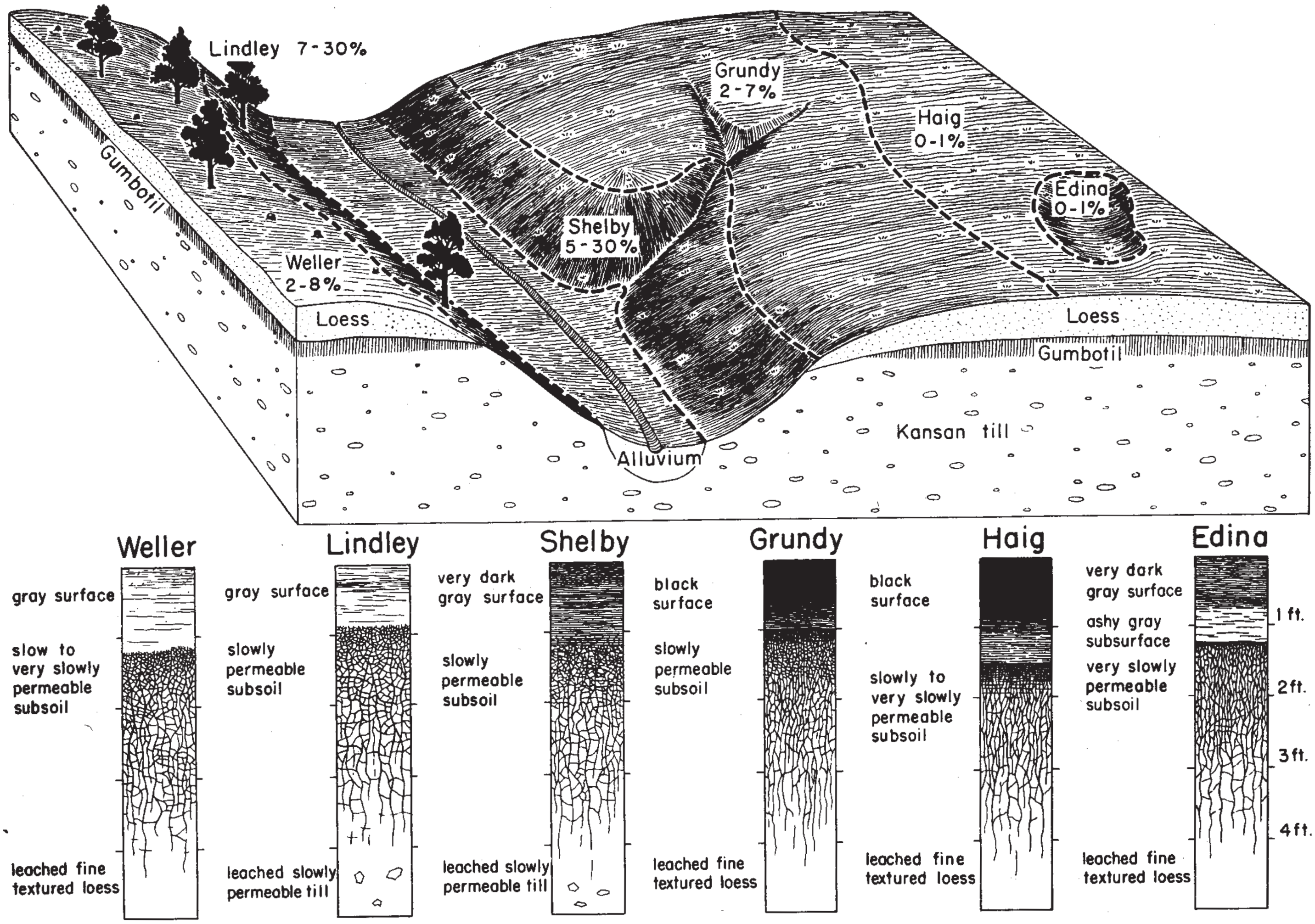

Figure 3.—Schematic diagram of some of the dominant soils in Lucas County.

flats in the uplands. The Gosport soils are moderately steep to steep and overlie shale at shallow depths.

This association is only moderately productive of crops. Much of it is under forest or is in permanent pasture. Livestock farming is predominant.

Nearly level soils of the bottom lands: Nodaway-Wabash.—This association occurs as narrow strips along streams. Much of it represents the present flood plains of streams, but some parts are above the level reached by floods. The Nodaway soil is moderately dark and is silty in texture; most of the areas lie next to the stream channel. The Wabash soil has a dark-colored surface soil and a subsoil of silty clay. Its subsoil is very slowly permeable.

The soils of the Gravity-Olmitz complex and the Humeston-Coppock complex also occur in this association. The Gravity and Olmitz soils are dark colored. They occupy nearly level to very gently sloping positions and have developed from soil materials washed down from the steep, adjacent uplands. The soils of the Humeston-Coppock complex occur on nearly level areas and in depressions. They are moderately dark colored and have a gray layer beneath the surface soil. The subsoil is moderately slow to slow in permeability.

Much of this association is very productive and is used rather intensively for row crops. Some areas are flooded to the extent that a crop is sometimes lost. Many farms in this association include some adjoining steep areas that are used for permanent pasture.

A Landscape May Contain Several Soils

The way in which the different soils occur in associations and the way different associations make up a landscape are shown in somewhat simplified fashion in figure 3. In this sketch the Haig soils are shown on the upland at the right. The Grundy and Shelby soils occupy one side of the valley, and the lighter colored Lindley and Weller soils of the Lindley-Weller soil association are on the opposite slope. The soils of the Nodaway-Wabash association are on bottoms similar to the alluvial plain shown in the sketch.

In this county the Haig soil occurs alongside areas of the more strongly sloping Grundy soil and the soils of the Shelby-Adair complex. These soils are all part of the Grundy-Haig-Shelby-Adair soil association. The Adair soils, not shown in the sketch, are also a part of the Shelby-Adair-Grundy soil association.

The sketches below the diagram show the nature of the surface soil, subsoil, and underlying material of each of these soil series. This succession of soil layers, from the surface downward, is called the soil profile. The layers, also called horizons, within some of the profiles differ greatly from each other in texture, color, and other properties.

A Soil Profile

The profile of Edina silt loam, a soil in which the horizons contrast greatly in color and texture, is shown in figure 4. Compare this photograph with the profile

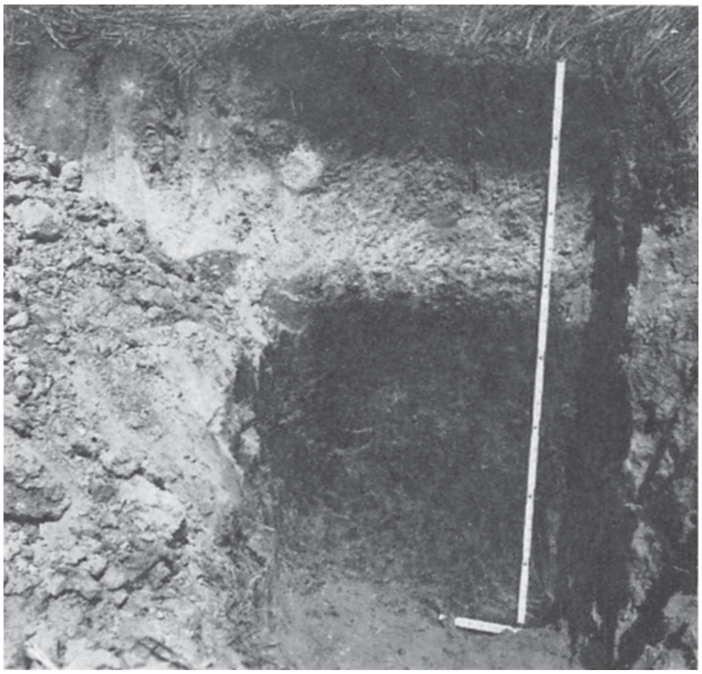

***Figure 4.*—Profile of Edina silt loam.**

sketch of the Edina soil in the lower part of figure 3. This dark-colored soil occurs in depressions and on level areas on the tablelike divides of the Grundy-Haig-Shelby-Adair association.

To a depth of about 8 inches, the surface soil is dark-gray silt loam. The subsurface soil, between depths of 8 and about 17 inches, is light-gray, acid silt loam. Soil scientists call the upper layer, which is colored darker by organic matter, the A_1 horizon, and the gray, acid layer, the A_2 horizon.

The subsoil in this profile, between depths of 17 and 33 inches, is much darker than the A_2 layer above it. It is very firm silty clay through which water moves slowly. Soil scientists call this layer the B_2 horizon. It has formed by the accumulation of clay, one of the soil-forming processes that causes a distinctive texture, structure, or color to develop.

Below a depth of about 33 inches, the soil is not so dark colored as that of the B_2 horizon and contains less clay and more silt. This layer is called the B_3 horizon. At a greater depth (not shown in the illustration) the B_3 horizon is transitional to leached loess that has a silt loam texture. This soil has developed from loess, or windblown material. This relatively unweathered parent material makes up the C horizon.

A typical profile of Edina silt loam as well as typical profiles of soils of each of the other soil series are described in the section, Descriptions of the Soils. In many of the profiles, the horizons are not so distinct as those of Edina silt loam. Some soils, such as the Nodaway, do not contain a B horizon.

Management of Soils

This section contains (1) suggestions for the use and management of the soils; (2) a brief explanation of a nationwide system of land capability grouping; and (3) a discussion of estimated yields that can be expected on each soil under two levels of management and an explanation of the relative suitability of the soils for corn.

Suggestions for Use and Management

The major characteristics of each soil that affect its use and management are shown in table 1. A more complete description of each soil series, including a description of the horizons in a representative profile and a short statement about each soil mapping unit are given in the section, Descriptions of the Soils.

Table 2 gives the principal management problems for each soil, the capability class and subclass to which each belongs, and some suggested cropping systems that can be used both with special practices for the control of runoff and erosion and without these practices.

Cropping systems

The cropping systems described in table 2 are those suggested at the time the report was written. Control of runoff and erosion on sloping soils and the use of good farming methods on all the soils are needed to support the cropping system.

In choosing a cropping system, you will need to consider several factors—the kinds of soils and their susceptibility to erosion, the type of farm and the size of the farm business, and the amount of capital that is available. Past management is also a factor; a rundown field, for example, may need special treatment for several years so that its productivity can be restored.

In many fields there are several different soils. If the soils differ greatly, you will need to choose a cropping system that will fit the soils making up the largest area. In some places field boundaries can be changed for the better grouping of soils with similar management problems. Some management practices, as liming, fertilizing, and drainage, can be fitted to individual soils within a field.

In Lucas County the crops grown in rotation are corn, soybeans, a small grain (usually oats), and meadow or pasture crops consisting of alfalfa and red clover grown in combination with bromegrass and timothy. Sweetclover is the main green-manure crop, and sorghum is sometimes grown in the rotation in place of corn. Corn, soybeans, and sorghum are the cash crops that have the highest value. Grain sorghum, however, is not grown extensively. Oats serve primarily as a nurse crop when meadows and pastures are seeded. A large acreage of meadow and pasture is needed to provide forage for livestock.

A crop rotation benefits most soils by controlling weeds, insects, and diseases. A grass-legume crop included in the

TABLE 1.—*Summary of important characteristics of the soils*

Map symbol	Soil	Surface soil, or A_1 horizon			Subsoil [1]		
		Organic-matter content	Thickness	Color when moist	Permeability	Predominant color when moist	Clay
			Inches				*Percent*
Aa	Alluvial land	Low to high	10 to 25	Dark gray to very dark gray.	Moderate to very slow.	Variable	Variable.
Ba	Beckwith silt loam	Low	4 to 8	Dark gray to gray	Very slow	Yellowish brown	50 to 55.
Bb	Belinda silt loam	Medium to low	5 to 10	Dark gray	Very slow	Yellowish brown with light olive-brown mottles.	46 to 55.
Ea	Edina silt loam	Medium	5 to 10	Very dark gray to dark gray.	Very slow	Dark gray with many light yellowish-brown mottles.	50 to 55.
Ga	Gosport silt loam, 13 to 20 percent slopes.	Very low	2 to 8	Dark grayish brown to grayish brown.	Very slow	Yellowish brown	35 to 45.
Gb	Gosport silt loam, 20 to 30 percent slopes.	Very low	2 to 6	Dark grayish brown to grayish brown.	Very slow	Yellowish brown	35 to 45.
Gc	Gravity-Olmitz complex, 2 to 8 percent slopes.	High	12 to 24	Very dark grayish brown to black.	Slow to moderate	Dark gray with brown mottles.	35 to 40.
Gd	Grundy silty clay loam, 2 to 7 percent slopes.	Medium	7 to 12	Black to dark gray	Slow	Dark gray to light yellowish brown.	43 to 48.
Ha	Haig silty clay loam	High	10 to 16	Black to very dark gray	Slow to very slow	Dark gray with many light yellowish-brown mottles.	45 to 50.
Hb	Humeston-Coppock complex.	Medium to high	7 to 14	Very dark gray	Moderate to very slow.	Very dark gray with brown mottles.	35 to 50.
La	Lindley loam, 7 to 13 percent slopes.	Low	6 to 8	Very dark grayish brown to dark grayish brown.	Slow to very slow	Yellowish brown to reddish brown.	30 to 50.
Lb	Lindley loam, 13 to 20 percent slopes.	Low	4 to 8	Very dark grayish brown to dark grayish brown.	Slow	Yellowish brown	30 to 40.
Lc	Lindley loam, 20 to 30 percent slopes.	Low	4 to 8	Very dark grayish brown to dark grayish brown.	Slow	Yellowish brown	30 to 40.
Ld	Lindley soils, 7 to 13 percent slopes, severely eroded.	Very low	2 to 4	Very dark grayish brown to dark grayish brown.	Slow to very slow	Yellowish brown to reddish brown.	30 to 50.
Le	Lindley soils, 13 to 20 percent slopes, severely eroded.	Very low	2 to 4	Very dark grayish brown to dark grayish brown.	Slow	Yellowish brown	30 to 40.
Lf	Lindley soils, 20 to 30 percent slopes, severely eroded.	Very low	2 to 4	Very dark grayish brown to dark grayish brown.	Slow	Yellowish brown	30 to 40.
Na	Nodaway silt loam	Medium	6 to 25	Dark gray to very dark gray.	Moderate to slow	Very dark gray with brown mottles.	25 to 30.
Oa	Olmitz-Gravity-Wabash complex, 2 to 5 percent slopes.	High	12 to 24	Very dark gray to black	Slow to moderate	Black to very dark gray; mottled.	Variable.
Pa	Pershing silt loam, 2 to 7 percent slopes.	Medium to low	4 to 8	Dark gray	Slow	Dark yellowish brown with light yellowish-brown mottles.	45 to 48.
Sa	Shelby-Adair complex, 5 to 13 percent slopes.	Medium to low	6 to 10	Very dark grayish brown to dark grayish brown.	Slow to very slow	Dark yellowish brown to grayish brown.	30 to 50.
Sb	Shelby-Adair complex, 5 to 13 percent slopes, severely eroded.	Low	2 to 4	Very dark grayish brown to dark grayish brown.	Slow to very slow	Dark yellowish brown to grayish brown.	30 to 50.
Sc	Shelby-Adair complex, 13 to 20 percent slopes.	Medium to low	4 to 8	Very dark grayish brown to dark grayish brown.	Slow	Dark yellowish brown	30 to 40.
Sd	Shelby-Adair complex, 13 to 20 percent slopes, severely eroded.	Low	2 to 4	Very dark grayish brown to dark grayish brown.	Slow	Dark yellowish brown	30 to 40.

See footnote at end of table.

TABLE 1.—*Summary of important characteristics of the soils*—Continued

Map symbol	Soil	Surface soil, or A_1 horizon			Subsoil [1]		
		Organic-matter content	Thickness	Color when moist	Permeability	Predominant color when moist	Clay
			Inches				*Percent*
Se	Shelby-Adair complex, 20 to 30 percent slopes.	Medium to low	4 to 8	Very dark grayish brown to dark grayish brown.	Slow	Dark yellowish brown	30 to 40.
Sf	Shelby-Adair complex, 20 to 30 percent slopes, severely eroded.	Low	2 to 4	Very dark grayish brown to dark grayish brown.	Slow	Dark yellowish brown	30 to 40.
Wa	Wabash silty clay	Very high to high	12 to 25	Black to very dark gray	Very slow to slow	Black to dark gray	45 to 55.
Wb	Weller silt loam, 2 to 8 percent slopes.	Low	2 to 8	Dark gray to dark grayish brown.	Slow to very slow	Yellowish brown	45 to 50.

[1] Generally at depths between 15 and 30 inches.

TABLE 2.—*Capability class and subclass, principal management problems, and suggested rotations or alternative uses for the soils*

Soil	Principal management problems	Capability class and subclass	Suitable rotations [1] or alternative uses
Alluvial land	Slight to severe wetness	V	Timber; permanent pasture.
Beckwith silt loam	Severe wetness	IIIw	1 year each of corn, oats, and meadow; 1 year of corn, 1 year of oats, 2 years of meadow.[2]
Belinda silt loam	Severe wetness	IIw	2 years of corn, 1 year of oats, 1 year of meadow; 1 year each of corn, oats, and meadow.[2]
Edina silt loam	Severe wetness	IIw	1 year each of corn, soybeans, corn, oats, and meadow; 2 years of corn, 1 year of oats, 1 year of meadow.[2]
Gosport silt loam, 13 to 20 percent slopes	Control of erosion	VIIe	Timber; permanent pasture.
Gosport silt loam, 20 to 30 percent slopes	Control of erosion	VIIe	Timber; permanent pasture.
Gravity-Olmitz complex, 2 to 8 percent slopes	Slight wetness; control of gully erosion	IIe	1 year each of corn, soybeans, corn, oats, and meadow; 2 years of corn, 1 year of oats, 1 year of meadow; permanent pasture.
Grundy silty clay loam, 2 to 7 percent slopes	Control of erosion; slight wetness	IIe, IIIe	1 year of corn, 1 year of oats, 2 years of meadow; with erosion control practices, 2 years of corn, 1 year of oats, and 1 year of meadow.[3]
Haig silty clay loam	Moderate to severe wetness	IIw	1 year each of corn, soybeans, corn, oats, and meadow; 2 years of corn, 1 year of oats, 1 year of meadow; 1 year each of corn, oats, and meadow.[2]
Humeston-Coppock complex	Severe wetness; overflow [4]	IIw, IIIw	1 year each of corn, soybeans, corn, oats, and meadow; 2 years of corn, 1 year of oats, 1 year of meadow; 1 year each of corn, soybeans, and corn; permanent pasture.[2]
Lindley loam, 7 to 13 percent slopes	Control of erosion	IVe	1 year of oats, 3 years of meadow; timber; permanent pasture; with erosion control practices, 1 year of corn, 1 year of oats, and 2 years of meadow.[3]
Lindley loam, 13 to 20 percent slopes	Control of erosion	VIe	Timber; permanent pasture.
Lindley loam, 20 to 30 percent slopes	Control of erosion	VIIe	Timber; permanent pasture.
Lindley soils, 7 to 13 percent slopes, severely eroded.	Control of erosion	VIe	Timber; permanent pasture.
Lindley soils, 13 to 20 percent slopes, severely eroded.	Control of erosion	VIIe	Timber; permanent pasture.

See footnotes at end of table.

Lindley soils, 20 to 30 percent slopes, severely eroded.	Control of erosion	VIIe	Timber; permanent pasture.
Nodaway silt loam	Overflow [4]	I	1 year each of corn, soybeans, corn, oats, and meadow; 2 years of corn, 1 year of oats, 1 year of meadow; 1 year each of corn, soybeans, corn, and oats grown with a green-manure crop; permanent pasture.[2]
Olmitz-Gravity-Wabash complex, 2 to 5 percent slopes.	Control of gully erosion; moderate wetness; overflow.[4]	IIw	1 year each of corn, soybeans, corn, oats, and meadow; 2 years of corn, 1 year of oats, 1 year of meadow; permanent pasture.
Pershing silt loam, 2 to 7 percent slopes	Control of erosion; slight wetness	IIe, IIIe	1 year of corn, 1 year of oats, 2 or 3 years of meadow; with erosion control practices, 1 year each of corn, oats, and meadow; or 2 years of corn, 1 year of oats, and 2 years of meadow.[3]
Shelby-Adair complex, 5 to 13 percent slopes	Control of erosion; slight to severe wetness	IIIw, IVe	1 year of corn, 1 year of oats, 3 or 4 years of meadow; permanent pasture; with erosion control practices, 1 year of corn, 1 year of oats, 2 years of meadow; or 1 year of corn, 1 year of oats, 3 years of meadow.[3]
Shelby-Adair complex, 5 to 13 percent slopes, severely eroded.	Control of erosion; slight to severe wetness	IVe	1 year of oats, 3 years of meadow; permanent pasture; with erosion control practices, 1 year of corn, 1 year of oats, and 3 years of meadow.[3]
Shelby-Adair complex, 13 to 20 percent slopes	Control of erosion	VIe	Timber; permanent pasture.
Shelby-Adair complex, 13 to 20 percent slopes, severely eroded.	Control of erosion	VIIe	Timber; permanent pasture.
Shelby-Adair complex, 20 to 30 percent slopes	Control of erosion	VIIe	Timber; permanent pasture.
Shelby-Adair complex, 20 to 30 percent slopes, severely eroded.	Control of erosion	VIIe	Timber; permanent pasture.
Wabash silty clay	Severe wetness; poor tilth when wet;[5] overflow [4]	IIIw	1 year each of corn, soybeans, corn, oats, and meadow; 2 years of corn, 1 year of oats, 1 year of meadow; 1 year each of corn, soybeans, corn, and oats grown with a green-manure crop; permanent pasture.[2]
Weller silt loam, 2 to 8 percent slopes	Control of erosion; slight wetness	IIIe	1 year of corn, 1 year of oats, 2 or 3 years of meadow; with erosion control practices, 1 year each of corn, oats, and meadow; or 2 years of corn, 1 year of oats, and 2 years of meadow.[2]

[1] Meadow crops consist of a mixture of legumes and grasses.

[2] Control of erosion and prevention of runoff are not a problem on this nearly level soil.

[3] For a discussion of contouring, stripcropping, terracing, and other practices used to control erosion and prevent runoff, see the section, Conservation of Soil and Water. Certain erosion control practices cannot be used in timbered areas. Only graded terraces should be considered for the soils of Lucas County.

[4] The risk of overflow varies from field to field.

[5] This fine-textured soil puddles if tilled when wet.

rotation will help to maintain the supply of organic matter and provide good tilth; the legume will supply nitrogen to the soil. In addition, a grass-legume crop helps to maintain the granular structure of the plow layer and thereby makes the soil more resistant to erosion. By growing different crops in a rotation, the farmer often is better able to meet the feed requirements of livestock.

Conservation of soil and water

Terracing, contour stripcropping, and the use of grassed waterways are practices used to prevent erosion and to control runoff on cropland in Lucas County. To be effective, these practices need to be used in conjunction with suitable rotations and other good management. Information on practices needed to control gully erosion is available through the local office of the Soil Conservation Service or the Extension Service.

Terracing is an effective way of reducing losses of soil. The terraces are, in effect, waterways installed almost crosswise to the slope. They reduce the amount of runoff that flows down the slope. The terraces in Lucas County should be built on a slight grade to allow water to flow along the terrace and out into a grassed waterway. They give the best results on slopes of between 2 and 12 percent. Oversized terraces, known as diversion terraces, can be used to shorten the length of slope and to divert the excessive amounts of water that might collect on the nearly level bottom lands.

Contour stripcropping consists of growing alternate strips of sod crops across the slope. In the spring the strips that must be cultivated are protected by the sod strips that help to slow down runoff and permit the water to soak into the soil. The sod strips also use a fair amount of moisture in early spring. Contour stripcropping can be done on all slopes on which farm machinery can be operated safely. It is not suited to irregular slopes.

A grassed waterway, consisting of a channel covered with grass, is designed to carry excess amounts of water safely down the slopes.

The contouring of tilled crops can be used in conjunction with terracing and contour stripcropping. If contouring is practiced alone, more sod crops will need to be grown in the rotation than if contouring is used with terraces and stripcropping.

A rotation of 1 year of corn, 1 year of a small grain, and 2 years of meadow is suitable for a field of Lindley loam, 7 to 13 percent slopes, that is terraced and farmed on the contour. The same rotation can be used on slopes of as much as 6 percent with contouring alone.

Lime and fertilizer requirements

Most of the upland soils in the county are acid unless they have been limed recently, and many of them need fertilizer. The Soil Testing Laboratory of Iowa State College made tests of 2,430 samples taken in the county to determine their content of lime, phosphorus, and potassium. They also tested 325 samples for nitrogen. The results of the tests for lime were as follows:

Lime requirements per acre	*Percent*
None	18
1.5 to 2 tons	20
2.5 to 3 tons	20
3.5 to 4 tons	30
More than 4 tons	12

The Beckwith and Weller soils are the most acid of any of the soils in the county, and they contain the least organic matter. These light-colored soils have formed under forest. Like other soils formed under forest, they need more lime and fertilizer, as a rule, than the darker colored soils that have formed under prairie grasses. The need for lime and fertilizer, however, depends largely on the crop to be grown and on how the soil has been managed in the past.

The results of soil tests made to determine the content of nitrogen, phosphorus, and potassium are shown in table 3. As indicated in the table, many soils in the county need a complete fertilizer. Before adding fertilizer or lime, however, soil tests should be made to determine the amount needed. The county extension director will furnish instructions for taking the soil samples.

TABLE 3.—*Results of soil tests*

Element	Percentage of samples testing—			
	High	Medium	Low	Very low
Nitrogen	7	31	46	16
Phosphorus	2	14	55	29
Potassium	23	66	11	0

Estimated Yields and Corn Productivity Ratings

Estimated average acre yields of principal crops and productivity ratings for corn are shown in table 4 for the soils of Lucas County. The estimated yields are shown under two levels of management.

The A, or average, level of management is based on the following assumptions: (1) The nearly level and gently sloping soils are used intensively for grain crops; (2) no definite rotations are used, but corn and oats are the main crops grown; fields are seeded to a meadow of red clover and timothy no oftener than once in 5 years; (3) pastures are unimproved and consist mainly of bluegrass; (4) adequate amounts of lime and some manure are used, but little commercial fertilizer is applied; and (5) no terracing or contour cultivation is practiced.

The B, or superior, level of management is based on the following assumptions: (1) Suitable crop rotations are used along with practices to control erosion (see the section, Management of Soils); and (2) lime and fertilizer are applied according to needs indicated by soil tests.

In preparing the estimated yields for both levels of management, the technicians assumed that (1) the level of management had been applied long enough, approximately 10 years, so that the yield figures would reflect the full effect of the practices applied; (2) the estimated figures represented the average yields expected over a 10-year period; (3) cultural operations were timely; (4) weeds, diseases, and insects were controlled according to the best known methods; and (5) suggested varieties of crops were grown, and recommended rates of planting were followed.

The estimated yield figures are considered to be fairly reliable estimates of the yields that can be expected at present. Improved farming practices, including better

TABLE 4.—*Estimated average acre yields of principal crops to be expected over a period of years, and corn productivity rating for the soils*

[Yields under A level of management are those obtained under average management; yields under B level of management are those obtained under superior management. Absence of a yield figure indicates the crop is not normally grown on the soil. Corn productivity ratings are based on a rating of 100 that is given to the most productive soil in the State]

Soil	Estimated yields of crops										Corn productivity rating
	A level of management					B level of management					
	Corn	Soybeans	Oats	Red clover	Alfalfa	Corn	Soybeans	Oats	Red clover	Alfalfa	
	Bu.	*Bu.*	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	
Beckwith silt loam	28	12	16	0.8	0.6	42	16	25	1.4	1.0	30
Belinda silt loam	34	16	20	1.2	1.4	50	18	28	1.4	1.8	50
Edina silt loam	36	18	23	1.2	1.6	52	20	30	1.5	2.0	55
Gosport silt loam, 13 to 20 percent slopes											15
Gosport silt loam, 20 to 30 percent slopes											10
Gravity-Olmitz complex, 2 to 8 percent slopes [1]	50	26	30	1.8	2.0	65	28	35	2.2	2.6	70
Grundy silty clay loam, 2 to 7 percent slopes	42	22	28	1.4	1.8	56	26	38	1.6	2.4	60
Haig silty clay loam	48	24	28	1.5	2.0	60	28	35	1.8	2.5	70
Humeston-Coppock complex [1]	38	20	25	1.6	1.4	50	24	30	1.4	1.8	([2])
Lindley loam, 7 to 13 percent slopes	20		16	.6	.8	34		24	1.0	1.6	25
Lindley loam, 13 to 20 percent slopes											20
Lindley loam, 20 to 30 percent slopes											15
Lindley soils, 7 to 13 percent slopes, severely eroded	18		14	.5	.6	30		22	.9	1.4	20
Lindley soils, 13 to 20 percent slopes, severely eroded											15
Lindley soils, 20 to 30 percent slopes, severely eroded											10
Nodaway silt loam [1]	55	26	30	1.8	2.8	65	28	35	2.0	2.5	([2])
Olmitz-Gravity-Wabash complex, 2 to 5 percent slopes [1]	50	26	40	1.8	2.1	60	28	35	2.2	2.6	([2])
Pershing silt loam, 2 to 7 percent slopes	34	14	24	1.2	1.6	48	16	32	1.6	2.0	50
Shelby-Adair complex, 5 to 13 percent slopes	30		20	.7	1.0	38		28	1.4	2.0	35
Shelby-Adair complex, 5 to 13 percent slopes, severely eroded	26		16	.6	.8	35		28	1.2	1.8	30
Shelby-Adair complex, 13 to 20 percent slopes	22		14	.6	.8	35		26	1.1	1.7	30
Shelby-Adair complex, 13 to 20 percent slopes, severely eroded	18		12	.5	.7	30		24	1.0	1.5	25
Shelby-Adair complex, 20 to 30 percent slopes											25
Shelby-Adair complex, 20 to 30 percent slopes, severely eroded											20
Wabash silty clay [1]	35	18	20	1.6	1.8	45	20	25	1.8	2.0	([2])
Weller silt loam, 2 to 8 percent slopes	30	10	16	.8	1.0	42	14	25	1.2	1.8	35

[1] Yield figures based on yields obtained from areas protected from overflow.

[2] The corn productivity rating varies markedly for this soil, depending on the amount of overflow and the degree of wetness.

methods of fertilization and the use of improved varieties of plants, may result in greater yields in the future.

Compare the estimated yield figures with the yields you are obtaining on your farm. If the average yields for your soils over the past 5 to 10 years are lower than those estimated under the B level of management, examine your management practices to see if changes are needed.

The productivity ratings for corn are based on a rating of 100. This rating is given to the soil from which the highest yields of corn in the State are obtained. Table 4 shows that the most productive soils in the county—Haig silty clay loam and the Gravity-Olmitz complex, 2 to 8 percent slopes—each have a rating of 70 and that none of the soils in Lucas County approach a rating of 100.

Capability Grouping

Capability grouping is a means of showing the relative suitability of soils for crops, grazing, forestry, and wildlife. It is a practical grouping based on the needs and limitations of the soils, the risks of damage to them, and also their response to management.

Eight general capability classes are recognized. In classes I, II, and III are soils that are suitable for regular cultivation for annual or short-lived crops. Class I soils are those that have the widest range of use and the least risk of damage. They are level or nearly level, productive, well drained, and easy to work. They can be cultivated with almost no risk of erosion and will remain productive if managed with normal care.

Class II soils can be cultivated regularly but do not have quite so wide a range of suitability as class I soils, or they need more protection. Some class II soils are gently sloping and need moderate care to control erosion; others may be slightly droughty, slightly wet, or somewhat limited in depth.

Class III soils can be cropped regularly but have a narrower range of use and need still more careful management than those of class II.

In class IV are soils that should be cultivated only occasionally or only under very careful management.

In classes V, VI, and VII are soils that, as a rule, should not be cultivated for annual or short-lived crops but can be used for pasture, range, woodland, or wildlife. Class

V soils are nearly level but are either under water much of the year or are flooded so frequently that it is not feasible to cultivate them.

Class VI soils are not suitable for crops because they are steep or droughty or otherwise limited, but they give fair yields of forage or forest products. Some soils in class VI can, without damage, be cultivated enough so that fruit trees or forest trees can be set out or pasture plants seeded. Class VII soils are suitable for forage or forest products but need more careful management than the soils of class VI.

In class VIII (none in Lucas County) are soils that have practically no agricultural use. Some of them have value as watersheds, wildlife habitats, or scenery.

Capability Subclasses.—The soils in any one capability class are limited by their natural features to about the same degree, but they may be limited for different reasons. For showing the main kind of limiting factor, any one of classes II through VIII may be divided into subclasses, each identified by a letter following the capability class number. The letter "e" indicates that the risk of erosion is what chiefly limits the uses of the soil; the letter "w" is used if the soil is too wet for general use and needs water control; and the letter "s" shows that the soil is shallow, droughty, or unusually low in fertility.

The capability classes and subclasses in Lucas County (as shown in table 2) are as follows:

Class I.—Soils that are easy to farm and have few or no serious limitations for use.

Class II.—Soils that have moderate limitations if cultivated.

- IIe.—Gently sloping and very gently sloping soils subject to erosion.
- IIw.—Soils moderately limited by wetness. Some have slowly permeable subsoils that are high in clay but will produce moderately good crops without tile drainage. Others are wet, principally because of landscape position, but tile will drain them satisfactorily.

Class III.—Soils that have severe limitations if cultivated.

- IIIe.—Sloping and gently sloping soils subject to erosion.
- IIIw.—Nearly level, poorly drained soils that do not drain readily through tile because of slowly permeable subsoils.

Class IV.—Soils suited to occasional cultivation under careful management.

- IVe.—Gently sloping, sloping, and strongly sloping soils that have a very severe erosion problem.

Class VI.—Soils suitable for growing pasture or trees but not suitable for cultivation.

- VIe.—Moderately steep and hilly soils on which erosion is the dominant problem.

Class VII.—Soils severely limited for use as pasture or woodland.

- VIIe.—Soils on steep slopes on which erosion is the dominant hazard.

How Soils Are Mapped and Described

The scientist who makes a soil survey examines soils in the field, classifies the soils in accordance with facts that he observes, and maps their boundaries on an aerial photograph or other map.

Field Study.—The soil surveyor bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern but are located according to the lay of the land. In most soils each boring or hole reveals several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how it differs from others in the profile and to learn the things about this soil that affect its capacity to support plant growth.

Color is usually related to the amount of organic matter in soils of the same texture and clay mineralogy. The darker the surface soils, the more organic matter they contain. The color of the subsoil indicates the drainage of the soil. In most of the better drained soils, the subsoil is brown, and in the poorly drained soils, the subsoil is generally gray. Streaks and spots of gray, yellow, and brown in the lower layers, however, generally indicate poor drainage and poor aeration.

Texture, or the content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers. It is later checked by laboratory analysis. Texture determines how well the soil retains moisture, plant nutrients, and fertilizer, and whether it is easy or difficult to cultivate.

Structure, which is the way the individual soil particles are arranged in larger grains and the amount of pore space between grains, gives us clues to the ease or difficulty with which the soil is penetrated by plant roots and by moisture.

Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is easy or difficult to keep the soil open and porous under cultivation. Terms commonly used to describe consistence in this report are: *Brittle*, *compact*, *firm*, *friable*, *loose*, *plastic*, *very compact*, *very firm*, *very friable*, and *very plastic*.

Other characteristics observed in the course of the field study and considered in classifying the soil include the following: The depth of the soil over bedrock or compact layers; the presence of gravel or stones in amounts that will interfere with cultivation; the steepness and pattern of slopes; the degree of erosion; the nature of the underlying parent material from which the soil has developed; surface and internal drainage; and acidity or alkalinity of the soil as measured by chemical tests.

Classification.—On the basis of the characteristics observed by the survey team or determined by laboratory tests, soils are classified by series, types, and phases.

As an example of soil classification, consider the Gosport series. In Lucas County, this series is made up of one soil type, subdivided into phases, as follows:

Series	*Type*	*Phase*
Gosport	Silt loam	13 to 20 percent slopes.
		20 to 30 percent slopes.

Soil series.—Two or more soil types that differ in surface texture but that are otherwise similar in kind, thickness, and arrangement of soil layers, are normally designated as a soil series. In a given area, however, it frequently happens that a soil series is represented by only one soil type. Each series is named for a place near which it was first mapped.

Soil type.—Soils having the same texture in the surface layers and similar in kind, thickness, and arrangement of soil layers are classified as one soil type.

Soil phase.—Because of differences other than those of kind, thickness, and arrangement of layers, some soil types are divided into two or more phases. Slope variations, frequency of rock outcrops, degree of erosion, and depth of soil over the substratum are examples of characteristics that suggest dividing a soil type into phases.

The soil phase (or the soil type if it has not been subdivided) is the unit shown on the soil map. It is the unit that has the narrowest range of characteristics. Use and management practices therefore can be specified more easily than for soil series or yet broader groups that contain more variation.

Miscellaneous land types.—Fresh stream deposits that are of mixed texture are not classified into types and series but are identified by descriptive names, as Alluvial land.

Soil complex.—If two or more soils are so intricately associated in small areas that it is not feasible to show them separately on the soil map, they are mapped together and called a soil complex. An example of this is the Humeston-Coppock complex.

Descriptions of the Soils

In this section the soils mapped in Lucas County are described and suggestions are given for their use and management. After the name of each soil is the letter symbol that identifies that particular soil on the map placed in the back part of this report. The approximate acreage and proportionate extent of each mapping unit are shown in table 5.

TABLE 5.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Alluvial land	1, 546	0. 6
Beckwith silt loam	367	. 1
Belinda silt loam	230	. 1
Edina silt loam	1, 412	. 5
Gosport silt loam, 13 to 20 percent slopes	122	(1)
Gosport silt loam, 20 to 30 percent slopes	73	(1)
Gravity-Olmitz complex, 2 to 8 percent slopes	3, 519	1. 3
Grundy silty clay loam, 2 to 7 percent slopes	52, 895	19. 0
Haig silty clay loam	24, 790	8. 9
Humeston-Coppock complex	1, 767	. 7
Lindley loam, 7 to 13 percent slopes	2, 593	. 9
Lindley loam, 13 to 20 percent slopes	9, 209	3. 3
Lindley loam, 20 to 30 percent slopes	14, 485	5. 2
Lindley soils, 7 to 13 percent slopes, severely eroded	2, 137	. 8
Lindley soils, 13 to 20 percent slopes, severely eroded	14, 761	5. 3
Lindley soils, 20 to 30 percent slopes, severely eroded	4, 858	1. 7
Nodaway silt loam	22, 096	8. 0
Olmitz-Gravity-Wabash complex, 2 to 5 percent slopes	30, 326	11. 0
Pershing silt loam, 2 to 7 percent slopes	5, 814	2. 1
Shelby-Adair complex, 5 to 13 percent slopes	11, 893	4. 3
Shelby-Adair complex, 5 to 13 percent slopes, severely eroded	20, 545	7. 4
Shelby-Adair complex, 13 to 20 percent slopes	4, 882	1. 8
Shelby-Adair complex, 13 to 20 percent slopes, severely eroded	28, 142	10. 1
Shelby-Adair complex, 20 to 30 percent slopes	520	. 2
Shelby-Adair complex, 20 to 30 percent slopes, severely eroded	940	. 3
Wabash silty clay	5, 089	1. 8
Weller silt loam, 2 to 8 percent slopes	12, 849	4. 6
Total	277, 760	100. 0

[1] Less than 0.1 percent.

Alluvial Land

Alluvial land (Aa).—This mapping unit occurs on bottom lands and has formed from materials washed from the uplands. It occupies about 0.6 percent of the county. Most of the areas are small and narrow, and many are cut by meandering streams. The streams sometimes overflow after heavy rains and spread alluvial material over the adjoining bottom lands.

This mapping unit is made up of light to moderately dark colored soils that consist of varying mixtures of sand, silt, and clay. Many of the areas are similar to areas of Nodaway soil. The mapping unit is best used for permanent pasture or trees.

Beckwith Series

The soils of the Beckwith series are light colored and are poorly drained. They have a claypan in the lower part of the profile. The soils have formed under forest. They occur on nearly level uplands and on loess-covered benches. Their parent material was loess.

These soils have a thin, gray A_1 horizon that is low in organic matter and nitrogen. They also have a distinct, gray A_2 horizon and a very fine textured, slowly permeable B horizon. Only one soil of this series, Beckwith silt loam, is mapped in Lucas County.

Profile description of Beckwith silt loam:

A_{1p} 0 to 5 inches, dark-gray to gray (10YR 4.5/1)[1] very friable, light silt loam; dark grayish brown to grayish brown (10YR 4.5/2) when crushed; weak thin platy structure.[2]

A_{12} 5 to 8 inches, dark-gray to gray (10YR 4.5/1) very friable, light silt loam; dark grayish brown to grayish brown (10YR 4.5/2) when crushed; weak thin to medium platy structure.

A_{21} 8 to 14 inches, light-gray (5Y 7/2) very friable silt loam to light silt loam; common grayish-brown (2.5Y 5/2) mottles; moderate thin platy structure.

A_{22} 14 to 18 inches, light olive-gray (5Y 6/2) friable silt loam to light silt loam; common grayish-brown (2.5Y 5/2) mottles; moderate medium platy structure.

B_2 18 to 27 inches, yellowish-brown (10YR 5/6) very firm, medium silty clay; has many very dark gray (5Y 3/1) coatings on peds, especially in the upper part of the layer; strong fine subangular blocky structure; common iron-manganese concretions.

B_3 27 to 42 inches, yellowish-brown (10YR 5/6) very firm, heavy silty clay loam; has common to many dark-gray (5YR 4/1) mottles; massive; common iron-manganese concretions.

C_1 42 to 55 inches, yellowish-brown (10YR 5/6) and brownish-gray (2.5Y 6/2) firm, light silty clay loam; common dark-gray (5YR 4/1) mottles; massive.

Variations.—The thickness of the A_1 horizons ranges from 4 to 8 inches. The content of clay in the B horizons ranges from about 50 to 55 percent. In general, the areas in the northern part of the county are less well developed and contain less clay in the B horizon than the areas in the southern part.

Beckwith silt loam (Ba).—This nearly level, poorly drained soil occupies about 0.1 percent of the county. It occurs chiefly in association with the Weller soil. The

[1] Symbols express Munsell color notations, which are explained in the Soil Survey Manual, Agriculture Handbook No. 18.

[2] The terms used to describe soil structure refer to the distinctness, size, and shape of the aggregates.

profile is the same as that described for the Beckwith series.

Wetness is a serious problem in managing this soil because of the very slowly permeable subsoil. Excessive rainfall in spring often makes the soil too wet. The soil is low in fertility. Erosion is not a problem.

Use and management.—Many of the small areas of this soil within larger areas of Lindley soils are pastured or used to grow trees. In areas that are cropped, yields of corn, soybeans, and oats are low because of the excessive moisture and low fertility. Because of the very slow permeability of the subsoil, tile drains are not effective. Surface drains will remove some, but not all, of the excess water.

Legumes, seeded with the sod crops, will increase the supply of nitrogen in this soil. They will also help to keep the surface soil loose and less likely to pack and crust after rains. Desirable rotations, if grain or meadow crops are to be grown, are (1) 1 year each of corn, oats, and meadow; or (2) 1 year of corn, 1 year of oats, and 2 years of meadow. Alfalfa should not be the only legume used in a seeding mixture on this soil because it does not tolerate the wet soil conditions that frequently exist. If red clover and alsike clover are included in the mixture, better meadow can be produced. Soil tests should be made to determine the need for lime and fertilizer.

Belinda Series

The soils of the Belinda series are moderately dark colored and are poorly drained. They have a claypan in the lower part of the profile. The soils occur on nearly level uplands and on loess-covered terraces. Their parent material was loess.

Originally, these soils were covered by prairie grasses, but trees invaded the areas. As a result, the characteristics of the Belinda soils are about halfway between those of the Haig soils, which have developed under prairie, and the Beckwith, which have developed under forest. Their A_1 horizon is lighter colored than that of the Haig soils but is darker colored than that of the Beckwith soils. The B horizons are very slowly permeable.

Only one soil of this series, Belinda silt loam, is mapped in Lucas County.

Profile description of Belinda silt loam:

A_{1p} 0 to 5 inches, dark-gray (10YR 4/1, dry) very friable silt loam; dark grayish brown (10YR 4/2) when crushed; weak medium subangular blocky structure; moderate fine granular structure when crushed.

A_{12} 5 to 8 inches, dark-gray (10YR 4/1) friable silt loam; many grayish-brown (10YR 5/2) mottles; dark grayish brown (10YR 4/2) when crushed; weak to moderate medium subangular blocky structure.

A_{21} 8 to 13 inches, grayish-brown (2.5Y 5/2) friable silt loam; has many dark-gray (10YR 4/1) mottles; moderate thin platy structure.

A_{22} 13 to 18 inches, light olive-gray (5Y 6/2) friable silt loam; has a few to common very dark gray (2.5Y 3/0) mottles and a few mottles of grayish brown (2.5Y 5/2); moderate medium platy structure.

B_{21} 18 to 24 inches, yellowish-brown (10YR 5/8) firm to very firm, medium silty clay; has a few light olive-brown (2.5Y 5/4) mottles; dark reddish-brown (5YR 3/2) coatings on peds; moderate to strong fine subangular blocky structure; a few iron-manganese concretions.

B_{22} 24 to 30 inches, yellowish-brown (10YR 5/8) firm to very firm, medium silty clay; has common light olive-brown (2.5Y 5/4) mottles; very dark gray (5YR 3/1) coatings on peds; moderate medium subangular blocky structure.

B_3 30 to 42 inches, strong-brown (7.5YR 5/8) firm, heavy silty clay loam; has common light olive-brown (2.5Y 5/4) mottles; very dark gray (7.5YR 3/0) coatings on peds; massive.

C_1 42 to 52 inches, strong-brown (7.5YR 5/8) and light olive-brown (2.5Y 5/4) firm, light silty clay loam; massive.

Variations.—The A_1 horizons range from dark gray to very dark gray in color and from silt loam to light silty clay loam in texture. In some places the A_2 horizons can be distinguished only by the gray coatings that cover the peds in the lower part of the horizons. In most areas of Belinda soil, however, this horizon consists of uniformly gray material that is several inches thick. The color of the B_{21} and B_{22} horizons ranges from dark gray with many yellowish-brown mottles to yellowish brown. The clay content of the B_{21} and B_{22} horizons ranges from 46 to 55 percent. The areas of this soil in the northern part of Lucas County have a less well-developed profile and have less clay in the B horizons than the areas in the southern part.

Belinda silt loam (Bb).—This nearly level, poorly drained soil occupies approximately 0.1 percent of the county. The profile is the same as that described for the Belinda series. This soil has a very slowly permeable subsoil.

Use and management.—Under similar management this soil is less productive than the Haig soil but more productive than the Beckwith. Wetness is the principal management problem. Water moves slowly through the subsoil, and therefore tile drains are not effective. Surface drains will help remove excess water, but they will not eliminate the problem entirely.

Rotations that are suitable for this soil are (1) 2 years of corn and 1 year each of oats and meadow; or (2) 1 year each of corn, oats, and meadow. Soil tests should be made to determine the need for lime and fertilizer.

Edina Series

The soils of the Edina series are dark colored and poorly drained. They have formed from loess under a cover of prairie grasses. The soils occur in the uplands in association with the Haig soils.

The Edina soils have a dark-colored A_1 horizon and a light-gray A_2 horizon. They have a claypan in the subsoil. Only one soil of this series, Edina silt loam, is mapped in Lucas County.

Profile description of Edina silt loam:

A_1 0 to 5 inches, very dark gray to dark-gray (10YR 3.5/1) friable silt loam; weak to moderate subangular blocky structure in place but breaks to moderate fine granular.

A_2 5 to 11 inches, gray (10YR 5/1) friable silt loam; has many dark-gray (10YR 4/1) and a few, fine, faint brown (10YR 5/3) mottles; light brownish-gray (2.5Y 6/2) coatings on peds; weak to moderate medium platy structure.

B_1 11 to 14 inches, dark grayish-brown to grayish-brown (10YR 4.5/2) firm, heavy silty clay loam; has common, medium, distinct dark-gray (10YR 4/1) mottles; moderate medium subangular blocky structure.

B_{21} 14 to 20 inches, very dark gray (10YR 3/1) very firm, medium silty clay; has many dark grayish-brown (10YR 4/2) mottles and a few, fine, faint mottles of yellowish brown (10YR 5/8); moderate to strong medium subangular blocky structure.

B_{22g}[3] 20 to 27 inches, light yellowish-brown (10YR 6/4 to 2.5Y 6/4) very firm, medium silty clay; has few to common, fine, distinct yellowish-brown (10YR 5/8) mottles; moderate medium subangular blocky.

B_3 27 to 40 inches, dark grayish-brown to grayish-brown (10YR 4.5/2) firm, heavy silty clay loam; has many, medium, prominent mottles of light yellowish brown (10YR 6/4) and a few to common, fine, distinct mottles of dark yellowish brown (10YR 4/8); moderate medium subangular blocky structure.

C_1 40 to 50 inches, grayish-brown (2.5Y 5/2) firm, medium silty clay loam; has common dark yellowish-brown (10YR 4/8) mottles; massive (structureless).

Variations.—The thickness of the A_1 horizon ranges from 5 to 10 inches. The A_2 horizon varies in thickness and in distinctness. In some places it is distinguished by gray coatings that cover the peds in the lower part of the horizon. In most areas of Edina soil, however, it consists of uniformly gray material that is several inches thick. The content of clay in the B_2 horizons ranges from 50 to 55 percent.

Edina silt loam (Ea).—This nearly level soil is poorly drained. It occurs in association with the Haig soil in shallow depressions in the nearly level uplands and at the heads of minor drainageways. This soil occupies about 0.5 percent of the county. Its profile is the same as that described for the Edina series.

Use and management.—Wetness is the principal problem in managing this soil. Because of the very slow permeability of the subsoil, tile drains are not effective. Surface drains will help to remove the excess water but will not eliminate the problem completely.

Suitable rotations for this soil are (1) 2 years of corn and 1 year each of oats and meadow; and (2) 1 year each of corn, oats, and meadow. Soil tests should be made to determine the need for lime and fertilizer.

Gosport Series

The soils of the Gosport series are light colored and are rolling to steep. They have developed from shale or from shallow loess and glacial till that overlies shale. The soils have formed under forest. They occupy less than 0.1 percent of the county. These soils adjoin areas of Lindley soils but generally occur on the slopes below the Lindley soils. Most of the areas are under forest, but some have a cover of bluegrass.

The A_1 layer of these soils is low in organic matter, and the soils are low in fertility. Because the subsoil is very slowly permeable and most of the slopes are steep, the soils erode readily.

Profile description of a Gosport silt loam:

A_1 0 to 5 inches, dark grayish-brown to grayish-brown (10YR 4.5/2) friable silt loam; moderate very fine granular structure.

A_2 5 to 9 inches, brown (10YR 5/3) friable silt loam; has many light brownish-gray (10YR 6/2) mottles; weak to moderate thin to medium platy structure.

B_1 9 to 15 inches, yellowish-brown (10YR 5/4) slightly firm silty clay; has many pale-brown (10YR 6/3) mottles; moderate to strong subangular blocky structure.

B_2 15 to 22 inches, yellowish-brown (10YR 5/6) firm to very firm silty clay; has common, fine dark-brown to brown (7.5YR 4/4) mottles; moderate to strong medium subangular blocky structure.

C_1 22 to 30 inches, yellowish-brown (10YR 5/6) firm to very firm silty clay; has common, fine dark reddish-brown (5YR 3/4) mottles; light olive-gray (5Y 6/2) coatings on peds; moderate to strong medium platy structure.

C_2 30 to 45 inches, yellowish-brown (10YR 5/4) firm to very firm silty clay loam; has many dark reddish-brown (5YR 3/4) mottles; massive (structureless); weathered shale.

Variations.—The thickness of the soil over shale ranges from 12 to 36 inches. In most places the A_1 horizon is between 2 and 6 inches thick. The degree of development of the B horizons varies. In places there is a thin B horizon that differs only in color from the horizons above and below. In other places there is an accumulation of clay in the B horizons.

Gosport silt loam, 13 to 20 percent slopes (Ga).—The profile of this soil is similar to that described for the series. The A_1 horizon ranges from 2 to 8 inches in thickness. The depth to unweathered shale varies considerably but is generally between 2 and 3 feet.

Use and management.—Some of this soil is pastured, but most of it is under forest. The trees are mainly various kinds of oaks and hickories. The pastures are generally poor. The soil is best kept in pasture or forest, however. To obtain the maximum returns from the areas used for growing trees, fence out livestock to allow new seedlings to grow, occasionally thin out young trees to eliminate overcrowding, select trees for cutting as they reach marketable size, and remove old or dead trees.

Gosport silt loam, 20 to 30 percent slopes (Gb).—The profile of this soil is similar to that described for the series. The A_1 horizon ranges from 2 to 6 inches in thickness. The depth to unweathered shale varies considerably but is generally between 1 and 2 feet. This soil is used and managed in about the same way as Gosport silt loam, 13 to 20 percent slopes.

Gravity-Olmitz Complex

The soils of the Gravity-Olmitz complex are deep, dark colored, and moderately well drained to somewhat poorly drained. They have developed from alluvial materials. The soils occur at the bases of slopes in the uplands and at the outlets of drainageways. In this county the soils were mapped as a complex because the areas were too small and intermingled to be shown separately on the soil map.

Profile description of Gravity loam:

A_{1p} 0 to 5 inches, black (10YR 2/1) friable loam; moderate medium granular structure.

A_{12} 5 to 15 inches, black (10YR 2/1) friable, heavy silt loam to light silty clay loam; weak fine subangular blocky structure.

A_3B_1 15 to 22 inches, black (10YR 2/1) friable, light silty clay loam; has a few, fine dark-brown to brown (7.5YR 4/4) mottles; weak to moderate fine subangular blocky structure.

B_2 22 to 32 inches, black (10YR 2/1) slightly firm, medium silty clay loam; common, fine dark-brown to brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure.

B_3 32 to 45 inches, very dark gray (10YR 3/1) friable, light silty clay loam; has a few, fine dark-brown to brown (7.5YR 4/4) mottles and discontinuous grayish mottles.

Variations.—The A_{1p} horizon ranges from loam to light silty clay in texture. The A horizons range from 12 to 24 inches in thickness. The texture of the B horizons ranges from medium silty clay loam to light silty clay.

Profile description of Olmitz loam:

A_{1p} 0 to 5 inches, very dark gray (10YR 3/1) friable loam; very dark grayish brown (10YR 3/2) when crushed; fine to medium granular structure.

A_{12} 5 to 18 inches, very dark gray (10YR 3/1) friable loam; weak fine to medium subangular blocky structure but breaks to fine to medium granular structure.

[3] The subscript g refers to a gleyed or somewhat gleyed layer, or horizon of reduction, characterized by the segregation of iron oxides in brownish mottles or concretions and by iron-gray colors.

A_3B_1 18 to 23 inches, black (10YR 2/1) slightly firm, light silty clay loam; weak to moderate fine to medium subangular blocky structure.

B_2 23 to 32 inches, black (10YR 2/1) slightly firm, light to medium silty clay loam; moderate fine to medium subangular blocky structure.

B_3 32 to 40 inches, very dark gray (10YR 3/1) friable, light clay loam; has many very dark grayish-brown (10YR 3/2) mottles; weak medium subangular blocky structure.

Variations.—The A_{1p} horizon ranges from loam to light silty clay in texture. The A horizons range from 12 to 24 inches in thickness. The texture of the B horizons ranges from heavy loam to medium clay loam or light silty clay loam.

Gravity-Olmitz complex, 2 to 8 percent slopes (Gc).—The moderately well drained to somewhat poorly drained alluvial soils that make up this complex occupy about 1.3 percent of the county. The individual areas range in size from only a few acres to about 40. The profiles of these soils are the same as those described for the Gravity and Olmitz series.

The risk of sheet erosion is slight in most areas of these soils, but gully erosion is a serious hazard. Because the soils occur at the bases of slopes and at the outlets of drainageways, they are frequently wet. In most places, however, surface runoff and internal drainage remove the excess water adequately. Occasionally, after heavy rains, soil material washes down from the nearby hills onto these soils. As a result the soils are thick and have a good supply of plant nutrients. On many of the areas there is a dark-gray layer of recent overwash. This overwash is similar in color and texture to that in the upper layers of the Nodaway soil. In some small, scattered areas, the soils have an A_2 horizon but are otherwise similar to the Gravity soils.

Use and management.—The principal management problem on these soils is the control of gully erosion. Grassed waterways should be maintained in all the areas. Diversion terraces may be needed in some areas to prevent hill water from damaging the crops. Soil tests should be made to determine the need for lime and fertilizer.

The large areas of these soils can be cropped intensively. Rotations that are suitable are: (1) 1 year each of corn, soybeans, corn, oats, and meadow; (2) 2 years of corn and 1 year each of oats and meadow; and (3) 2 years of corn, 1 year of oats, and 2 years of meadow.

Some areas of these soils are too small to be farmed separately. These areas can be used in the same way as the adjacent soils. (Consult the soil map in the back of the report to determine what soils are adjacent to Gravity-Olmitz complex, 2 to 8 percent slopes, which is identified by map symbol Gc.)

Grundy Series

The soils of the Grundy series are moderately well drained to imperfectly drained. They have developed principally under prairie. Their surface layer is dark colored and moderately thick, and their subsoil is fine textured and slowly permeable. The soils are on undulating to gently rolling uplands and on loess-covered benches. They occur in association with the Haig soil and with the soils of the Shelby-Adair complexes. The Shelby and Adair soils have developed from Kansan till, whereas the Grundy and Haig soils have developed from loess. Only one soil of this series, Grundy silty clay loam, 2 to 7 percent slopes, occurs in this county.

Profile description of Grundy silty clay loam:

A_1 0 to 7 inches, very dark gray to dark-gray (10YR 3.5/1) friable, light silty clay loam; weak to moderate fine subangular blocky structure.

A_3 7 to 11 inches, very dark gray (10YR 3/1) friable to slightly firm, light silty clay loam; has many dark grayish-brown (10YR 4/2) mottles; very dark grayish brown (10YR 3/2) when crushed; weak to moderate fine subangular blocky structure.

B_1 11 to 14 inches, dark grayish-brown (10YR 4/2) firm, heavy silty clay loam; has many very dark gray (10YR 3/1) mottles; weak to moderate fine subangular blocky structure.

B_{21} 14 to 22 inches, dark grayish-brown (10YR 4/2) firm to very firm, light to medium silty clay; has a few to common very dark gray (10YR 3/1) mottles; moderate medium subangular blocky structure.

B_{22} 22 to 28 inches, dark-gray (2.5Y 4/0) firm to very firm, light to medium silty clay; has common, medium, distinct light yellowish-brown (2.5Y 6/4) mottles and common dark yellowish-brown (10YR 4/8) mottles; moderate medium subangular blocky structure.

B_3 28 to 40 inches, light yellowish-brown (2.5Y 6/4) firm, heavy silty clay loam; has many, medium, distinct dark-gray (2.5Y 4/0) mottles and common, medium, distinct dark yellowish-brown (10YR 4/8) mottles; massive (structureless).

C_1 40 to 50 inches, grayish-brown (2.5Y 5/2) firm, light silty clay loam; has common dark yellowish-brown (10YR 4/8) mottles; massive (structureless).

Variations.—In most places the thickness of the combined A horizons ranges from 7 to 12 inches. On some of the more eroded slopes, however, the A horizons have washed away. The clay content of the B horizons ranges from about 43 to 48 percent. In areas of this soil that border the Haig soil, the loess is between 8 and 10 feet thick. In areas that border the Shelby-Adair soils, the layer of loess is only 2 to 4 feet thick.

Grundy silty clay loam, 2 to 7 percent slopes (Gd).—This moderately well drained to imperfectly drained soil is the most extensive soil in the county, occupying about 19 percent of the acreage. It lies next to the Haig soil of the nearly level uplands and next to the Shelby and Adair soils of the rolling uplands. Its profile is the same as that described for the Grundy series (fig. 5).

Because of the slow permeability of the subsoil, most of the water runs off this soil during heavy rains and little infiltrates into the soil. As a result erosion is a serious hazard.

Use and management.—This soil needs practices to control erosion. In years when rainfall is excessive, some areas may require artificial drainage. Fertilizer and lime are needed for highest yields.

Contouring and terracing will help to control erosion. Only graded terraces should be used. Soil tests will help to determine the kinds and amounts of fertilizer and lime to use. If adequate amounts of fertilizer are applied and proper practices are used to control erosion, fairly high yields can be obtained in a rotation that consists of 2 years of corn and 1 year each of oats and meadow.

Haig Series

The soils of the Haig series have developed under prairie. Their parent material was loess. The soils occur in the uplands. Only one soil of this series, Haig silty clay loam, occurs in this county.

Profile description of Haig silty clay loam:

A_1 0 to 9 inches, very dark gray (10YR 3/1) friable, light silty clay loam; moderate medium subangular blocky structure.

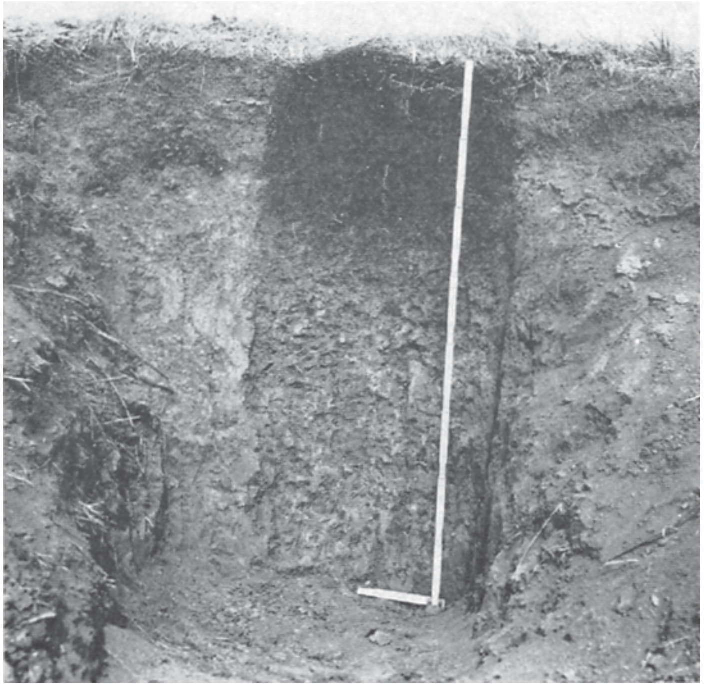

Figure 5.—**Profile of Grundy silty clay loam, 2 to 7 percent slopes. This soil has developed under prairie grass.**

A_3 9 to 14 inches, very dark gray (10YR 3/1) friable, light silty clay loam; weak medium subangular blocky structure; moderate medium granular structure when crushed.

B_1 14 to 18 inches, very dark gray (10YR 3/1) slightly firm to firm, heavy silty clay loam; moderate medium granular structure.

B_{21} 18 to 25 inches, very dark gray (10YR 3/1) firm to very firm, medium silty clay; has common dark grayish-brown to dark-brown (10YR 4/2.5) mottles; moderate fine subangular blocky structure.

B_{22g} 25 to 32 inches, very dark gray to dark-gray (2.5Y 3.5/0) firm to very firm, medium silty clay; has common, fine, faint dark yellowish-brown (10YR 4/8) mottles; moderate medium subangular blocky structure.

B_{3g} 32 to 40 inches, dark-gray (2.5Y 4/0) firm, medium silty clay loam; has a few, fine, faint dark yellowish-brown (10YR 4/8) mottles; moderate fine subangular blocky structure to massive (structureless).

C_1 40 to 50 inches, light olive-gray (5Y 6/2) friable to slightly firm, light silty clay loam; a few, fine, faint yellowish-brown (10YR 5/8) mottles; massive (structureless).

Variations.—The combined A horizons range in thickness from 10 to 18 inches. The clay content in the B horizons ranges from 43 to 48 percent. The profile is not so well developed in the areas in the northern part of the county, and there is less clay in the B horizons than in areas in the southern part. The areas of this soil in the southern part of the county have a weakly developed A_2 horizon in places.

Haig silty clay loam (Ha).—This nearly level soil occurs in association with the Grundy and Edina soils. It occupies approximately 8.9 percent of the county. The profile is the same as that described for the Haig series.

This soil is not subject to erosion. During wet seasons it is often too wet. The subsoil is slowly to very slowly permeable. In the areas in the northern part of the county, permeability is slightly more rapid than in the areas in the southern part.

Use and management.—This soil is fairly well suited to the general crops grown in the county (fig. 6). Drainage

Figure 6.—**Typical field of Haig silty clay loam. Corn, small grains, and hay are the principal crops.**

needs to be improved. Because of the slow permeability of the soil, however, tile may not be effective in the areas in the southern part of the county.

The following rotations are suitable on this soil: (1) 1 year each of corn, soybeans, corn, oats, and meadow; (2) 2 years of corn and 1 year each of oats and meadow; and (3) 1 year each of corn, oats, and meadow. This soil needs lime and a complete fertilizer. The amounts of lime and fertilizer and the kinds of fertilizer to use should be determined by soil tests.

Humeston-Coppock Complex

The soils of the Humeston-Coppock complex occur on bottom lands. They are forming from medium- and fine-textured alluvium that washed down from the uplands. In this county the soils were mapped as a complex because the areas were too small and intermingled to be shown separately on the soil map.

Profile description of Humeston silt loam:

A_1 0 to 7 inches, very dark gray (10YR 3/1) friable silt loam; moderate coarse subangular blocky structure.

A_2 7 to 14 inches, dark-gray (10YR 4/1) friable silt loam; light-gray (5Y 7/2) coatings on peds; dark grayish brown (10YR 4/2) when crushed; moderate medium platy structure.

B_1 14 to 18 inches, very dark gray (10YR 3/1) slightly firm to firm, medium silty clay loam; has a few strong-brown (7.5YR 4/8) mottles; moderate fine subangular blocky structure.

B_2 18 to 30 inches, very dark gray (10YR 3/1) firm to very firm, medium silty clay; has many dark-brown to brown (7.5YR 4/2) mottles and a few strong-brown (7.5YR 4/8) mottles; moderate fine subangular blocky structure.

B_3 30 to 42 inches, very dark gray (2.5Y 3/0) firm, heavy silty clay loam; has common dark grayish-brown to grayish-brown (2.5Y 4.5/2) mottles; moderate fine subangular blocky structure.

Variations.—The B horizons range in texture from medium to heavy silty clay loam to light to medium silty clay.

Profile description of Coppock silt loam:

A_1 0 to 12 inches, very dark gray (10YR 3/1) friable silt loam; has many dark grayish-brown (10YR 4/2) mottles; weak medium subangular blocky structure.

A_{21} 12 to 22 inches, very dark gray (10YR 3/1) and dark grayish-brown (10YR 4/2) friable silt loam; has a few light brownish-gray (2.5Y 6/2) mottles; weak fine subangular blocky structure.

A_{22} 22 to 30 inches, very dark gray (10YR 3/1) and dark grayish-brown (10YR 4/2) friable silt loam to light silty clay loam; has common light brownish-gray (2.5Y 6/2) mottles; weak fine subangular blocky structure.

B_2 30 to 45 inches, very dark gray (10YR 3/1) and dark grayish-brown (10YR 4/2) friable, light silty clay loam; has common light brownish-gray (2.5Y 6/2) mottles; massive (structureless).

Variations.—The B_2 horizon ranges in texture from light silty clay loam to heavy silt loam.

Humeston-Coppock complex (Hb).—The soils of this complex occur on nearly level bottom lands in association with the Wabash and Nodaway soils. They occupy approximately 0.7 percent of the county. The soils are forming from medium- and fine-textured alluvium. Drainage through the soils is good to poor, and the soils are flooded frequently.

The A_2 horizon of the Humeston soils is more distinct than the comparable horizons in the Coppock soils, and the B_2 horizon is medium silty clay while that of the Coppock soils is silty clay loam. The profiles of these soils are the same as the typical profiles described for the two series.

Use and management.—Many areas of these soils that are subject to overflow are used for pasture. Normally, they provide grazing during most of the season. In places where the drainage through the soil is adequate and overflows are not serious, these soils can be used for cultivated crops.

Lindley Series

The Lindley soils have developed under forest. Their parent material was glacial till. The soils are rolling to steep and are subject to erosion (fig. 7). They occupy

***Figure 7.*—Area of Lindley soil that has been severely damaged by gully erosion.**

about 17.2 percent of the county and occur chiefly in association with the Weller soil.

The color and texture of the lower layers of these soils vary. In some areas the subsoil is yellowish brown and has a medium texture. In others it is reddish brown and has a fine texture. These differences were brought about as a result of the complex geological history of these soils.

Profile description (variation A):

A_1 0 to 6 inches, very dark grayish-brown (10YR 3/2) very friable, heavy loam; moderate fine granular structure tending towards platy.

A_2 6 to 10 inches, very dark gray to dark-gray (10YR 3.5/1) very friable, heavy sandy loam that is dark grayish brown (10YR 4/2) when crushed; has common dark grayish-brown to brown (10YR 4/2.5) mottles; moderate fine granular structure.

B_1 10 to 15 inches, yellowish-brown (10YR 5/6) friable to slightly firm loam; brown to yellowish-brown (7.5YR 5/4 to 10YR 5/4) coatings on peds; moderate medium to fine subangular blocky structure.

B_2 15 to 29 inches, yellowish-brown (10YR 5/6) firm clay loam; brown to yellowish-brown (7.5YR 5/4 to 10YR 5/4) coatings on peds; moderate medium subangular blocky structure.

B_3 29 to 39 inches, strong-brown (7.5YR 5/8) firm to very firm clay loam; has common grayish-brown (2.5Y 5/2) mottles; massive (structureless); contains a few iron-manganese concretions.

C_1 39 to 47 inches, grayish-brown (2.5Y 5/2) firm clay loam; has common strong-brown (7.5YR 5/8) mottles; massive (structureless); few to common iron-manganese concretions.

C_2 47 to 60 inches, grayish-brown (2.5Y 5/2) firm clay loam; has common strong-brown to yellowish-brown (7.5YR 5/8 to 10YR 5/8) mottles and a few light yellowish-brown (2.5Y 6/4) mottles; massive (structureless); common iron-manganese concretions.

Profile description (variation B):

A_1 0 to 4 inches, very dark grayish-brown to dark grayish-brown (10YR 3.5/2) friable loam; weak medium platy structure but fine granular when crushed.

B_{11} 4 to 8 inches, strong-brown (7.5YR 5/6) friable to slightly firm clay loam; has thin coatings of reddish brown to brown (5YR 5/4 to 7.5YR 5/4) on peds; moderate fine subangular blocky structure.

B_{12} 8 to 12 inches, brown (7.5YR 5/4) heavy clay loam that is firm to very firm when moist and plastic when wet; has common reddish-brown (5YR 4/4) and red (2.5YR 4/6) mottles; moderate very fine subangular blocky structure; contains a band of pebbles.

B_{21} 12 to 16 inches, brown (7.5YR 5/4) gritty clay that is very firm when moist and very plastic when wet; common reddish-brown (5YR 4/4) and red (2.5YR 4/6) mottles; has some pale-brown (10YR 6/3) coatings on peds; moderate to strong fine subangular blocky structure; contains a band of pebbles.

B_{22} 16 to 21 inches, brown (7.5YR 5/4) gritty clay that is very firm when moist and plastic when wet; has many strong-brown (7.5YR 5/6), a few reddish-brown (5YR 4/4), a few light brownish-gray (2.5Y 6/2), and a very few red (2.5YR 3/6) mottles; massive (structureless); a few iron-manganese concretions.

B_{23} 21 to 27 inches, strong-brown (7.5YR 5/6) gritty clay that is very firm when moist and plastic when wet; has a few light brownish-gray (2.5Y 6/2) mottles; brown (7.5YR 5/4) coatings on peds; a few reddish-brown (5YR 5/4) stains; massive (structureless); a few iron-manganese concretions.

B_{31} 27 to 34 inches, strong-brown (7.5YR 5/6) very firm to firm, heavy clay loam; has many light brownish-gray (2.5Y 6/2) mottles; massive (structureless); a few iron-manganese concretions.

B_{32} 34 to 42 inches, strong-brown to yellowish-brown (7.5YR 5/8 to 10YR 5/8) firm to very firm clay loam; has common grayish-brown (2.5Y 5/2) mottles; massive (structureless); common iron-manganese concretions.

C_1 42 to 50 inches, strong-brown (7.5YR 5/8) firm to very firm clay loam; has many grayish-brown (2.5Y 5/2) mottles and a few reddish-brown (5YR 5/4) stains; massive (structureless); many iron-manganese concretions.

Use and management.—These soils are used mainly for pasture or for growing trees (fig. 8). Most of the wooded

Figure 8.—**One of the many steeply sloping areas of Lindley soils that is used for timber.**

areas have been cut over at least once and do not produce good yields. To obtain maximum yields, operators need to fence out livestock to allow new seedlings to grow, occasionally thin out young trees to eliminate overcrowding, select trees for cutting as they reach marketable size, and eliminate old or dead trees.

Lindley loam, 7 to 13 percent slopes (La).—The A_1 horizon of this soil ranges from 6 to 8 inches in thickness. In most areas, the subsoil is reddish brown and is fine textured. In other areas the subsoil is medium textured.

This soil is best kept under a permanent plant cover. Grain crops can be grown, but the soil should be kept in meadow most of the time. Practices to control erosion are needed. If cropped, this soil should be tested for lime and fertilizer needs.

Lindley loam, 13 to 20 percent slopes (Lb).—The A_1 horizon of this soil is 4 to 8 inches thick. In most areas the subsoil is medium textured, but in some areas it is fine textured and is reddish brown.

This soil is best kept in pasture or under forest. If it is used for meadow, oats may be grown as a nurse crop when the meadow is being renovated.

Lindley loam, 20 to 30 percent slopes (Lc).—The A_1 horizon of this soil ranges from 4 to 8 inches in thickness. In most areas the subsoil is medium textured, but in a few areas it is fine textured and is reddish brown.

This soil is best kept under permanent pasture or forest. If all of the surface soil has been lost through erosion, a good stand of grass is difficult to establish. Therefore, some plant cover should be maintained during pasture renovation, but corn or other row crops should not be grown.

Lindley soils, 7 to 13 percent slopes, severely eroded (Ld).—The A_1 horizon of this soil is 3 to 6 inches thick. In most areas the subsoil is reddish brown and of fine texture. In other areas the subsoil is of medium texture.

This soil is best kept under a permanent plant cover. Corn can be grown occasionally if erosion is controlled.

Lindley soils, 13 to 20 percent slopes, severely eroded (Le).—The A_1 horizon of this soil is 2 to 4 inches thick. In most places the subsoil has a medium texture, but in some areas it is fine textured and has a reddish-brown color. This soil is best kept under permanent pasture or forest.

Lindley soils, 20 to 30 percent slopes, severely eroded (Lf).—The A_1 horizon of this soil is 2 to 4 inches thick. In most places the subsoil is of medium texture, but in some areas it is fine textured and has a reddish-brown color. This soil is best kept in pasture or under forest.

Nodaway Series

The soils of the Nodaway series are moderately dark colored and are moderately well drained to well drained. They occur on low-lying flood plains and are developing from alluvial materials. Only one soil of this series, Nodaway silt loam, is mapped in the county.

Profile description of Nodaway silt loam:

A_1 0 to 6 inches, very dark gray (10YR 3/1) friable silt loam; has common dark grayish-brown (10YR 4/2) mottles; weak medium subangular blocky structure.

C_{11} 6 to 15 inches, very dark gray (10YR 3/1) friable silt loam; has common dark grayish-brown (10YR 4/2) mottles; moderate medium subangular blocky structure.

C_{12} 15 to 22 inches, very dark gray (10YR 3/1) friable silt loam; moderate medium subangular blocky structure.

A_b 22 inches +, black (10YR 2/1) firm, heavy silty clay loam; has a few strong-brown mottles; massive. (This layer represents the A_1 horizon of a buried soil.)

Variations.—The profile above the A_b horizon ranges from very dark gray to grayish brown. Depth to a darker buried soil (the A_b horizon) varies, not only in different parts of the county but also within individual fields. In places the buried soil is at depths of as little as 15 inches. In others it is at depths of several feet. The buried soil ranges in texture from heavy silty clay loam to silty clay.

Nodaway silt loam (Na).—This is one of the most extensive soils of the bottom lands. It occupies approximately 8 percent of the county. It occurs throughout the county in association with the Wabash soil and with the soils of the Humeston-Coppock complex. This soil is subject to overflow. It is developing from silty alluvial sediments that have washed down recently from the uplands.

The profile of this soil is the same as that described for the Nodaway series. In most of the areas, however, there is considerable stratification, and in many of the areas there is a darker colored and finer textured substratum that occurs at depths of 2 to 6 feet. This substratum was formerly the surface soil but has been covered by fairly recent alluvial deposits.

Use and management.—Areas of this soil that are flooded frequently are used mainly for pasture or for growing trees. Normally, these areas provide pasture throughout most of the grazing season. The areas in which drainage and flooding are not problems are suited to corn and soybeans. Here, a high proportion of row crops can be grown in the rotation, as 1 year each of corn, soybeans, corn, oats, and meadow.

In many places the risk of flooding can be reduced by straightening the stream channels and constructing levees or drainage ditches. In areas used for crops, soil tests should be made to determine the need for lime and fertilizer.

Olmitz-Gravity-Wabash Complex

The soils of this complex occur in the uplands. The areas were too small and intermingled to show separately on the soil map, so they were mapped as a complex. The profiles of the Olmitz and Gravity soils are the same as those described for the soils of the Gravity-Olmitz complex. The profile of the Wabash soil is the same as that described for the Wabash series.

Olmitz-Gravity-Wabash complex, 2 to 5 percent slopes (Oa).—This complex is made up mainly of Olmitz loam, Gravity loam, and Wabash silty clay, but it includes small areas of Nodaway soil. It occupies approximately 11 percent of the county. The soils occur on narrow drainageways in the uplands. They have formed from materials washed down from the adjacent slopes. Gully erosion is a serious hazard on these soils.

Use and management.—Most areas of these soils are too small and narrow to be farmed separately and are used in the same way as the adjacent soils. (Consult the soil map in the back part of the report to determine what soils lie next to the Olmitz-Gravity-Wabash complex, 2 to 5 percent slopes, which is identified by map symbol Oa.) The areas that have been damaged by gullying and small areas that lie next to steeper soils are used for pasture.

If damage caused by gully erosion is not too great, the larger areas of these soils can be cropped in a rotation of 2 years of corn and 1 year each of oats and meadow, and good yields can be obtained. Soil tests should be made to determine the need for lime and fertilizer. Grassed waterways that have been laid out properly should be maintained. In places diversion terraces may be needed to prevent gullying.

Pershing Series

The soils of the Pershing series are moderately dark colored and are moderately well drained. They occur on undulating to gently rolling uplands and on loess-covered benches. The soils have developed from loess. Originally, prairie grasses covered the areas, but trees later invaded. These soils have a moderately well developed A_2 horizon and a clayey subsoil (B horizon).

Profile description of Pershing silt loam:

A_1 0 to 4 inches, very dark gray to dark-gray (10YR 3.5/1) friable silt loam; weak medium subangular blocky structure.

A_2 4 to 9 inches, very dark gray to dark-gray (10YR 3.5/1) friable silt loam; has many dark-brown (10YR 3.5/3) mottles; weak to moderate medium subangular blocky structure.

B_1 9 to 12 inches, dark-brown to brown (10YR 4/3) firm, heavy silty clay loam; has common dark-gray (10YR 4/1) mottles; moderate medium subangular blocky structure.

B_{21} 12 to 18 inches, yellowish-brown (10YR 5/4) firm silty clay; moderate medium subangular blocky structure.

B_{22} 18 to 24 inches, light brownish-gray (2.5Y 6/2) firm to very firm, light to medium silty clay; has many yellowish-brown (10YR 5/8) mottles; moderate medium subangular blocky structure.

B_3 24 to 34 inches, dark yellowish-brown (10YR 4/6) firm, heavy silty clay loam; has many light brownish-gray (2.5Y 6/2) mottles; moderate medium subangular blocky structure to massive (structureless).

C_1 34 to 50 inches, dark yellowish-brown (10YR 4/6) and light brownish-gray (2.5Y 6/2) slightly firm, light silty clay loam; massive (structureless).

Variations.—In most places the A_1 horizon is between 4 and 8 inches thick, but in severely eroded areas, the A_1 horizon is lacking. In some places the A_2 horizon can be distinguished only by the gray coatings that cover the peds in the lower part of the A_1 horizon. In other places the A_2 horizon consists of gray material that is several inches thick.

The color of the B_2 horizon ranges from dark gray or light brownish gray with light yellowish-brown mottles to yellowish brown; the clay content of the B_2 horizon ranges from about 45 to 48 percent. The areas in the northern part of the county are less well developed and contain less clay in the B horizons than the areas in the southern part.

In places where this soil borders areas of Belinda or Haig soils, the layer of loess is generally 8 to 10 feet thick. Where it borders areas of Lindley soils or of the soils of the Shelby-Adair complex, the loess is generally only 2 to 4 feet thick.

Pershing silt loam, 2 to 7 percent slopes (Pa).—This moderately well drained soil occupies about 2.1 percent of the county. Its profile is the same as that described for the series. The soil occurs in association with the dark-colored Grundy soil and the gray Weller soil. Its characteristics are intermediate between those of the associated soils. This soil has a slowly permeable subsoil. Because water does not penetrate readily, much of it runs off during heavy rains, causing the soil to erode.

Use and management.—Much of this soil is used for pasture or for growing trees because the areas occur within larger areas of steeply sloping Lindley soils or within steep areas of soils of the Shelby-Adair complex. It is fairly well suited to general crops, although yields will not be so high as on the Grundy soil. The soil will erode if it is cultivated intensively without using practices to control erosion.

Contouring, terracing, and stripcropping will reduce the risk of erosion. If these practices are used, suitable rotations are (1) 1 year each of corn, oats, and meadow; or (2) 2 years of corn, 1 year of oats, and 2 years of meadow. A longer rotation will be needed if erosion control practices are not used. Soil tests should be made to determine the need for lime and fertilizer.

Shelby-Adair Complexes

The soils of the Shelby-Adair complexes have developed under prairie, although in some places trees have encroached. In this county these soils were mapped as soil complexes because the individual areas were too small to be shown separately on the soil map. The soils occur chiefly in association with the Grundy soil and with soils of the Gravity-Olmitz and Olmitz-Gravity-Wabash complexes. They occupy about 24.1 percent of the county. If they are cultivated, erosion is a serious problem.

The Shelby soils are dark colored and are moderately well drained. They have developed from weakly weathered glacial till. In uneroded areas these soils have a moderately thick surface layer of loam and a yellowish-brown subsoil of clay loam. They occur mainly on slopes of more than 12 percent and in areas where the more strongly weathered materials had eroded away before the present soils were formed.

The Adair soils are dark colored and are moderately well drained to imperfectly drained. They have developed from more strongly weathered glacial till than have the Shelby soils. In uneroded areas there is a moderately thick surface layer of loam and a reddish-brown or grayish-brown subsoil of gritty silty clay. These soils occur mostly on the upper parts of the slopes; the areas are not so steep as those occupied by the Shelby soils.

Profile description of Shelby loam:

A_1 0 to 4 inches, very dark grayish-brown to dark grayish-brown (10YR 3.5/2 to 2.5Y 3.5/2) friable loam; moderate medium granular structure.

B_1 4 to 7 inches, very dark grayish-brown to dark grayish-brown (10YR 3.5/2 to 2.5Y 3.5/2) slightly firm clay loam; has many dark yellowish-brown (10YR 4/6) mottles; moderate medium granular structure.

B_2 7 to 13 inches, dark yellowish-brown (10YR 4/6) firm clay loam; has many dark grayish-brown (10YR 4/2) mottles; moderate medium subangular blocky structure.

B_{31} 13 to 19 inches, yellowish-brown (10YR 5/8) firm clay loam; has brown (10YR 5/3) coatings on peds; weak medium subangular blocky structure.

B_{32} 19 to 26 inches, yellowish-brown (10YR 5/8) firm clay loam; has a few to common light olive-gray (5Y 6/2) mottles; brown (10YR 5/3) coatings on peds; weak medium subangular blocky structure.

B_{33} C_1 26 to 40 inches, yellowish-brown (10YR 5/8) firm clay loam; has a few light olive-gray (5Y 6/2) mottles; brown (10YR 5/3) coatings on peds; massive to weak coarse subangular blocky structure.

Profile description of Adair loam:

A_1 0 to 4 inches, very dark grayish-brown to dark grayish-brown (2.5Y 3.5/2) friable loam; moderate medium subangular blocky structure.

A_3 4 to 7 inches, very dark gray (2.5Y 3/0) firm to very firm, gritty light silty clay; has many light olive-brown to light yellowish-brown (2.5Y 5.5/4) mottles; moderate medium subangular blocky structure.

B_1 7 to 11 inches, grayish-brown (2.5Y 5/2) very firm, gritty silty clay; has many light olive-brown to light yellowish-brown (2.5Y 5.5/4) mottles, common very dark gray (2.5Y 3/1) mottles, and a few fine yellowish-brown (10YR 5/6) mottles; moderate medium angular blocky structure.

B_2 11 to 15 inches, light brownish-gray (2.5Y 6/2) very firm, gritty silty clay; has common light yellowish-brown (2.5Y 6/4) mottles and a few to common mottles that are yellowish brown (10YR 5/6); moderate medium angular blocky structure.

B_3 15 to 19 inches, brownish-yellow (10YR 6/8) firm, gritty silty clay; has many light olive-gray (5Y 6/2) mottles; massive to weak coarse angular blocky structure.

B_3 C_1 19 to 45 inches, light olive-gray (5Y 6/2) very firm, gritty silty clay; has common to many brownish-yellow (10YR 6/8) mottles; massive to weak coarse angular blocky structure.

Shelby-Adair complex, 5 to 13 percent slopes (Sa).—The A_1 horizons of these soils range from 6 to 10 inches in thickness. The Adair soils are more extensive than the Shelby in this mapping unit. Because of the predominance of the Adair soils, the areas are likely to be seepy during wet seasons. To provide adequate drainage, contour rows should be laid out on a slight slope. If corn is grown, the rotation should include a high proportion of meadow.

Shelby-Adair complex, 5 to 13 percent slopes, severely eroded (Sb).—Much of the surface layer of these soils has been removed through erosion. The A_1 horizons range from 2 to 4 inches in thickness. The Adair soils are more extensive in this mapping unit than the Shelby soils.

These soils are best used for pasture or for growing trees. If corn is grown, erosion must be controlled and the rotation should include a high proportion of meadow.

Shelby-Adair complex, 13 to 20 percent slopes (Sc).—The A_1 horizons of the soils in this complex are 4 to 8 inches thick. The Shelby and Adair soils occur in about equal proportions. Because of the strong slopes, these soils are not well suited to corn. If they are cultivated, runoff is rapid and erosion is a serious problem. The soils are best used for permanent pasture.

Shelby-Adair complex, 13 to 20 percent slopes, severely eroded (Sd).—The use of these soils for corn has caused them to be severely eroded. The A_1 horizon is now only 2 to 6 inches thick. This soil complex is made up of about equal proportions of Adair and Shelby soils. It is best suited to permanent pasture or timber.

Shelby-Adair complex, 20 to 30 percent slopes (Se).—The A_1 horizons of the soils in this mapping unit are 4 to 8 inches thick. The Shelby soils are more extensive than the Adair soils.

These soils occur on steep slopes and are best kept in permanent pasture or timber. Severe erosion will result even if corn is grown only occasionally. If the surface soil is removed, it is difficult to establish a good stand of grass. Therefore, pastures should be renovated without growing an intervening corn crop.

Shelby-Adair complex, 20 to 30 percent slopes, severely eroded (Sf).—The soils of this complex have lost most of the surface soil through erosion. The A_1 horizons are only 2 to 4 inches thick. The Shelby soils are more extensive than the Adair soils. Because they are steep, these soils are best used for permanent pasture or timber.

Wabash Series

The soils of the Wabash series are dark colored and are poorly drained. They have a thick, dark-colored A_1 layer that is high in organic matter. These soils have developed on nearly level bottom lands from fine-textured alluvial sediments. They lie next to areas of Nodaway and Humeston soils. In this county the Wabash soils are mapped as a part of the Olmitz-Gravity-Wabash complex, and Wabash silty clay is mapped separately.

Profile description of Wabash silty clay:

A_{11} 0 to 6 inches, very dark gray (10YR 3/1) firm, light silty clay; weak to moderate coarse subangular blocky structure.

A_{12} 6 to 12 inches, very dark gray (2.5Y 3/0) firm, light silty clay; moderate coarse subangular blocky structure.

A_b 12 to 19 inches, black (10YR 2/1) firm, light silty clay with a few dark-brown (7.5YR 3/4) mottles; very dark brown (10YR 2/2) when crushed; moderate medium subangular blocky structure.

A_b 19 to 40 inches, black (2.5Y 2/0) firm to very firm, medium silty clay; moderate medium subangular blocky structure.

Variations.—The texture of the A_{11} horizon (layer of overwash) ranges from light silty clay to heavy silty clay loam. In some areas the surface layer consists of recent overwash of silt loam that is 6 to 12 inches thick. This overwash is similar in color and texture to the material in the upper part of the Nodaway soil.

Wabash silty clay (Wa).—This soil of the bottom lands is poorly drained. It occupies approximately 1.8 percent of the county.

The profile of this soil is the same as that described for the Wabash series. This soil is subject to flooding, and some areas remain wet most of the summer. Surface drainage and internal drainage are slow. Water moves very slowly through the fine-textured subsoil.

Use and management.—Wetness is the principal management problem on this soil. The areas that remain wet during most of the summer are best used for pasture. The better drained areas are fairly well suited to corn, and on these areas soybeans will produce moderately good yields. A rotation that includes a high proportion of row crops can be used on the better drained areas.

This soil is difficult to till properly because of the fine-textured plow layer. To maintain good tilth, farmers need to cultivate when the soil is not too wet. Tile drains do not work well; surface ditches aid in removing the excess water.

Weller Series

The soils of the Weller series are light colored and are moderately well drained. They have a silty A_1 horizon, a silty A_2 horizon if uneroded, and a clayey, slowly permeable subsoil. The soils have developed under forest. Their parent material was loess. They occur in uplands and on loess-covered benches. Only one soil of this series, Weller silt loam, 2 to 8 percent slopes, is mapped in this county.

Profile description of Weller silt loam:

A_1 0 to 4 inches, dark-gray (10YR 4/1) very friable, light silt loam; moderately weak thin platy structure.

A_2 4 to 7 inches, dark-brown to brown (10YR 4/3) very friable, light silt loam; common light olive-gray (5Y 6/2) and a few dark-gray (10YR 4/1) mottles; moderate thin platy structure.

B_1 7 to 15 inches, dark-brown to brown (10YR 4/3) firm, heavy silty clay loam with a few dark-gray (10YR 4/1) mottles; has a few light brownish-gray (2.5Y 6/2) coatings on peds; moderate fine subangular blocky structure.

B_2 15 to 23 inches, yellowish-brown (10YR 5/4) firm to very firm, medium silty clay; has a few light brownish-gray (2.5Y 6/2) coatings on peds; moderate fine subangular blocky structure.

B_3 23 to 34 inches, yellowish-brown (10YR 5/6), firm, heavy silty clay loam; many light brownish-gray (2.5Y 6/2) mottles; massive (structureless).

C_1 34 to 50 inches, yellowish-brown (10YR 5/6) slightly firm, light silty clay loam; common light brownish-gray (2.5Y 6/2) mottles; massive (structureless).

Variations.—The A_1 horizon ranges from dark gray to dark grayish brown in color and from 2 to 8 inches in thickness. In many cultivated areas the A_1 horizon in many places is mixed with the A_2 horizon; the color of this mixed layer ranges from light brownish gray to dark grayish brown. The content of clay in the B horizons ranges from about 45 to 50 percent. The areas of this soil in the northern part of the county are generally less well developed and contain less clay in the B horizons than the areas in the southern part. The thickness of the layer of loess that overlies the glacial till ranges from 2 to 10 feet, but it is generally between 2 and 7 feet.

Weller silt loam, 2 to 8 percent slopes (Wb).—This moderately well drained soil occurs on undulating to gently rolling uplands and on loess-covered benches. It is in the same general areas as the Beckwith and Lindley soils. Many of the areas are small and occur within larger areas of steeply sloping Lindley soils. This soil occupies about 4.6 percent of the county.

The profile of this soil is the same as that described for the Weller series. The A_1 horizon is thin and light colored and is low in organic matter. The subsoil is slowly permeable. During heavy rains much of the water runs off the soil instead of penetrating. The soil is therefore subject to severe sheet erosion.

Use and management.—Many of the small areas of this soil, within larger areas of steeply sloping Lindley soils, are under forest. On the cultivated areas, grain crops produce moderate yields, but the yields are considerably lower than those on the Grundy soil. Fair yields of corn are obtained by using a rotation that consists of 1 year each of corn, oats, and meadow; employing adequate measures to control erosion; and applying lime and a complete fertilizer.

Formation and Classification of Soils

This section has three main parts. The first describes how the main factors of soil formation have acted to form the soils of the county. The second gives physical and chemical data for some of the soils. The third shows how soil series are classified by great soil groups and gives profile descriptions of typical soils of each group.

Factors of Soil Formation

The soils of Lucas County vary widely in physical and chemical properties and in productivity. The characteristics of the soil at any given point depend on the interaction of the following factors of soil formation: (1) The physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life in and on the soil, (4) the topography, or lay of the land, and (5) the length of time the forces of development have acted on the material. The way in which each of these factors of soil formation has caused differences in the soils is explained in the following pages.

Parent material

The soils of Lucas County have formed from (1) glacial till (ice-laid material); (2) loess (windblown material); (3) shale (residual material); and (4) alluvium (water-laid material). In table 6 the soil series of the county are arranged alphabetically and their parent material—glacial till, loess, shale, or alluvium—is indicated.

TABLE 6.—*Parent material, slope range, and native vegetation of the soils*

Soil series	Parent material	Slope range	Native vegetation
		Percent	
Adair	Glacial till	5 to 30	Prairie.
Beckwith	Loess	0 to 2	Trees.
Belinda	Loess	0 to 2	Prairie and trees.
Coppock	Alluvium	0 to 1	Prairie and trees.[1]
Edina	Loess	0 to 2	Prairie.
Gosport	Shale	13 to 30	Trees.
Gravity	Alluvium	2 to 8	Prairie.
Grundy	Loess	2 to 7	Prairie.
Haig	Loess	0 to 2	Prairie.
Humeston	Alluvium	0 to 1	Prairie and trees.[1]
Lindley	Glacial till	7 to 30	Trees.
Nodaway	Alluvium	0 to 1	Prairie and trees.[1]
Olmitz	Alluvium	2 to 8	Prairie.
Pershing	Loess	2 to 7	Prairie and trees.
Shelby	Glacial till	5 to 30	Prairie.
Wabash	Alluvium	0 to 1	Prairie.
Weller	Loess	2 to 8	Trees.

[1] Influenced mainly by prairie.

Glacial till material.—Four glaciers left deposits of till in Iowa (*3*, *4*). The glacial till in Lucas County is from the two oldest glaciers, the Nebraskan and Kansan. The Nebraskan was the first glacier to cover the county. The deposits left by this glacier were later covered by till deposited by the Kansan glacier. These two periods of glaciation occurred many thousands of years ago.

After till was deposited by the Kansan glacier, soils began to develop and have continued to develop over thousands of years. Drainageways became established, and areas along the major streams became dissected severely. The areas farther back from the tributaries did not erode; these areas now form the nearly level divides that separate the major streams. On these undissected areas, gumbotil (*3*) soils formed. No gumbotil soils have formed in the strongly dissected areas.

Loess.—This material consists of windblown silt that was deposited long after the Kansan glacier covered Iowa. In Lucas County the deposits of loess came chiefly from the broad bottoms of the Missouri River, though some came from central Iowa. When the Wisconsin glacier was melting in northern Iowa and Minnesota, the melt water, with its load of fine material, flowed partly into the Missouri River, and large, bare, mud flats were formed. Whenever cold weather checked the melting of the ice, the mud flats dried out and strong winds from the northwest blew the loess over the uplands.

The layer of loess is as much as 100 feet thick near the Missouri River, but it gradually becomes thinner as it extends in a southeasterly direction away from the river. Consequently, the loess in the northwestern part of the county, nearer the Missouri River, is slightly thicker than that in the southeastern part. On most of the slopes of more than 5 to 7 percent, the loess is thin or lacking and the glacial till is exposed. On the more nearly level divides, the layer of loess is about 100 inches thick. The loess contains no grit or pebbles, but the underlying glacial till contains a large amount.

The soils formed from loess vary widely in characteristics and in productivity. Soils close to the bottom lands of the Missouri River, near the source of the loess, are well aerated and well drained. Soils farther away, as the Grundy and other Lucas County soils derived from loess, have a fine-textured subsoil that is slowly permeable. They are not so well suited to crops as the soils nearer the source of the loess. Variations in soils related to the distance from the source of loess have been reported by Hutton (*2*), Godfrey (*1*), and Ulrich.[4] They have also been reported by Swenson.[5]

Shale.—Before the glaciers covered Iowa, shale, limestone, and sandstone were exposed on the surface. Most of these materials were later covered by glacial till. In some areas geologic erosion has removed the till and re-exposed the residual material. Shale is exposed in a few areas, mostly in the northeastern part of the county. The Gosport are the only soils in the county that have developed from shale.

Alluvium.—The soils of the bottom lands have formed from alluvium. The sediments that settled from the water that moved rather rapidly as it ran off the soil consisted mainly of friable, silty materials. The Nodaway soil has developed from this material, and the Gravity and Olmitz soils have developed from similar material that was deposited earlier. In areas of slack water, where the water moved slowly, finer textured materials settled out and soils similar to the Wabash, which have a clayey surface soil and subsoil, have developed.

Climate

Climate is an important factor in the formation of soils. The climate has been uniform throughout the county, however, and therefore it has not been responsible for differences among the soils. The soils of the county differ considerably from the soils formed in the relatively dry climate of the northern States of the Great Plains and from soils formed in the humid climate of the southeastern States. They are not so leached of plant nutrients as the soils in areas that receive a greater amount of rainfall.

Living organisms

Plants have been an important influence in the development of the soils of Lucas County. Animals have influenced the soils to a lesser extent. Originally, forests covered most of the more dissected, sloping areas, and prairie grasses covered the nearly level uplands. In areas between these two zones, as in areas of Belinda and Pershing soils, trees encroached on the native prairie grasses. (See table 6 to find the kind of native vegetation under which the soils have formed.)

Topography

The development of soils is influenced by variations in the degree of slope. In areas that are nearly level, much of the water percolates down through the soil. In sloping soils more of the water runs off. As a result the nearly level soils of the uplands—the Beckwith, Belinda and Edina—generally have a greater degree of differentiation in their profiles than the Weller, Shelby, and Grundy soils of the more sloping uplands. The subsoil of the Edina and Beckwith soils is olive gray and is strongly mottled in contrast to the yellowish-brown subsoil of the more sloping Weller soil and soils of the Shelby-Adair complex.

Time

Time is an important factor in the formation of soils. Some of the soils in this county have been developing since the time of the Nebraskan and Kansan glaciers. Others are just beginning to form; Nodaway silt loam, for example, is developing from alluvium that has been deposited recently, mostly since the county was settled. The soils derived from loess began to develop during the Wisconsin age.

The Lindley and Shelby soils vary considerably in age. A study made by Prill [6] shows that some of the Lindley soils of this county are similar in characteristics to other Gray-Brown Podzolic soils developed on till of Late Wisconsin age in north-central Iowa. Other Lindley soils are much older and apparently began to develop during the pre-Wisconsin age. Figure 9 shows how Lindley soils of the Wisconsin age and Lindley soils of the pre-Wisconsin age occur on a typical landscape in Lucas County. The Lindley soils of the pre-Wisconsin age have a much redder and finer textured B horizon than the Lindley soils of Wisconsin age and occur on the slopes above the Lindley soils of the Wisconsin age. In many

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[4] ULRICH, RUDOLPH. SOME PHYSICAL AND CHEMICAL PROPERTIES OF PLANOSOL AND WEISENBODEN SOIL SERIES AS RELATED TO LOESS THICKNESS AND DISTRIBUTION. [Doctor's thesis, Iowa State College.] 1949.

[5] SWENSON, R. M. MOVEMENT OF IRON, MANGANESE, AND TITANIUM IN THE DEVELOPMENT OF LOESS-DERIVED PRAIRIE SOILS. [Doctor's thesis, Iowa State College.] 1951.

[6] PRILL, R. C. VARIATIONS IN FOREST-DERIVED SOILS FORMED FROM KANSAN TILL. [Doctor's thesis, Iowa State College.] 1955.

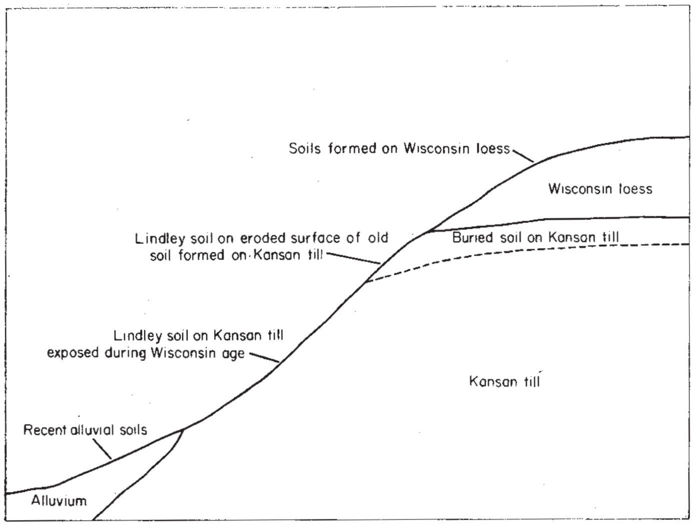

Figure 9.—**Lindley soils of the pre-Wisconsin age and Lindley soils of the Wisconsin age as they occur on a typical landscape.**

places only the soils of the Wisconsin age are exposed on the landscape, and the soils of the pre-Wisconsin age are covered by loess.

The soils of the Shelby-Adair complex also differ in age. The Adair soils, which have been developing over a much longer period of time, are considered to be Late Sangamon paleosols, but the younger Shelby soils are believed to have originated in the Late Wisconsin and Recent ages (*5*).

In elevation the Adair soils are intermediate between the higher lying soils derived from loess and the lower lying Shelby soils. They once were covered completely with loess, but in many areas the loess has been removed. On slopes that have been stripped of their mantle of loess and their paleosol through geologic erosion leaving relatively unweathered till of the Kansan age, Shelby soils have formed.

Formation of the Soils

The influence of the five factors of soil formation—parent material, climate, living organisms, topography, and time—varies from place to place. In one place parent material may be the dominating factor; in another, relief or climate may be more important. In Lucas County the action of the five factors has been such that the following results are evident (*6, 7*):

(1) Bases have leached out of the soils, and the solum (generally the A and B horizons) has become acid.
(2) Clay, most of which has a high exchange capacity and is of a montmorillonite-illite type, has formed.
(3) Clay has accumulated in the B horizon by moving down from the A horizon, by in-place formation, or by both processes.
(4) Organic matter has accumulated in the surface layer, or A horizon.

Leaching and the accumulation of clay in the B horizon are evident in soils formed from silty and loamy materials, as loess and till. They are also more evident in the older soils or in soils that have been influenced by a fluctuating water table than in other soils. In areas where the water table fluctuates, more water has filtered through the soil than in areas where the water table is fairly constant. This has caused a greater degree of leaching and the downward movement of clay. In the section, Laboratory Determinations, the results of physical and chemical analyses are given for samples of seven soils that occur in this county. The figures for pH and for base saturation indicate that there has been considerable leaching of bases and that the solum in all of these soils has therefore become acid.

A large percentage of clay in the subsoil, generally at depths between 15 and 30 inches, indicates that the soil has undergone considerable development. The Haig, Edina, Grundy, Pershing, and Weller soils all have considerable clay in the subsoil and all have well-developed profiles; that is, the original material from which these soils have formed has been altered extensively. Figures giving the percentage of clay in samples of Haig silty clay loam, Edina silt loam, Grundy silty clay loam, Pershing silt loam, and Weller silt loam are shown in tables 8 and 9. For each of these soils, compare the percentage of clay in the C horizon (parent material) with that in the subsoil, or B layer. The large amount of clay in the B horizon indicates that each of these soils has undergone considerable development.

The amount of clay in the B horizon also affects permeability and so is an important factor in using and managing the soils. In this county the slow permeability of the subsoil is a problem in all of the soils derived from loess, but it is a greater problem in the Edina and Beckwith soils than in the Grundy and Haig soils. In the five soils listed in tables 8 and 9, the content of clay in the subsoil ranges from 45.8 percent in the Grundy soil to 54.6 percent in the Edina. The Tama and Marshall soils, which are not mapped in this county but which occur in other counties in Iowa, have a moderately permeable subsoil, and the content of clay ranges from 30 to 35 percent.

The amount of organic matter in the surface layer, or A horizon, is determined by the action of the factors of soil formation and is important in using and managing the soils. In the Haig soil and in other soils developed under prairie, the surface layer is thick and has a fairly high content of organic matter and nitrogen. In the Weller and other soils developed under forest, the surface layer is thin and contains little organic matter.

Laboratory Determinations

Physical and chemical data for some of the soils of the county are shown in tables 7, 8, and 9.

The percentage of carbon in the soils listed on tables 8 and 9 was determined by the gravimetric dry-combustion procedure, and the percentage of nitrogen was determined by a modified Kjeldahl procedure. The analyses of the percentage of free iron, as shown on tables 7 and 8, was made as follows: Iron was reduced to ferrous form in an oxalic acid-potassium oxalate buffered solution with magnesium ribbon; the percentage of iron was determined by the colorimetric orthophenanthroline method using an Evelyn colorimeter.

For all the soils studied, the following laboratory procedures were used: (1) Mechanical analyses of sand, silt, and clay were made by the pipette method using hydrogen peroxide to destroy the organic matter and sodium hexametaphosphate as a dispersing agent; (2) the pH was determined by the glass electrode method; (3) the

TABLE 7.—*Physical and chemical data on two Lindley soils*

Soil, profile number, and horizons	Depth	Sand (more than 0.05 mm.)	Coarse silt (0.05–0.02 mm.)	Fine silt (0.02–0.002 mm.)	Clay (less than 0.002 mm.)	pH	Exchangeable cations in m. e. per 100 gm.			Free iron
							Ca	Mg	H	
	Inches	*Percent*	*Percent*	*Percent*	*Percent*					*Percent*
Lindley-Variation A(P–459):										
A_1	0–6	52. 6	18. 3	15. 3	13. 8	5. 8	7. 0	1. 4	3. 8	0. 88
A_3	6–10	52. 4	16. 8	16. 4	14. 4	5. 9	6. 4	1. 4	3. 3	. 90
B_1	10–15	45. 8	16. 5	17. 5	20. 2	5. 6	5. 8	1. 8	3. 0	1. 17
B_{21}	15–19	34. 8	15. 9	20. 5	28. 8	4. 8	6. 5	2. 0	5. 1	1. 61
B_{22}	19–24	33. 2	14. 8	19. 2	32. 8	4. 9	7. 1	2. 2	6. 6	1. 77
B_{23}	24–29	32. 8	14. 0	16. 7	36. 5	4. 8	8. 9	2. 3	6. 8	1. 80
B_3	29–39	31. 5	12. 8	18. 0	37. 7	4. 7	--------	--------	--------	1. 85
C_1	39–47	34. 7	13. 2	16. 5	35. 6	5. 7	12. 3	2. 7	3. 1	1. 98
C_2	47–60	35. 7	13. 9	18. 8	31. 6	5. 7	--------	--------	--------	1. 98
Lindley-Variation B (P–532):										
A_1	0–4	28. 5	24. 8	22. 3	24. 4	5. 4	8. 4	2. 2	6. 7	. 97
B_{11}	4–8	28. 9	18. 2	21. 7	31. 2	4. 8	4. 2	2. 7	10. 1	1. 24
B_{12}	8–12	31. 5	13. 8	17. 0	37. 7	4. 7	5. 9	4. 6	9. 4	1. 55
B_{21}	12–16	27. 6	10. 5	13. 4	48. 5	5. 1	10. 1	8. 3	7. 4	1. 73
B_{22}	16–21	27. 1	8. 3	13. 9	50. 7	5. 3	12. 9	10. 3	5. 6	2. 44
B_{23}	21–27	28. 2	10. 1	15. 7	46. 0	5. 5	--------	--------	--------	2. 10
B_{31}	27–34	32. 5	11. 2	16. 6	39. 7	5. 8	--------	--------	--------	2. 00
B_{32}	34–42	31. 9	11. 8	17. 8	38. 5	6. 2	--------	--------	--------	1. 06
C_1	42–50	33. 3	12. 5	18. 2	36. 0	6. 3	13. 7	6. 6	1. 6	1. 10

TABLE 8.—*Physical and chemical data on Grundy, Pershing, and Weller soils*

Soil and profile number	Depth	Sand (more than 0.05 mm.)	Clay (less than 0.002 mm.)	pH	Exchangeable cations in m. e. per 100 gm.			Free iron	Total N	Carbon
					Ca	Mg	H			
	Inches	*Percent*	*Percent*					*Percent*	*Percent*	*Percent*
Grundy silty clay loam, 2 to 7 percent slopes (P–3).	0–4	--------	33. 6	4. 6	13. 8	5. 8	9. 5	1. 07	0. 228	2. 73
	4–7	--------	33. 6	4. 7	--------	--------	--------	--------	. 200	2. 35
	7–10	--------	36. 0	4. 8	14. 9	6. 4	8. 1	1. 12	. 191	2. 24
	10–13	--------	36. 7	4. 7	--------	--------	--------	--------	. 150	1. 72
	13–16	--------	42. 2	--------	14. 9	8. 5	6. 6	1. 20	--------	1. 30
	16–19	--------	43. 7	4. 8	15. 7	9. 7	--------	--------	. 093	. 99
	19–22	--------	45. 3	5. 0	--------	--------	4. 8	1. 38	--------	. 74
	22–25	--------	45. 8	5. 3	18. 9	11. 1	--------	--------	. 068	. 54
	25–28	--------	42. 5	5. 6	19. 2	11. 0	2. 9	. 99	--------	. 37
	28–30	--------	39. 4	5. 8	--------	--------	--------	--------	. 045	. 33
	30–33	--------	38. 2	5. 9	17. 8	10. 9	1. 9	. 65	--------	. 23
	33–36	--------	35. 5	6. 0	--------	--------	--------	--------	. 032	. 21
	36–39	--------	33. 4	6. 1	--------	--------	--------	. 36	--------	. 17
	39–42	--------	31. 0	6. 1	--------	--------	1. 6	--------	--------	. 17
	42–45	--------	31. 1	6. 2	16. 3	11. 0	1. 4	. 23	. 028	. 11
	45–48	--------	30. 8	6. 2	--------	--------	1. 4	--------	--------	. 11
	48–51	--------	26. 6	6. 3	--------	--------	--------	. 58	--------	. 10
	51–54	--------	24. 7	6. 3	15. 7	9. 4	--------	--------	--------	. 11
Pershing silt loam, 2 to 7 percent slopes (P–429).	0–3	2. 8	24. 3	6. 1	15. 5	3. 8	5. 0	. 97	. 278	3. 28
	3–6	3. 0	24. 3	6. 1	12. 1	3. 6	4. 5	1. 05	. 174	2. 05
	6–9	3. 0	25. 8	5. 7	8. 8	3. 9	4. 9	1. 16	. 098	1. 16
	9–12	2. 6	28. 2	5. 2	8. 4	4. 8	5. 3	1. 27	. 073	. 80
	12–15	2. 0	34. 6	4. 9	9. 3	6. 6	6. 7	1. 33	. 067	. 66
	15–18	1. 2	46. 0	4. 7	12. 8	9. 7	8. 3	1. 62	. 070	. 66
	18–22	1. 1	48. 5	4. 8	14. 4	11. 6	8. 0	1. 58	. 067	. 57
	22–26	1. 2	45. 8	4. 9	14. 5	11. 5	7. 1	1. 46	. 051	. 52
	26–30	1. 4	44. 6	5. 1	14. 8	11. 8	6. 0	1. 41	. 046	. 46
	30–34	1. 4	41. 5	5. 2	14. 8	11. 5	4. 5	1. 36	. 042	. 40
	34–40	1. 6	37. 5	5. 4	14. 7	11. 1	3. 2	1. 37	. 040	. 31
	40–46	1. 3	36. 5	5. 8	14. 6	11. 1	2. 4	1. 25	. 036	. 24
	46–52	1. 6	34. 2	6. 0	13. 8	10. 4	1. 9	1. 14	. 028	. 19
	52–58	1. 9	33. 2	6. 2	13. 8	10. 2	1. 7	1. 17	. 023	. 17

TABLE 8.—*Physical and chemical data on Grundy, Pershing, and Weller soils*—Continued

Soil and profile number	Depth	Sand (more than 0.05 mm.)	Clay (less than 0.002 mm.)	pH	Exchangeable cations in m. e. per 100 gm.			Free iron	Total N	Carbon
					Ca	Mg	H			
	Inches	*Percent*	*Percent*					*Percent*	*Percent*	*Percent*
Weller silt loam, 2 to 8 percent slopes (P-4).	0-1.5	3.3	20.0	4.8	8.3	3.1	4.5	.75	.261	3.72
	1.5-4	-	-	4.3	4.3	2.3	4.5	-	.102	1.16
	4-6	2.6	21.3	4.3	-	-	4.6	-	-	.68
	6-8	1.7	24.3	4.1	2.4	3.0	5.7	.98	.055	.52
	8-10	1.7	27.8	3.9	-	-	8.3	-	-	.46
	10-13	1.7	31.6	3.8	2.5	4.1	10.7	1.26	-	.42
	13-16	1.5	34.2	3.75	-	-	12.3	-	-	.43
	16-19	1.6	35.4	3.75	3.7	5.3	13.8	1.37	-	.36
	19-22	1.4	40.9	3.8	-	-	15.0	-	-	.37
	22-25	1.2	47.3	3.9	7.2	8.7	-	1.46	-	.31
	25-28	1.2	46.7	3.8	-	-	15.7	-	-	.32
	28-31	1.1	44.3	3.9	-	-	14.0	-	.033	.27
	31-34	1.4	42.7	4.0	8.7	9.5	12.6	1.28	-	.28
	34-37	1.7	39.3	4.0	-	-	-	-	-	.27
	37-40	1.4	35.8	4.1	9.2	9.4	9.3	1.13	-	.21
	40-43	1.3	35.1	4.2	-	-	-	-	-	.21
	43-46	1.3	34.2	4.3	10.5	10.2	7.2	1.08	-	.21
	46-49	1.5	34.3	4.5	-	-	-	-	.258	.21
	49-52	1.7	33.6	4.7	12.0	10.8	-	.99	-	.19
	52-55	1.6	32.7	4.8	-	-	-	-	-	.19
	55-58	1.6	31.7	5.1	12.6	10.5	4.0	1.06	-	.17

TABLE 9.—*Physical and chemical data on Haig and Edina soils*

Soil, profile number, and horizons	Depth	Sand (more than 0.05 mm.)	Coarse silt (0.05–0.02 mm.)	Fine silt (0.02–0.002 mm.)	Clay (less than 0.002 mm.)	Aeration porosity	Capillary porosity	pH	Exchangeable cations in m. e. per 100 gm.			Total N	Organic carbon
									Ca	Mg	H		
Haig silty clay loam (P-220):	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*					*Percent*	*Percent*
A_{11}	0-7	5.3	30.4	38.9	25.4	17.55	44.77	5.6	15.4	4.7	5.7	0.205	2.71
A_{12}	7-10	4.7	29.5	39.4	26.4	17.52	43.44	5.2	-	-	-	-	-
A_3	10-14	5.9	27.6	39.4	27.1	-	-	5.3	13.8	4.7	6.5	.161	2.24
A_3B_1	14-18	6.3	22.9	37.6	33.2			5.3	-	-	-	-	-
B_1	18-22	5.1	19.6	34.6	40.7	11.40	40.71	5.5	18.1	8.9	4.4	.094	1.26
B_{21}	22-26	2.1	20.0	28.4	49.5	1.70	47.96	5.4	-	-	-	-	-
B_{22}	26-30	2.5	19.2	29.1	49.2	.66	49.82	5.6	23.2	12.3	2.7	.061	.63
B_{31}	30-34	3.1	21.2	31.5	44.2	1.58	47.35	6.0	-	-	-	-	-
B_{32}	34-40	3.1	22.7	32.2	42.0	-	-	6.1	-	-	-	-	-
C_{11}	40-46	2.1	23.7	35.0	39.2	3.01	43.14	6.3	20.6	10.9	1.6	.034	.22
C_{12}	46-52	2.2	25.4	36.0	36.4	-	-	6.4	-	-	-	-	-
C_2	52-60	2.9	27.4	36.8	32.9	-	-	-	-	-	-	-	-
Edina silt loam (P-223):													
A_{11}	0-6	3.5	31.1	43.8	21.6	11.76	44.12	5.1	10.1	2.9	5.3	.177	1.94
A_{12}	6-10	2.3	31.7	44.6	21.4	-	-	5.2	-	-	-	-	-
A_2	10-15	3.2	29.6	43.4	23.8	6.91	42.32	5.3	9.0	3.5	3.9	.097	1.08
A_2B_1	15-19	3.9	28.0	42.4	25.7	-	-	5.4	-	-	-	-	-
B_1	19-24	1.8	21.4	33.2	43.6	5.09	44.13	5.4	15.6	8.2	5.5	.084	.98
B_{21}	24-29	1.1	17.2	27.1	54.6	-	-	5.5	-	-	-	.082	.97
B_{22}	29-34	2.5	17.6	28.5	51.4	.94	52.69	5.7	21.3	11.7	5.2	-	-
B_3	34-40	2.9	18.6	30.2	48.3	-	-	6.0	-	-	-	-	-
C_1	40-46	4.2	21.5	32.9	41.4	.14	45.88	6.1	19.2	9.6	1.8	.043	.35

exchangeable calcium was determined volumetrically by a permanganate titration of the oxalate; (4) the exchangeable magnesium was precipitated as ammonium phosphate and was determined volumetrically by using a standard acid and a base; and (5) the exchangeable hydrogen was determined by the barium acetate method.

The laboratory data were obtained by R. C. Prill (see footnote 6) for the Lindley soils listed on table 7, by Everett White (*8*) for the Grundy, Pershing, and Weller soils listed on table 8, and by Rudolph Ulrich (see footnote 4) for the Haig and Edina soils listed on table 9.

Classification of Soils by Great Soil Groups

The lower categories of soil classification—phases, types, and series—are explained in the section, How Soils

Are Mapped and Described. Briefly, a soil type consists of one or more phases and a soil series of one or more soil types. Soil types or phases are the units shown on the detailed soil map.

Soil series are classified into a broader category, the great soil group. Each great soil group is made up of soils that have certain internal characteristics in common. In this section the soil series are classified by great soil groups and each group is discussed. Except for the Alluvial soils, each great soil group has an illustration (see figs. 10, 11, 12, and 13) showing a typical profile of a soil that is in the group. The following lists the soil series of this county and the great soil group to which each belongs:

Soil series	*Great soil group*
Gosport, Lindley, Weller	Gray-Brown Podzolic soil.
Pershing	Gray-Brown Podzolic-Brunizem intergrade.
Adair, Gravity, Grundy, Olmitz, Shelby	Brunizem.
Beckwith, Belinda, Coppock, Edina, Humeston	Planosol.
Haig, Wabash	Wiesenboden.
Nodaway	Alluvial.

Gray-Brown Podzolic soils

This great soil group is made up of soils that have developed under forest. The soils have a light-colored, thin A_1 horizon and a grayish-brown or brownish-gray, leached A_2 horizon. The B_1 horizon is brown and is richer in clay than the A_1 and A_2 horizons.

In Lucas County the soils of the Gosport, Lindley, and Weller series are classified as Gray-Brown Podzolic soils. A profile of Weller silt loam, 2 to 8 percent slopes, is shown in figure 10. In general the Gosport, Lindley, and Weller soils have a brownish-gray, medium-textured A_2 horizon and a brown B horizon, 6 to 10 inches thick. The structure of the B horizon is strong blocky. The Weller soil has developed from loess, the Lindley from till, and the Gosport from shale. These soils make up about 20 percent of the county. Most of them are acid and are fairly low in plant nutrients. Their thin, A_1 horizon is low in organic matter.

The Pershing soil has some characteristics of a Gray-Brown Podzolic soil, but it also has characteristics similar to those of the Brunizems. It has therefore been classified as a Gray-Brown Podzolic-Brunizem intergrade.

Brunizems

The soils of the Brunizem great soil group have developed under tall grasses. Their surface layer is dark colored, but the soil becomes lighter colored with increasing depth.

In this county the Adair, Gravity, Grundy, Olmitz, and Shelby soils are classified as Brunizems. These soils have the dark-colored A_1 horizon typical of the Brunizems. There is a gradual transition from the A to the B horizon, and the B_2 horizon has a dark-brown matrix that is in many places mottled with gray. Clay has accumulated in the B horizon. The Brunizems differ from the Gray-Brown Podzolic soils of Lucas County in that their A_1 horizon is darker and thicker, they lack an A_2 horizon, and their B_2 horizon generally has a weak blocky structure. A profile of Grundy silty clay loam, 2 to 7 percent slopes, is shown in figure 11.

The Brunizems occupy about 40 percent of the county. They occur in nearly level to steeply sloping areas. The Grundy soils have developed from loess, the Shelby and Adair soils from till, and the Olmitz and Gravity soils from alluvium.

Planosols

The Planosols of Lucas County have an eluviated surface horizon underlain by a claypan. They have developed on nearly level to gently sloping uplands.

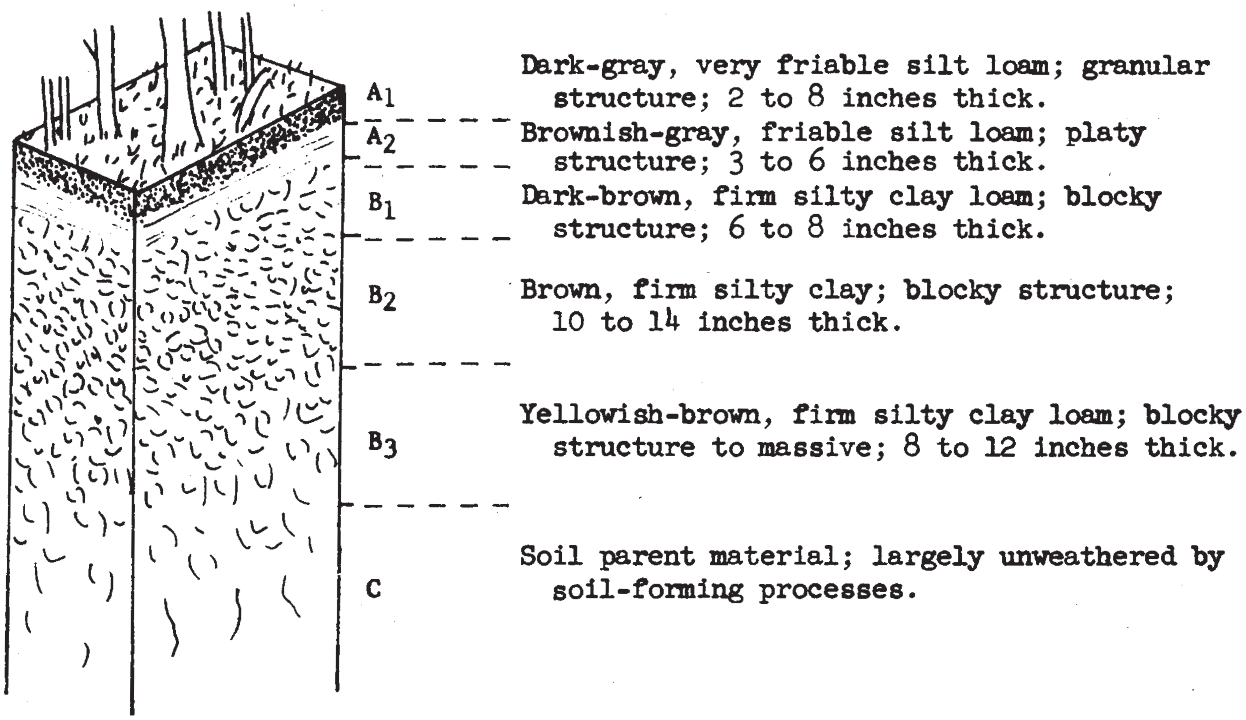

Figure 10.—Profile of Weller silt loam, 2 to 8 percent slopes.

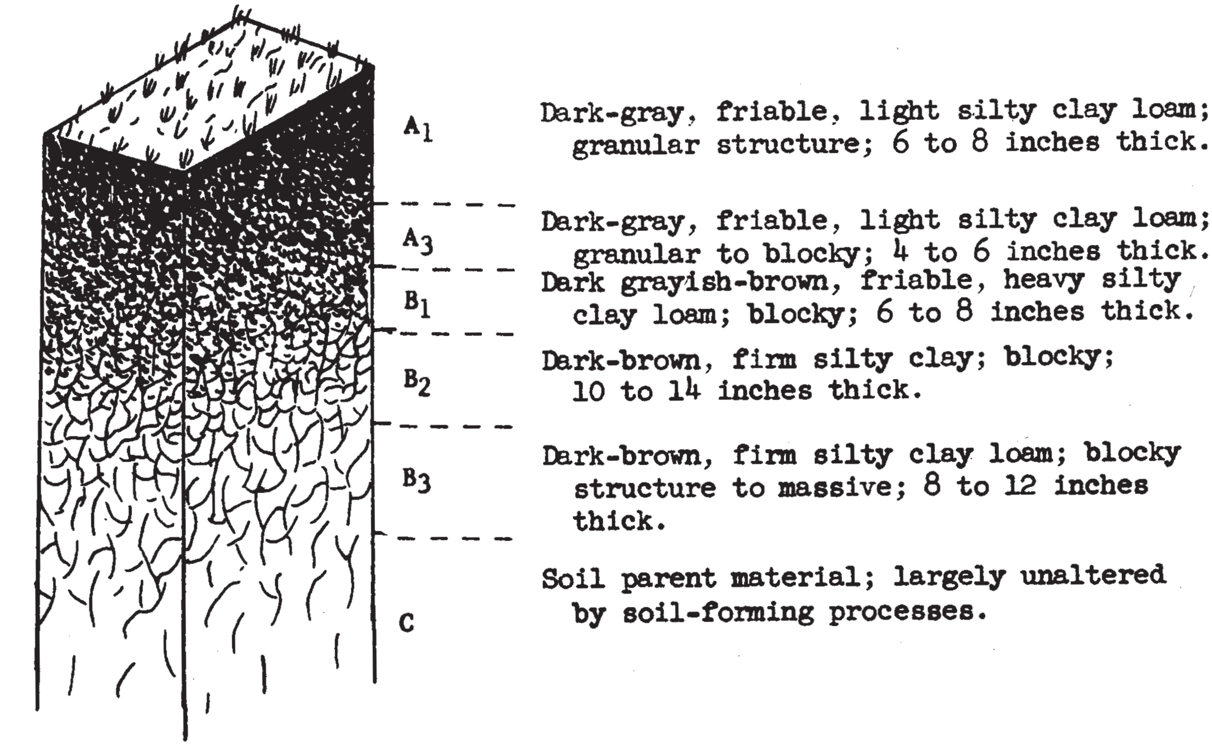

Figure 11.—**Profile of Grundy silty clay loam, 2 to 7 percent slopes.**

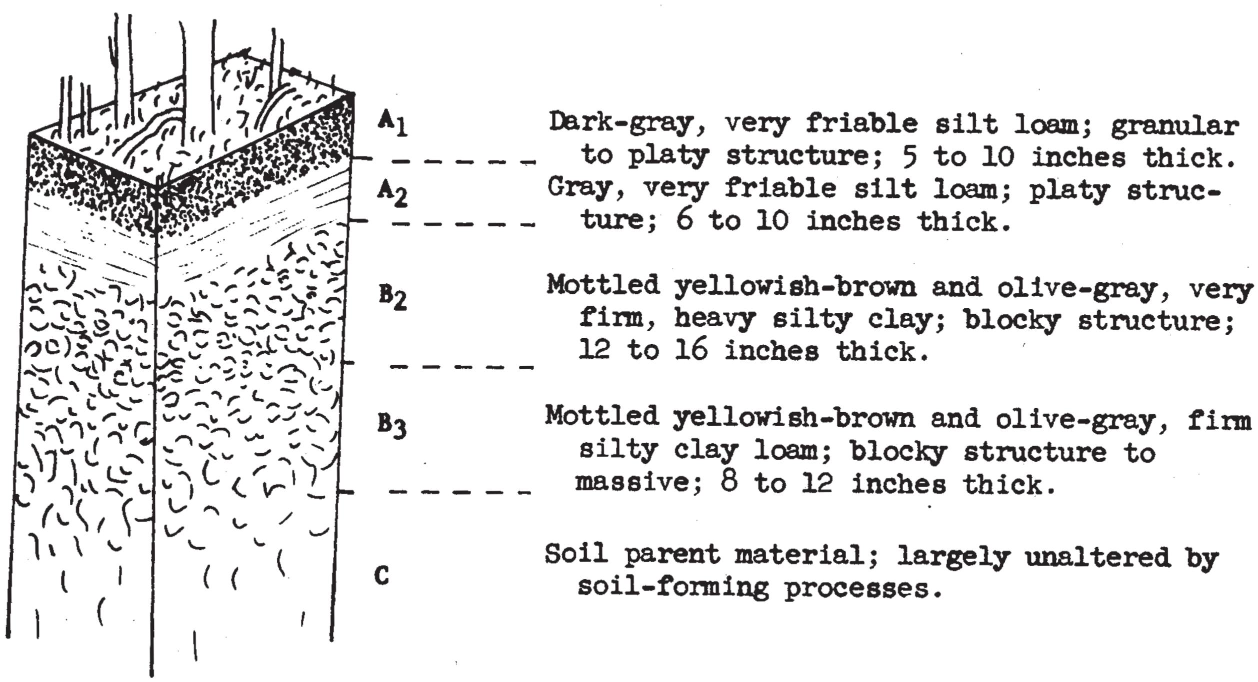

Figure 12.—**Profile of Beckwith silt loam, a Planosol formed under forest.**

In this county the soils of the Beckwith, Belinda, Coppock, Edina, and Humeston series are classified as Planosols. These soils have a medium-textured A_1 horizon and an ashy, gray, medium-textured A_2 horizon. The A_2 horizon has a platy structure. Some of these soils differ from the soils of the other great soil groups in the county in having a firm to very firm, very fine textured B_2 horizon, or pan layer, immediately below the A_2 horizon. The B_2 horizon restricts the movement of water and the penetration of plant roots.

The Beckwith, Belinda, and Edina soils have developed from loess and occur on the nearly level uplands; the Coppock and Humeston soils have developed from alluvium and occupy the bottom lands. The Edina soil

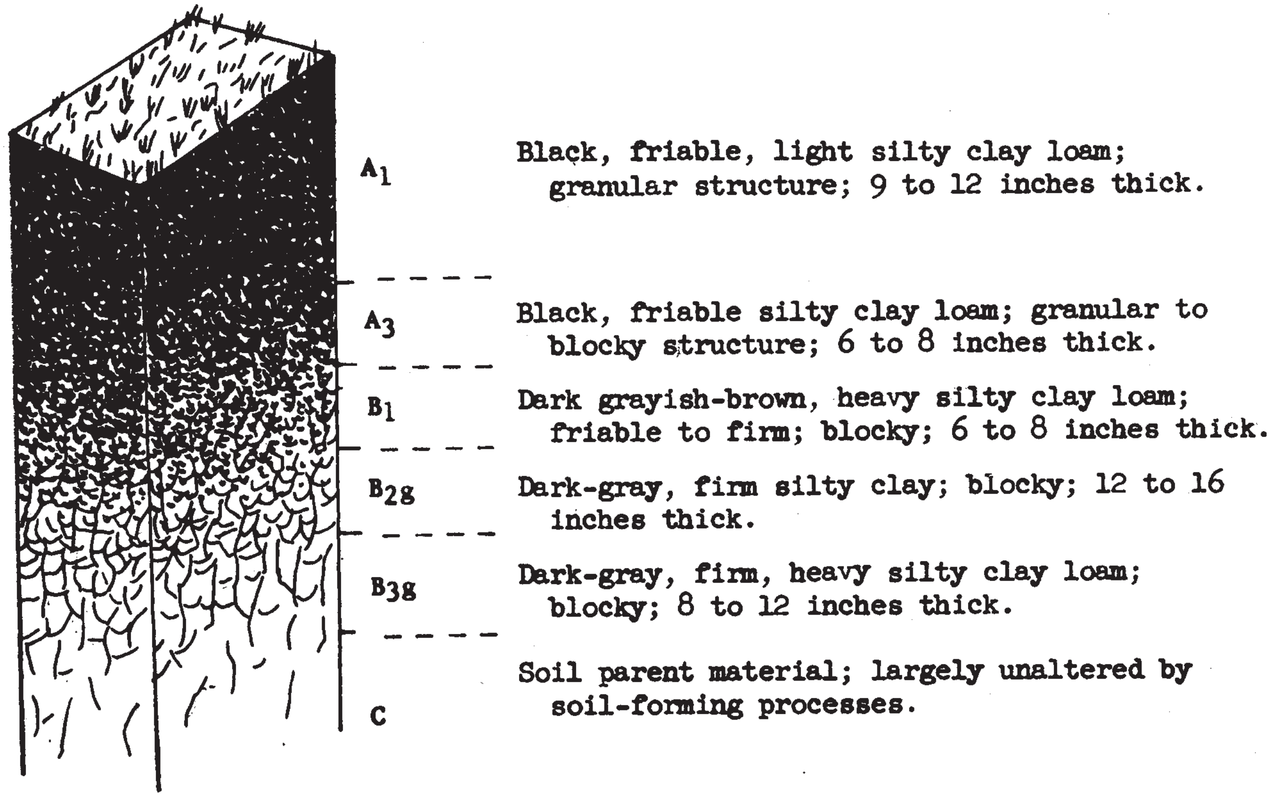

***Figure 13.*—Profile of Haig silty clay loam, a Wiesenboden developed from loess.**

has developed under prairie; the Beckwith, under forest (fig. 12); and the Belinda, Humeston, and Coppock soils, under mixed forest and prairie vegetation. These soils make up less than 2 percent of the county.

Wiesenbodens

The soils of the Wiesenboden great soil group have developed on poorly drained sites under grasses. They have a thick, dark-colored A horizon that is high in organic matter and nitrogen and a dark-gray B horizon. The Wiesenbodens are distinguished from the Brunizems by a thicker A_1 and a darker colored B_2 horizon. In contrast to the Gray-Brown Podzolic soils, the Wiesenbodens have a much thicker, darker colored A_1 horizon, lack an A_2 horizon, and have a darker B horizon. The Wiesenbodens differ from the Planosols in having a thicker A_1 horizon and in lacking an A_2 horizon.

In Lucas County the soils of the Haig and Wabash series are classified as Wiesenbodens. The Haig soil has developed from loess and occurs on the nearly level uplands (fig. 13); the Wabash soils have developed from alluvium and occur on the bottom lands. These soils make up about 10 percent of the county.

Alluvial soils

The soils of this great soil group occupy the flood plains, or first bottoms, of streams and are subject to flooding. They are developing from relatively recent deposits of alluvium and lack the distinct horizons that are evident in the soils of the other great soil groups. Each time they are flooded, they receive fresh deposits of alluvial material. The different soil layers commonly reflect the flood history of the soils.

Nodaway silt loam is the only Alluvial soil in Lucas County. It occupies about 8 percent of the county.

Additional Facts About Lucas County

The following section discusses the organization and population of Lucas County and describes the transportation facilities. It also describes the climate and gives information about agriculture in the county.

Organization and Population

Lucas County was organized in 1846 by an act of the Legislature of the Territory of Iowa. It was named for Robert Lucas, the first Territorial Governor of Iowa.

The population of the county has decreased from 15,114 in 1930 to 12,069 in 1950. In 1950, about 56 percent of the population was classified as rural. Chariton, the county seat, had a population of 5,320 in 1950.

Climate

The normal monthly, seasonal, and annual temperatures and precipitation, as recorded by the United States Weather Bureau Station at Chariton, are given in table 10. In Lucas County the average length of the frost-free season is 161 days, extending from April 29 to October 7. Killing frosts, however, have occurred as late as May 25 and as early as September 14. The growing season is generally long enough for field crops to mature. In some years, however, the soils are wet until late in the season, causing spring planting to be delayed. Then, early fall frosts may damage the corn crop.

TABLE 10.—*Temperature and precipitation at Chariton, Lucas County, Iowa*

[Elevation, 940 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1910)	Wettest year (1902)	Average snowfall
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	27. 0	69	−20	1. 07	0. 40	1. 91	5. 1
January	22. 9	64	−23	1. 05	. 70	. 74	7. 5
February	25. 6	70	−23	1. 04	. 67	1. 15	4. 7
Winter	25. 1	70	−23	3. 16	1. 77	3. 80	17. 3
March	37. 9	86	−15	1. 68	(3)	1. 10	5. 8
April	50. 0	87	8	2. 74	. 42	3. 42	. 2
May	60. 8	104	25	3. 75	5. 07	5. 60	(3)
Spring	49. 5	104	−15	8. 17	5. 49	10. 12	6. 0
June	69. 8	105	34	4. 66	1. 53	7. 19	0
July	75. 4	113	45	3. 61	1. 59	10. 07	0
August	73. 5	114	35	3. 72	. 37	8. 23	0
Summer	72. 9	114	34	11. 99	3. 49	25. 49	0
September	65. 7	102	20	4. 21	3. 02	9. 10	(3)
October	54. 4	94	14	2. 45	(3)	4. 55	. 1
November	40. 0	82	−6	1. 73	(3)	2. 89	1. 9
Fall	53. 3	102	−6	8. 39	3. 02	16. 54	2. 0
Year	50. 2	114	−23	31. 71	13. 77	55. 95	25. 3

[1] Average temperature based on a 61-year record, through 1955; highest temperature on an 18-year record and lowest temperature on a 21-year record, through 1952.
[2] Average precipitation based on a 62-year record, through 1955; wettest and driest years based on a 59-year record, in the period 1879–1955; snowfall, based on a 20-year record, through 1952.
[3] Trace.

Transportation

Lucas County is served by a number of highways and railroads. U. S. Highway No. 34 extends from east to west through the central part of the county, and U. S. Highway No. 65 extends from north to south through the western part. State Highway No. 14 crosses the central part of the county in a north-south direction. Several gravelled county roads can be used in all kinds of weather.

The Chicago, Burlington and Quincy Railroad extends from east to west across the central part of the county. The Chicago, Rock Island and Pacific Railroad crosses central Lucas County in a north-south direction. Branch lines of the Chicago, Burlington and Quincy Railroad serve areas to the north and to the southwest of Chariton.

Agriculture

The agriculture of Lucas County is based on the growing of field crops and on the raising of livestock. In the following pages the more important features of this agriculture are discussed. The statistics used are from reports published by the United States Bureau of the Census.

Types, sizes, and tenure of farms

In 1954, 13.8 percent of the farms in Lucas County were miscellaneous and unclassified. The rest were classified by major source of income as follows:

	Percent
Field crop (other than vegetable and fruit and nut)	14. 5
Dairy	4. 8
Poultry	2. 1
Livestock (other than dairy or poultry)	51. 7
General	13. 1

The number of farms in the county decreased from 1,594 in 1930 to 1,345 in 1954. During this period, however, the average size of farms increased from 159.8 acres to 189.9 acres. The total land in farms was 255,418 acres in 1954 as compared to 254,776 acres in 1930.

Since 1930, an increasing proportion of farmland has been operated by owners, and tenancy has declined. By 1954, owners, part owners, or managers operated 204,421 acres, or 80 percent, of the total farmland as against 153,645 acres, or 60.3 percent, of the total farmland in 1930.

Crops

Corn, oats, and hay are the principal crops grown in Lucas County. In recent years soybeans have been increasing in importance. The acreages of the principal crops grown in the county are given in table 11.

TABLE 11.—*Acreages of the principal crops*

Crop	1929	1939	1949	1954
	Acres	Acres	Acres	Acres
Corn	54, 728	39, 063	46, 381	47, 964
Oats threshed or combined	24, 605	21, 435	25, 484	24, 360
Wheat threshed or combined	1, 965	719	4, 092	403
Soybeans for all purposes	1, 979	10, 625	3, 365	10, 575
Hay (does not include soybeans cut for hay)	35, 876	26, 636	28, 364	30, 331
Alfalfa and alfalfa mixtures	1, 810	3, 191	8, 179	12, 466
Clover, timothy mixture	26, 633	13, 387	[1] 17, 472	[1] 15, 656
Other hay crops	7, 433	10, 058	2, 713	2, 209

[1] Includes grass hay.

Livestock and livestock products

Livestock raising is important in Lucas County. The numbers of domestic animals on farms in 1954 are shown in the following list:

Chickens (4 months old and over)	137, 266
Hogs and pigs	38, 969
Cattle and calves	31, 695
Sheep and lambs	19, 426
Horses and mules	1, 115

In 1954, a total of 2,313,035 pounds of whole milk, 599,491 pounds of butterfat, and 1,103,350 dozen eggs were sold.

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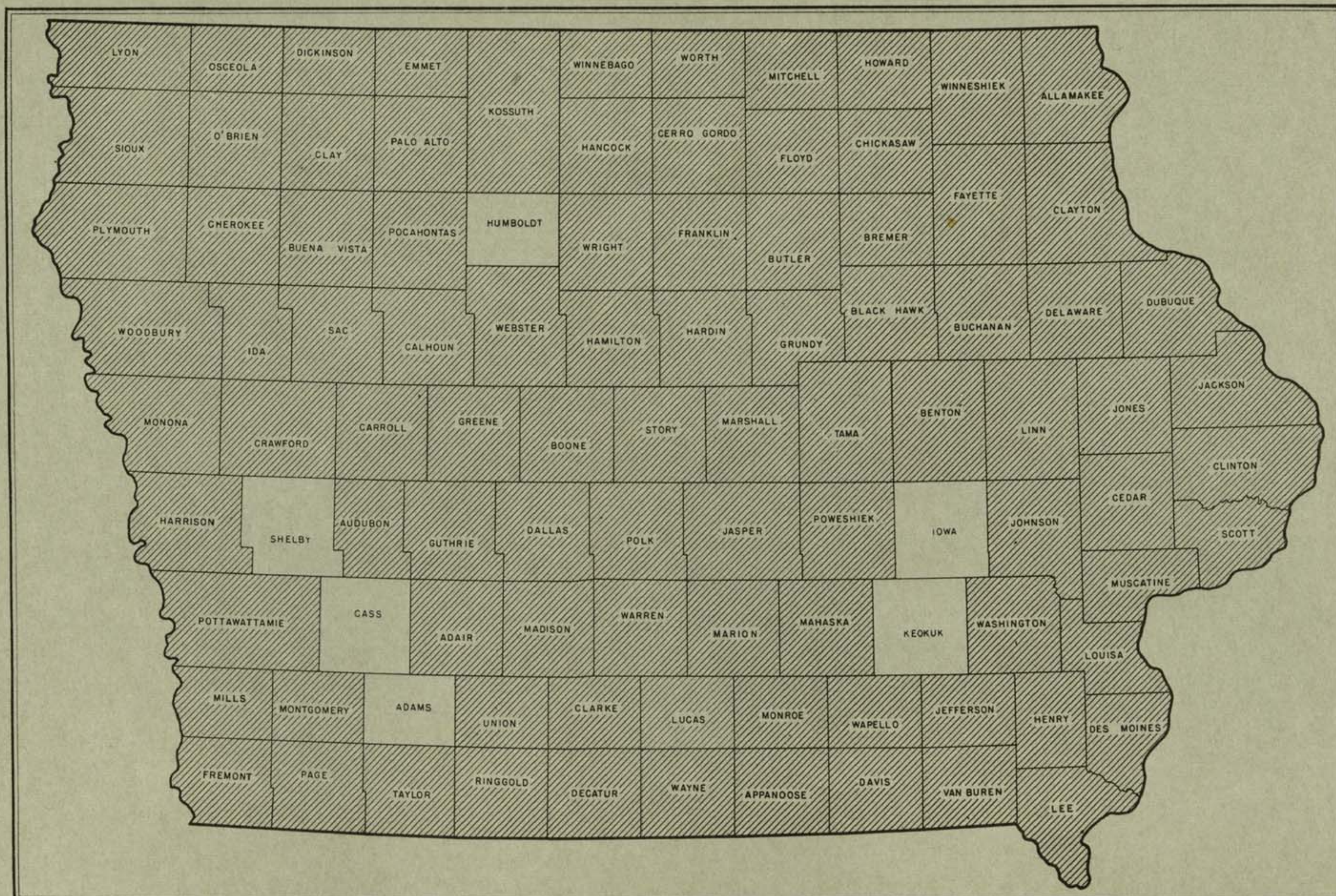

Areas surveyed in Iowa shown by shading.