Soil Survey of Iowa, Report No. 82—Ida County Soils

Roy W. Simonson
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IOWA AGRICULTURAL EXPERIMENT STATION

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SOIL SURVEY OF IOWA

Report No. 82—IDA COUNTY SOILS

BY ROY W. SIMONSON AND T. H. BENTON

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R. E. Buchanan, Director
Ames, Iowa
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Ida County Soils

By Roy W. Simonson and T. H. Benton

Ida County is situated in the northwestern part of Iowa, lying in the second tier of counties east of the Missouri River and in the fourth tier south of the Iowa-Minnesota line. Ida Grove, the county seat and largest town, is 50 miles east and a little south of Sioux City, 80 miles northeast of Council Bluffs and 110 miles northwest of Des Moines. The county lies in the eastern part of a rolling, loess-covered plain which, in places, reaches a width of 100 miles along the western boundary of Iowa. All of Ida County lies within the drainage basin of the Missouri River, and the major part of the county is drained by the Maple River and its tributaries.

The total area of Ida County is 430 square miles, or 275,200 acres, divided into 12 townships. As an average for the 10-year period, 1921-30, the land in farms comprised 98.7 percent of the county, or 271,812 acres, with 72 percent of that land in crops, 20.5 percent in pasture and the remainder in miscellaneous uses. The general utilization of farm land in Ida County during the 10-year period 1929-38, is given in table 1.

### Table 1. General Utilization of Farm Lands in Ida County, Iowa, for 10-Year Period, 1929-1938.

<table>
<thead>
<tr>
<th>Present utilization</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>All land in farms...</td>
<td>271,812</td>
</tr>
<tr>
<td>Cropland, all...</td>
<td>199,329</td>
</tr>
<tr>
<td>Idle cropland...</td>
<td>4,451</td>
</tr>
<tr>
<td>Pasture, all kinds...</td>
<td>56,378</td>
</tr>
<tr>
<td>Farmsteads, feed lots, highways...</td>
<td>14,850</td>
</tr>
<tr>
<td>Wood lots used for timber only...</td>
<td>495</td>
</tr>
<tr>
<td>Wasteland, not used for any purpose...</td>
<td>891</td>
</tr>
</tbody>
</table>

* Data are from Iowa Agricultural Statistics, Ida County. County Statistical Bulletin 51. Mimeographed.

**THE TYPE OF AGRICULTURE IN IDA COUNTY**

There were 1,434 farms in Ida County in 1939 as compared to 1,422 in 1935 and 1,443 in 1930, the number of operating units having changed very little during the past decade.² The average size of farms in Ida County was

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² All statistical data in this section of the report are from Iowa Yearbooks of Agriculture for the stated years unless otherwise noted.
190 acres in 1939, 32 acres larger than the average for the state as a whole. The total number, average size and tenure of farms in Ida County in 1929, 1935 and 1939 follow:

<table>
<thead>
<tr>
<th></th>
<th>1929</th>
<th>1935</th>
<th>1939</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of farms</td>
<td>1,421</td>
<td>1,422</td>
<td>1,434</td>
</tr>
<tr>
<td>Average size of farms in acres</td>
<td>192</td>
<td>191</td>
<td>190</td>
</tr>
<tr>
<td>Percent operated by owners</td>
<td>31.2</td>
<td>29.1</td>
<td>32.9</td>
</tr>
<tr>
<td>Percent operated by tenants</td>
<td>68.8</td>
<td>70.9</td>
<td>67.1</td>
</tr>
</tbody>
</table>

As is indicated in the preceding table, there has been little change in the relative proportions of owner-operated and tenant-operated farms during the past 10-year period. The percentage of farms operated by owners decreased from 1929 to 1935, but it has increased since 1935 so as to be slightly higher at the close of the 10-year interval than it was at the beginning. If the changes of the past 30 years are considered, however, there has been a considerable decrease in the number of owner-operated farms. According to the data of the United States census, 50.5 percent of the farm land in Ida County was operated by owners in 1910, 42.6 percent in 1920 and 32.3 percent in 1930.

The type of farming in Ida County has not changed greatly since 1890, except for recent development of some dairying. The growing of grains and hay and the production of cattle and hogs have been the most important agricultural enterprises in the region for many years. Most of the grain and hay produced is fed to livestock on farms within the county, but part of the corn and oats crop is shipped out in the more favorable years. In extremely dry years feed is sometimes shipped into the region, although this occurs infrequently. During ordinary years, the region of which Ida County is a part produces slightly more grain than is needed to fatten the livestock.

In the United States census of 1930, 70 percent of all farms in the county were classed as animal specialty, 17 percent as cash grain, 6 percent as general, 1 percent as dairy and 5 percent as miscellaneous types. The definitions of the various types of farms provide that 40 percent or more of the total income of a farm unit must be derived from a particular enterprise or closely related group of enterprises before that farm is included in a given class. For example, 40 percent or more of the total income must be derived from the sale of livestock and livestock products on an animal specialty farm, 40 percent or more from the sale of grain on a cash grain farm, and so on. On general farms, no one enterprise contributes as much as 40 percent of the total income.

The sale of livestock, principally beef cattle and hogs, furnishes the largest single share of the farm income in Ida County and is followed by the sale of grain crops. The sale of livestock provides much more income than does the sale of grain, since the latter is largely fed to animals on the farms. Important supplementary sources of farm income include dairying, poultry production and the growing of popcorn, the latter being localized to a great extent in the eastcentral part of the county. Sources of farm income minor for the county as a whole but important on individual farms include the raising and feeding of sheep and the growing of various crops such as wheat and soybeans.
The more widely grown farm crops in Ida County in the order of decreasing acreage in 1939 were corn, oats, hay and barley. Of these crops corn and oats are the most extensively grown, making up more than 70 percent of the total crop acreage. Minor crops, some of which are locally important, include popcorn, rye, winter wheat, sweet clover, sudan grass and a number of the sorghums. The total acreage, percent of farm land, average yield and the total yield of the various crops grown in the county in 1939 are given in table 2. These data are representative of conditions during the past decade.

**TABLE 2. ACREAGES, PERCENT OF FARM LAND AND YIELDS OF CROPS GROWN IN IDA COUNTY, IOWA, IN 1939.***

<table>
<thead>
<tr>
<th>Crop</th>
<th>Acreage</th>
<th>Percent of farm land</th>
<th>Average acre-yield</th>
<th>Total yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>93,541</td>
<td>34.4</td>
<td>50.1 bu.</td>
<td>4,686,400 bu.</td>
</tr>
<tr>
<td>Husked or snapped</td>
<td>91,705</td>
<td>33.7</td>
<td>50.1</td>
<td>4,596,170</td>
</tr>
<tr>
<td>Cut for fodder</td>
<td>583</td>
<td>.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cut for silage</td>
<td>328</td>
<td>.1</td>
<td>8.1 T.</td>
<td>2,660 T.</td>
</tr>
<tr>
<td>Hogged down</td>
<td>925</td>
<td>.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td>39,185</td>
<td>14.4</td>
<td>21.1 bu.</td>
<td>828,710 bu.</td>
</tr>
<tr>
<td>Winter wheat</td>
<td>323</td>
<td>.1</td>
<td>12.9</td>
<td>4,160</td>
</tr>
<tr>
<td>Spring wheat</td>
<td>204</td>
<td>.1</td>
<td>14.0</td>
<td>2,860</td>
</tr>
<tr>
<td>Barley</td>
<td>15,301</td>
<td>.6</td>
<td>18.5</td>
<td>283,350</td>
</tr>
<tr>
<td>Rye</td>
<td>1,189</td>
<td>.4</td>
<td>11.6</td>
<td>13,860</td>
</tr>
<tr>
<td>Sweet clover, all</td>
<td>8,663</td>
<td>3.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweet clover, seed</td>
<td>1,049</td>
<td>.4</td>
<td>1.4</td>
<td>1,420</td>
</tr>
<tr>
<td>Soybeans for seed</td>
<td>969</td>
<td>.4</td>
<td>13.8</td>
<td>13,500</td>
</tr>
<tr>
<td>Flaxseed</td>
<td>342</td>
<td>.1</td>
<td>5.3</td>
<td>1,820</td>
</tr>
<tr>
<td>Popcorn</td>
<td>3,212</td>
<td>1.2</td>
<td>1,488 lb.</td>
<td>4,778,740 lb.</td>
</tr>
<tr>
<td>Timothy seed</td>
<td>23</td>
<td></td>
<td>1.1 bu.</td>
<td>25 bu.</td>
</tr>
<tr>
<td>Red and alsike clover seed</td>
<td>76</td>
<td></td>
<td>1.3</td>
<td>100</td>
</tr>
<tr>
<td>Hay, all kinds</td>
<td>21,488</td>
<td>7.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clover and timothy</td>
<td>1,790</td>
<td>.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alfalfa</td>
<td>9,166</td>
<td>3.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soybeans</td>
<td>2,431</td>
<td>.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain hay</td>
<td>5,155</td>
<td>1.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other tame hay</td>
<td>2,941</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wild hay</td>
<td>599</td>
<td>.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorghum for all purposes</td>
<td>1,025</td>
<td>.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All other crops not cited</td>
<td>340</td>
<td>.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Iowa Yearbook of Agriculture, 1939.

Corn has been an important crop in the agriculture of Ida County since the early days of settlement. In 1939 the crop was grown on approximately one-third of the farm land with an average yield of 50 bushels per acre. This yield is higher than the average of 46 bushels per acre for the 10-year period, 1920-29, the decade with the highest average yield of corn from 1890 to 1940. 3 Although the average yields for 10-year periods have fluctuated only over a range of 9 bushels per acre, considerable variations in yield have occurred from year to year because of changes in weather conditions. Within

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3 Iowa Yearbook of Agriculture, 1935 and 1939.
the last 10 years, the average acre-yield of corn in Ida County has ranged from 16 bushels in the drouth year of 1934 to 50 bushels in 1939. Yields of corn also vary greatly from field to field and from one locality to another because of differences in soil or in its past management. Average yields of corn for the decade, 1930-39, are given by townships in table 3.

**TABLE 3. AVERAGE ACRE-YIELDS OF CORN AND OATS BY TOWNSHIPS IN IDA COUNTY, IOWA, FOR THE DECADE, 1930-1939.***

<table>
<thead>
<tr>
<th>Township</th>
<th>Corn (acre-yields)</th>
<th>Oats (acre-yields)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battle</td>
<td>32.3</td>
<td>26.1</td>
</tr>
<tr>
<td>Blaine</td>
<td>30.3</td>
<td>25.0</td>
</tr>
<tr>
<td>Corwin</td>
<td>26.1</td>
<td>21.1</td>
</tr>
<tr>
<td>Douglas</td>
<td>32.8</td>
<td>25.7</td>
</tr>
<tr>
<td>Galva</td>
<td>33.3</td>
<td>25.7</td>
</tr>
<tr>
<td>Garfield</td>
<td>26.6</td>
<td>23.2</td>
</tr>
<tr>
<td>Grant</td>
<td>29.7</td>
<td>25.1</td>
</tr>
<tr>
<td>Griggs</td>
<td>36.0</td>
<td>31.1</td>
</tr>
<tr>
<td>Hayes</td>
<td>33.6</td>
<td>26.3</td>
</tr>
<tr>
<td>Logan</td>
<td>31.7</td>
<td>26.3</td>
</tr>
<tr>
<td>Maple</td>
<td>30.2</td>
<td>24.1</td>
</tr>
<tr>
<td>Silver Creek</td>
<td>32.4</td>
<td>25.6</td>
</tr>
</tbody>
</table>

* Iowa Yearbook of Agriculture, 1939.

Most of the corn planted within the county in the last several years has been hybrid; it is estimated that more than 85 percent of the entire crop of 1940 consisted of various kinds of hybrid corn. The small remainder of the corn acreage is generally planted to yellow, open-pollinated varieties, which are still used by a few farmers.

Approximately 95 percent of the corn crop is husked or snapped for grain, and the rest is cut for fodder, hogged down or cut for silage. Most of the corn is husked from the standing stalk, either by hand or by the use of mechanical pickers. Mechanical pickers have been coming into more general use in recent years, because they permit more rapid harvesting of the crop after it is ripe. The purchase of a mechanical picker, however, requires a considerable capital investment, which is not available on all farms.

Oats, used principally for feed on the farm where grown, rank second to corn in acreage among the various crops produced in Ida County. The total acreage of oats is generally about half as large as that of corn, 14 percent of the farm land having been used for the crop in 1939. In that year the average yield was 21.1 bushels per acre as compared to an average of 31 for the state as a whole. Average yields of oats by townships in Ida County for the 10-year interval, 1929-38 are given in table 3. Yields vary considerably from one year to another depending upon the amount of moisture available and upon the temperature and winds, particularly during the period when the oat crop is in the milk or dough stage. Most of the oat crop is sown broadcast on the corn ground after the corn stubble has been cut up and the seedbed prepared by double disking. The crop is grown as a part of a rotation which includes only corn and oats on a number of farms, and it is used as a nurse crop for seedings of alfalfa, sweet clover or legume-grass...
mixtures on other farms. The principal varieties grown are Iowar, Green Russian, Swedish Select, Iowa 105 and Early Champion.

Small grains which are grown to a much lesser extent than oats, but which are important on some farms, include barley, rye and wheat. Barley is the most widely grown of these three crops and was produced on 15,291 acres, or 5.6 percent of the farm land in 1939, with an average yield of 18.5 bushels per acre. The large part of the crop is fed to hogs or to calves, but small quantities sold to local elevators or to truckers are fed in adjacent parts of Iowa or in nearby Nebraska. The more popular varieties of barley are Velvet, Oderbrucker, Trebi and Wisconsin 38. As compared to barley, rye and wheat are grown on very limited acreages. Rye is grown on the few areas of sandy soils and on some of the more rolling upland areas, whereas wheat, important as a cash crop prior to 1900, is now grown on only a few hundred acres each year.

The combined acreage of hay of all kinds ranks third among the various crops in Ida County. In 1939, 7.9 percent of the farm land, or 21,483 acres, was used for the production of hay. The various crops grown for hay, in the order of decreasing acreage, are alfalfa, soybean hay, clover-timothy mixtures, red clover and miscellaneous grasses. Approximately half of the hay crop, either from the standpoint of acreage or total production, consists of alfalfa. Minor hay crops, used almost every year by a small number of farmers, include millet, sweet clover, sudan grass and some of the native grasses.

Alfalfa can be grown on many of the soils in Ida County without the use of lime. It is generally sown in the spring with oats as a nurse crop, but satisfactory results also have been obtained when alfalfa alone was planted in the late summer. Alfalfa seed is either scattered broadcast or planted with a seeder attachment on a grain drill at rates of approximately 15 pounds per acre. After the alfalfa stand has become established, two or more cuttings can be made in a single season with yields ranging from $1\frac{1}{2}$ to 4 tons per acre. The average acre-yield is approximately $2\frac{1}{2}$ tons of hay in ordinary years, though large fluctuations do occur because of seasonal weather conditions.

Hay crops other than alfalfa are produced on much smaller acreages in any single year. Soybean hay was harvested from 2,431 acres in 1939, whereas clover and timothy were grown on 1,790 acres. The acreage of clover-timothy mixtures is much smaller than that grown 5 or 10 years ago, probably because of the severe drouths and the difficulties of obtaining seedings in 1934 and 1936. Soybean hay has been used as a supplementary source of feed and forage on a number of farms where other hay crops have been poor. It is not generally adapted to the Marshall soils of Ida County. Soybeans leave the surface layer of the soil in a loose, fluffy condition which permits ready harmful erosion on the rolling lands occupied by Marshall silt loam.

Some of the crops which are grown for hay are also used as rotation pasture. Small acreages of clover-timothy seedings are devoted to pasture each year, and occasional fields of alfalfa are also grazed. Among the legume
SOIL SURVEY OF IOWA

crops, however, sweet clover is more commonly used for pasture than any of the others. It is sown at the rate of 10 or 12 pounds per acre with oats as a nurse crop, grazed lightly in the fall after the oats have been harvested, and pastured again the following spring and summer. The late growth in the fall of the second year is ordinarily plowed under and the land planted to corn the following spring. In addition to the rotation pastures, commonly legumes or legume-grass mixtures, there are a number of permanent pastures, especially in the bottom lands. Kentucky bluegrass is by far the most common of the grasses used in permanent pastures, but there are occasional small areas occupied by big blue stem, meadow fescue or mixtures of the various native grasses.

One of the more locally important crops in Ida County is popcorn grown on 8,212 acres in 1939. The bulk of this acreage is located in the east-central part of the county where popcorn provides a larger share of the cash income than does field corn on a number of farms. Acre-yields range from 1,300 to 1,600 pounds, averaging about 1,500 pounds in a normal season. The growing of popcorn started in 1892 and has been followed to some extent by the farmers in the eastern part of the county since that time. Total acreage planted in any one year depends upon the current market demand reflected in prices ranging from $5 to $9 per hundred pounds. A large part of the popcorn produced in any one year is marketed in Arthur, Ida Grove and Odebolt, where there are large warehouses for the storing of the crop. Odebolt does not lie within Ida County but is situated in Sac County approximately 3 miles east of the county line.

In addition to the field crops produced on most of the farms, small quantities of vegetables and some small fruits are grown. Among the different vegetables, a few potatoes, chiefly Irish Cobblers, Early Ohio and Idaho Russets, are produced commercially near the principal towns. Small fruits including strawberries, raspberries and currants, are sometimes grown in quantities which exceed the needs of the farm family. Scattered orchards of apple, plum, cherry or peach trees also exist within the county although the total number of fruit trees has been gradually declining for the past 20 or 30 years. No fruits or vegetables are grown in sufficient quantities to supply the farm families and to meet additional local demands.

LIVESTOCK PRODUCTION IN IDA COUNTY

As has been indicated in the earlier part of this section of the report, the sale of livestock and livestock products is the principal source of farm income in Ida County. The types of livestock most widely distributed in the area are beef cattle and hogs, followed by dairy cattle, sheep and the different kinds of work animals. Numbers of livestock and poultry on farms in the early months of 1940 and the production of various types of animals in 1939 are given in table 4. These data are representative of the 10-year period preceding 1940.

The total number of cattle in Ida County, according to the United States agricultural census of 1935, was 38,894. Earlier census data and the figures in the Iowa Yearbooks of Agriculture usually range from 30,000 to 40,000 head. Most of these cattle are of beef types, including Herefords, Short-
TABLE 4. NUMBERS AND KINDS OF LIVESTOCK AND CHICKENS ON FARMS IN IDA COUNTY.

<table>
<thead>
<tr>
<th></th>
<th>1940</th>
<th>1939</th>
<th>1940*</th>
<th>1939</th>
<th>1940*</th>
<th>1940*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows and heifers kept for milk</td>
<td>7,224</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calves born, 1939</td>
<td>9,434</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle in feeding, 1940*</td>
<td>3,031</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heifers, 1 and 2 years old, 1940*</td>
<td>3,922</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steers, 1 and 2 years old, 1940*</td>
<td>2,205</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swine, 9 months old and over, 1940*</td>
<td>2,627</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sows bred to farrow in spring of 1940</td>
<td>15,096</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring pigs, 1939</td>
<td>91,992</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall pigs, 1939</td>
<td>17,927</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheep, 9 months old and over, 1940*</td>
<td>3,461</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lambs born, 1939</td>
<td>3,552</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Horses, 1 year old and over, 1940*</td>
<td>4,538</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colts born, 1939</td>
<td>430</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mules, 1 year old and over, 1940*</td>
<td>343</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chickens, all kinds, 1940</td>
<td>201,060</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Iowa State Tax Commission Annual Report, p. 27-60, 1940. Other figures are from Iowa Yearbook of Agriculture, 1939. Data were collected in and about the month of February, 1940.

horns, Aberdeen Angus and grades from these breeds. Somewhat less than one-fourth of the total number of cattle in Ida County are cows and heifers kept for milk production. Considerable numbers of beef cattle are raised in the area and fattened for market in the locality where grown. Additional stock, usually Herefords purchased at Omaha, Sioux City or points in the western range states, are brought in each year and are fed on farms within the county. Approximately 3,000 head of cattle were being fed in the early part of 1940, in addition to those which were raised locally. After having been finished, cattle are shipped by rail to Chicago or by truck to Omaha and Sioux City, with the largest numbers going to Chicago.

There are a limited number of dairy farms in Ida County, chiefly located near the towns. On almost all farms, however, cows are kept for milk production. The cattle on the dairy farms are usually of the Holstein, Guernsey or Jersey breeds, whereas those on other farms are grades of these breeds or other breeds such as Milking Shorthorn. Milk production within the county in 1934 amounted to 2,664,824 gallons, according to the United States Census. The production of milk and cream has been stimulated by the building of a large creamery at Ida Grove. Milk routes now cover all parts of the county and extend out into other regions. There are also cream-buying stations in each of the towns. Among the dairy products sold from the farms in Ida County, cream is perhaps the most important from the standpoint of revenue produced. The sale of cream, milk and butter, although it provides a major share of the farm income in relatively few instances, is an important supplementary source of income on many farms.

The place of hog-raising in the agriculture of Ida County is indicated by the numbers of pigs farrowed in 1939. The number of spring pigs in that year was 91,992, and there was an additional 17,927 fall pigs. The general practice in the raising of hogs is to have the sows farrow in the spring, keep the pigs over the summer months and fatten them for market in the fall after the corn is harvested. Approximately 15,000 sows were bred to farrow in the spring of 1940. The number of swine on farms fluctuates widely with
the different seasons of the year, reaching a maximum at the time of farrowing in the spring and declining sharply when the hogs are sent to market in the fall and early winter months. The bulk of the hogs are sold at weights ranging from 200 to 300 pounds, principally in Sioux City and Omaha, with a few carloads being sent to Chicago. Poland China and Duroc Jersey breeds are the more popular in the region, but there are also a number of herds of Hampshire, Tamworth and Chester White hogs.

The raising and feeding of sheep, a minor enterprise for the county as a whole, is practiced on a number of farms, especially in the northern part. Most farmers raise the lambs and fatten them, but some carloads of feeder lambs are brought into the county each year. In 1939, 3,562 lambs were raised and there were 3,461 sheep, 9 months old and over, reported on farms in 1940. During most years, the sale of fat lambs provides a larger income than does the sale of the wool clip which amounted to 46,233 pounds in 1934. The wool clip is marketed largely through cooperative shipping associations, and fat lambs are usually sent to Chicago.

There were 201,060 chickens of all kinds in Ida County in 1940, and most of these were distributed among flocks that ranged in size from 150 to 200 birds. Many flocks, a few of which range up to 450 or 500 birds, consisted of mixtures of several breeds, with Rhode Island Reds, Plymouth Rocks, White Leghorns and Wyandottes predominating. The production of eggs, largely from farm flocks, totalled 870,277 dozen in 1934, most of which were either used at home or sold to local buyers. The poultry produced is marketed either in live or dressed form, part of it being sold to local buyers and part of it being shipped to far away points such as Chicago and New York. Considerable quantities of live poultry, principally chickens, with small numbers of turkeys and other birds, are received by a poultry dressing plant at Holstein. Poultry other than chickens includes turkeys, geese and ducks, all of which are grown in limited numbers in Ida County. Larger numbers of turkeys are produced than either geese or ducks.

GEOLOGIC FACTORS AFFECTING THE SOILS OF IDA COUNTY

The nature of the soils of any region depends upon the combined influences of a large group of factors, among which several are geologic. Geologic factors of particular importance are topography and the kind or character of the regolith. These factors are governed by the geologic history of a region or by the conditions that have prevailed in the past. A brief discussion of these conditions and of the present topography and regolith should, therefore, contribute to a better understanding of the soils of Ida County.

At some long-distant time in the past, the limestones and calcareous shales that are now deeply buried in Ida County were exposed at the surface. These rocks had been weathered deeply to form a considerable regolith.

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4 United States Agricultural Census, 1935.
5 United States Agricultural Census, 1935.
6 The regolith is the unconsolidated or broken mantle of rock material. It includes the soil itself, but the bulk of the regolith consists of the weathered rock or sediment that lies beneath the soil and can serve as soil parent material.
The running water of the streams had dissected the landscape, as it is doing now, to develop a rolling to hilly topography not so different from the present one. This topography and the distribution of weathered rock material were then altered by successive advances of great ice sheets invading the region from the north, picking up a part of the regolith and carrying it onward, shoving materials from the tops of the ridges to fill or partially fill the valleys, and generally tending to level the land surface. Three separate ice sheets, known as the Nebraskan, Kansan and Wisconsin glaciers, invaded the region of Ida County at various times, with intervening periods between the retreat of one glacier and the advance of the next. During the intervening periods and following the retreat of the last glacier, large quantities of a fine, wind-blown material known as loess were deposited over the surface of the unsorted glacial debris (drift) left by the melting of the ice. In some places hills and ridges have been built by the local deposition of unusually large quantities of loess, but over most of Ida County the original thickness of the loess blanket was fairly uniform. During the interval of loess deposition following the retreat of the last glacier, streams resumed the work of dissecting the land surface, and that process continues at the present time. The landscape has again become a rolling plain with some relatively level areas and some hilly regions. Dissection of the land by streams, or geological erosion, has cut through the loess blanket in a number of places to expose glacial drift, and in a few of the largest stream valleys, cutting has progressed down to the limestone bedrock which appears in the form of escarpments along streams in southwestern Ida County.

SOIL PARENT MATERIALS

Three different kinds of soil parent materials comprise the regolith found in Ida County. Two of them, loess (wind-deposited sediment) and glacial drift (a mixture of rock debris, etc., left by ice and its outflowing waters), already have been mentioned, and the third is alluvium (water-laid sediments) derived largely from the loess and till of the uplands but reworked and deposited by streams. Of the three different kinds of soil parent materials, loess is the most extensive and most important, covering approximately three-fourths of Ida County. Alluvial materials in the flood plains and terraces of the streams of the region make up most of the remaining area of the county, or 23.8 percent of the land. Glacial drift outcrops only on valley slopes where the loess blanket has been removed, and the total area of soils formed from the drift amounts to 1.8 percent of the county acreage.

The loess mantle in Ida County, thought to be of Peorian age, becomes slightly thinner from west to east, and the thickness varies considerably within local areas. Estimated maximum thickness of the loess blanket is 30 feet in the southwestern and western parts of the county, whereas the depth on uneroded positions in the eastern part is nearer 20 feet. Locally, the thickness of the loess ranges from the maximum depths of 20-30 feet on gently rounded ridge tops to a matter of inches on some of the valley slopes. The loess has been entirely removed from a number of the slopes along the more deeply incised streams.
All of the loess in Ida County originally consisted of highly calcareous silts and clays, with the silts predominating. Gravel and boulders ordinarily found in glacial drift are absent from wind-blown deposits. The texture of the loess is generally a silt loam, and the colors range from light grayish-yellow to pale yellowish-brown with some white or light gray spots and splotches. Most of the light gray spots and splotches are due to accumulations of lime leached down from overlying portions of the loess. Although the loess was originally calcareous throughout, much of it, especially in gently rolling or undulating regions, has lost the lime in the upper portions through the leaching action of percolating waters. On the gently rounded sites the carbonates have been leached to depths that range from 36 to 80 inches. Calcium carbonate (lime) in finely divided form is still present in all of the deeper layers of loess and also in the upper layers on the steeper slopes. Carbonates in the form of concretions, either rounded or cylindrical, are present in the unleached loess, and a few of them sometimes persist where the finely divided lime has been removed.

The alluvial materials, with an extent approximately one-third that of the loess, are distributed in all parts of Ida County. Alluvial deposits occupy the flood plains of the major streams and the smaller upland drainageways, and they also occur as terraces in the larger stream valleys. Flood plains or first bottom lands are much more extensive than terraces in Ida County, covering about six times as large an acreage.

Most of the alluvial deposits were derived from the loess of the uplands and are therefore silty in nature. The alluvium in the upper reaches of small drainageways has been carried only a short distance and consists almost exclusively of sediments derived from loess. The alluvial material in the flood plains of the large streams has been transported greater distances, but much of that alluvium has also been derived from loess with an admixture of sediments washed from till. Gravelly or sandy materials were deposited in places in the flood plains of the streams, especially in the large valleys such as that of the Little Sioux River. The sand or gravel in the first bottoms is usually interbedded with layers of silt and clay, is often deeply buried and seldom affects the character of the soil. In the terraces, however, the stratified sand and gravel may occur near the surface and affect the character of the present soil profile. Silty materials, ranging in thickness from a few inches to a number of feet, commonly overlie the sand or gravel beds of the terraces. Where the silty materials are thin, O'Neill soils have been formed, whereas Waukesha soils have been developed where the silty alluvium is thick.

The flood plains or first bottoms of the streams are still receiving deposits of sediment from time to time. Deposition of fresh alluvium is associated with floods or overflow in periods of extremely wet weather occurring at irregular intervals that are often years apart. Alluvial materials are also being deposited on some of the low fan-like structures along the borders of the large streams, but the well-defined terraces no longer receive additions of sediments from overflow or flood waters.

Glacial drift, composed chiefly of the till (mixed debris left in place when
the ice melted), outcrops only on the valley slopes where all of the loess has been removed by the dissection of the land surface. Drift materials underlie all of Ida County, but only 1.3 percent of the county acreage is not now covered by loess or alluvium. Glacial till deposits consist of an unsorted mixture of clay, sand, gravel and boulders in variable proportions. Most of the till exposed in Ida County is a clay loam in texture, and throughout the matrix of fine material there are occasional gravels, coarse sand and boulders. Colors range from grayish-blue through gray and grayish-yellow to reddish-brown, with grayish-yellow and dull yellowish-brown shades predominating. The till is calcareous in the deeper portions and often contains lime within the profile of the present soil. Carbonates or lime are present in a finely divided form, as soft masses in the till and as small concretions or nodules.

**PHYSIOGRAPHY AND DRAINAGE**

The topography of Ida County is that of a rolling, loess-covered plain with a widely branching network of intermittent stream valleys. The bulk of the county has a landscape of rounded hills and moderate slopes separated by narrow swales or drainageways. Parts of the uplands, especially in the northeastern and northcentral sections of the county, are nearly level or only gently rolling. Other parts of the uplands are sharply rolling or hilly. The hilly or strongly rolling areas occur as irregular bands, ranging up to 3 miles in width, along the large tributaries of the Maple and Little Sioux Rivers. The largest individual bodies of land with hilly relief are located north of Ida Grove, north of Battle Creek and in Garfield Township. Smaller bodies occur in southwestern Corwin Township and in the southern part of Douglas Township.

The land surface of Ida County slopes gently toward the southwest. The highest elevation lies at 1,448 feet above sea level in the uplands near Holstein in the north-central part of the county. The lowest recorded elevation in the uplands is 1,347 feet at Battle Creek, with lower altitudes occurring in the valleys of the streams. The elevation of 1,225 feet above sea level at Ida Grove is the lowest one recorded in the county, and the towns of Galva and Arthur lie at altitudes of 1,290 and 1,282 feet, respectively. Ida Grove, Galva and Arthur are all situated in the valleys of streams and lie below the general level of the uplands. Elevations lower than that of Ida Grove occur in the valley of the Maple River, with the lowest point located where the river leaves the county near the southwest corner. The maximum range in elevation within Ida County is therefore slightly more than 218 feet, the difference between the altitudes of Holstein and Ida Grove. Local differences in relief range from as little as 5 to 10 feet in a square mile in the undulating uplands or the flood plains of streams to as much as 60 feet in upland sections bordering the major stream valleys.

The flood plains and terraces of streams constitute the major part of the level to undulating land in Ida County. The flood plains or first bottoms in

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7 Relief refers to differences in elevation between the high and low points in a given area, such as a square mile, a township or a continent. The local relief determines the flatness or hilliness of a countryside.

the larger stream valleys are commonly smooth or very gently undulating with a slight slope downstream. The widths of the first bottoms range from 10 to 15 rods along creeks to as much as 1 mile in some places along the Maple River. Upland drainageways are normally shallow swales between moderate slopes, and they seldom reach widths of more than 5 or 6 rods. The shallow swales gradually become narrower and finally disappear as the draws extend into the uplands.

Terraces are much less extensive than the flood plains or bottoms, and they occur chiefly along the large streams. Most of the terraces lie at elevations that are between 10 and 50 feet above the normal water level of the streams. The highest ones are situated along the Little Sioux River, whereas those along the Maple River and its tributaries seldom lie 25 feet above the stream. Many of the terraces are level or very nearly so. A few of them are undulating or gently rolling because of small intermittent streams that cross them to empty into the channels of the creeks or rivers.

Four different rivers and their tributaries drain the region of Ida County. The Maple River, entering the county near the northeast corner and leaving it in the southwest, drains approximately 290 square miles of a total area of 430 square miles. Seventy square miles in the northwest and northcentral sections of the county are drained by the Little Sioux River, and an equal area in the southern tier of townships is reached by the Soldier River and a tributary of the Boyer River. Otter Creek, a tributary of the Boyer River, drains approximately one-fifth of Hayes Township in the southeastern corner of Ida County.

The gradients of the streams in Ida County are usually large enough to provide easy removal of drainage waters. The average fall per mile is 6 feet along the Maple River between Galva and Ida Grove and the fall is almost twice as great along Odebolt Creek from Arthur to Ida Grove. The slopes of the streams range from the gradient of 6 feet per mile along the Maple River to as much as 20 percent* along some of the drains in the hilly upland sections.

Overflow or flooding of the bottoms of the large streams does not occur frequently, and the terraces are not flooded. The narrow strips of bottom land in the upland drainageways and the bodies of land at the junctions of master and tributary streams are covered by overflow waters at irregular intervals. Crops on these latter sites are damaged frequently enough so that much of the land is kept in permanent pasture. Damage to crops by flood waters over the entire acreage of bottom land in Ida County is normally small in any one year.

The widely branching system of intermittent streams, illustrated in fig. 2, ensures adequate natural drainage for almost all of the soils in Ida County. There are a few shallow swales in the uplands north of Holstein and occasional local areas in the flood plains of streams where drainage is restricted and interferes with the satisfactory production of crops. Tile drains have been installed in the upland swales near Holstein, and open ditches as well

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*Percent slope expresses the number of feet of vertical fall per 100 feet of horizontal distance along the ground.
as occasional tile drains are used in poorly drained spots in the bottom lands. Areas which lack adequate natural drainage in the bottoms include partly filled former stream channels and depressed sites near the uplands. Not all of these poorly drained spots in the flood plains have been tiled out or ditched, so that a number of them are still undrained.

**THE SOILS OF IDA COUNTY**

The formation of soil is a very slow process that goes on in three overlapping steps. First of all, parent material must accumulate, either by the breakdown of rock in place or by the deposition of weathered rock by ice, wind or water. After the parent material has accumulated, or sometimes
while it is collecting, simple forms of life such as bacteria and fungi invade the mass of loose rock and begin to grow there. As they grow, multiply and die, they leave their dead bodies to decay slowly in the rock debris and thus organic matter begins to accumulate. The gradual accumulation of organic matter is the second step in the formation of soil. It is due in part to the activity of the microorganisms but in large measure to higher forms of plants such as the trees and grasses, which soon follow the simpler forms in growing on the weathered rock materials and profoundly influence the soil-forming processes. As plants continue to grow and organic matter gradually accumulates, the upper layers of the unconsolidated mass of soil parent material are slowly changed and begin to differ from the layers below. This is the beginning of the development of the soil profile, the last step in the formation of soil.

A soil profile, which can be seen on the walls of a freshly dug pit or in a new road cut, consists of the succession of layers or horizons\textsuperscript{10} in a vertical cut down through the soil. These horizons grade into one another and are separated by transitional zones rather than sharply defined boundaries. Some profiles do include horizons that are set apart by distinct boundaries, but such soils are not common in Iowa. In most of the upland soils of Iowa, the profile consists of a deep, dark-colored surface horizon merging with a transitional, lighter-colored layer that separates it from the parent material beneath. All three horizons, the dark-colored one, the transitional layer, and the upper part of the parent material, are ordinarily included within a depth of 5 feet.

The first step in soil formation, namely the accumulation of parent materials, is a geological rather than soil-forming process. The breaking down of rock and the transportation of the weathered material are forerunners of soil formation; such processes do not in themselves give rise to soils. Occasionally the second and third steps in soil formation begin before the rock is fully broken down and soon give rise to a very young soil. In a large area such as the state of Iowa, soils can be found in all the different stages of formation, ranging from the sand bars recently laid down by the Mississippi River to soils with well-defined profiles such as Marshall silt loam in Ida County. Most of the soils used for the production of crops in Iowa have advanced beyond the stage of accumulation of soil parent materials and have reached the third step in soil formation—the development of the profile.

Although the same steps occur in the formation of every soil, the processes operating in each of the three steps differ from place to place. The deposition of soil parent material by wind leaves a well-sorted, fine-textured sediment, whereas the materials left by ice are unsorted and include particles that range from huge boulders to the finest clays. The soils formed from each of these two types of parent materials differ in a number of important respects. Similarly, soils formed under different climatic conditions or under different types of native vegetation on identical parent materials will not be the same once profile development has started. The nature of a soil depends

\textsuperscript{10} A soil horizon is a layer of soil approximately parallel to the land surface and different from the layers either above or below it. Differences are due to soil-building processes and can be either great or small.
upon the combined influences of climate, native vegetation, parent materials, relief and age (the interval during which the soil has been developing). Regional differences in the nature of soils, as between Iowa and Maine, for example, are commonly due to influences of climate and native vegetation. Local differences within smaller areas such as Ida County are most often due to parent materials and relief. For example, the Marshall and Clarion soils in Ida County are different because the former was developed from loess and the latter from glacial till. Marshall silt loam, light-colored phase, differs from normal Marshall because it occupies steeper slopes.

All of the well-drained soils of Ida County belong to the group of Prairie soils, a group already described as being marked by relatively deep, dark-colored surface horizons over lighter-colored materials. This group includes six soil types, Marshall silt loam, Clarion silt loam, Clarion loam, Waukesha silt loam, O’Neill loam and O’Neill silt loam, all found either in the uplands or on terraces. All of these soils were formed under a vegetation of tall prairie grasses and therefore have many properties in common. Each type differs from every other one, however, because of original differences in the material from which it was derived. Marshall silt loam is developed from loess, Clarion loam from glacial till and Clarion silt loam from a thin layer of loess over till. Waukesha silt loam was formed from fine-textured alluvium in terraces, whereas the O’Neill soils are found where there is a shallow covering of loam or silt loam material over stratified sand and gravel.

A group of soils with excessive natural drainage is associated with the well-drained ones of Ida County. The excessive drainage is due to the steeper relief, as on Marshall silt loam, light-colored phase and Clarion loam, steep phase, or to the extremely permeable nature of the soil material, as in Marshall fine sand. These latter soils are all found in the uplands and do not have as deep or as well-developed profiles as do the associated Prairie soils. The surface horizon of dark-colored material is either shallow or absent from most areas of excessively drained soils, though there are occasional local spots where a fairly deep layer can be found.

The soils of the flood plains or bottom lands are a third group of importance in Ida County. These soils, which include four individual types, are Wabash silt loam, Wabash silty clay loam, Judson silt loam, Ray silt loam and Wabash-Judson silt loam. The soils in the bottom lands, known as Alluvial soils, are in the early stages of profile development and commonly lack well-defined horizons. The profile may be uniform throughout the entire vertical section, or it may consist of markedly differing layers, according to what was laid down by the stream. For example, Wabash silt loam may consist of dark-colored, silty material to depths of 5 or 6 feet, or the profile may include interbedded layers of sand and silt. A large degree of variability in profile features can be expected in all of the Alluvial soils.

Twelve soil types and two phases in seven soil series occur in Ida County. The acreage and proportionate extent of each type and phase are given in table 5, and the distribution of each of these soils is shown on the colored map of the county in the envelope attached to the inside back cover of this report.
# SOIL SURVEY OF IOWA

## TABLE 5. ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS MAPPED IN IDA COUNTY, IOWA.

<table>
<thead>
<tr>
<th>Type of Soil</th>
<th>Acres</th>
<th>Percent</th>
<th>Type of Soil</th>
<th>Acres</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marshall silt loam</td>
<td>172,992</td>
<td>62.8</td>
<td>Judson silt loam</td>
<td>2,176</td>
<td>1.0</td>
</tr>
<tr>
<td>Marshall silt loam, light-colored phase</td>
<td>32,832</td>
<td>11.9</td>
<td>O'Neill silt loam</td>
<td>320</td>
<td>.1</td>
</tr>
<tr>
<td>Marshall fine sand</td>
<td>576</td>
<td>.2</td>
<td>Wabash silt loam</td>
<td>28,608</td>
<td>10.3</td>
</tr>
<tr>
<td>Clarion loam</td>
<td>576</td>
<td>.2</td>
<td>Wabash silty clay loam</td>
<td>384</td>
<td>.1</td>
</tr>
<tr>
<td>Clarion loam, steep phase</td>
<td>192</td>
<td>.1</td>
<td>Ray silt loam</td>
<td>256</td>
<td>.1</td>
</tr>
<tr>
<td>Clarion silt loam</td>
<td>2,176</td>
<td>1.0</td>
<td>Wabash-Judson silt loam</td>
<td>24,960</td>
<td>9.0</td>
</tr>
<tr>
<td>Waukesha silt loam</td>
<td>8,892</td>
<td>3.1</td>
<td>Total</td>
<td>275,200</td>
<td></td>
</tr>
</tbody>
</table>

For purposes of discussion, the soils of Ida County have been classified into three groups. The bases for classification have been the profiles of the various soils and associated features of relief and natural drainage. All of these properties affect the utilization of the various kinds of soil and are reflected in their productive capacities. The three groups of soils in Ida County are called "Dark-Colored Soils with Free Natural Drainage," "Upland Soils with Excessive Natural Drainage" and "Soils of the Stream Bottoms" in the subsequent discussions. Each of the three groups is described briefly in the text, after which the individual soil types, phases and complexes are described in detail and their agricultural relationships are considered. The occurrence, extent and profile characteristics of the soil types and phases and the problems of utilization or management peculiar to each one are discussed individually. General problems of soil management or problems that are common to many soils, such as maintenance of an adequate supply of organic matter, are considered in a later section of this report.

### DARK-COLORED SOILS WITH FREE NATURAL DRAINAGE

The well-drained and dark-colored soils are widely distributed in Ida County and comprise 67.3 percent of the land. The area occupied by a single soil type, Marshall silt loam, equals more than half of the county. The large bodies of Marshall silt loam are continuous over entire townships except for the narrow tongues of Wabash-Judson silt loam along the drainageways that finger into the uplands. Less widely distributed soils of the well-drained group, commonly found in small individual bodies, are Clarion silt loam, Clarion loam, Waukesha silt loam, O'Neill loam and O'Neill silt loam. These five soils occupy only 12,224 acres or 4.5 percent of the county area.

The six soil types in the well-drained, dark-colored group are similar in having very dark grayish-brown surface soils over lighter-colored subsoils. The profiles are different, however, in a number of ways because of differences in the parent materials from which they were formed or in the topographic position which they occupy. Marshall silt loam has developed from a calcareous, medium-textured loess under prairie grasses and associated plants. The relief is gently rolling, as a rule, but it may range from gently undulating, as on the upland divides near Holstein, to distinctly rolling in the strips of land near the larger creeks. Waukesha silt loam closely resembles the Marshall in profile; both soils are dark colored at the surface,
both have brown transitional horizons beneath the surface horizon and
neither contains any sand or gravel. However, Waukesha soils occur on silty
alluvium in smooth or gently sloping terraces, and the soil is usually more
acid in reaction than is Marshall silt loam. O'Neill loam and O'Neill silt loam
also occur on terraces, but they are found where gravel or sand deposits lie
near the surface. Both of the latter soils have gravel or coarse sand occurring
at depths of 24 to 30 inches, but the surface material is finer-textured in
O'Neill silt loam than in O'Neill loam. Natural drainage of the O'Neill soils
is excessive, and crops grown are subject to drought damage except in the
most favorable years. Clarion loam differs from Marshall silt loam because
it was formed from calcareous glacial till which contains sand, gravel and
occasional boulders. Otherwise, Clarion and Marshall soils are quite similar
in their characteristics. Clarion silt loam differs from Clarion loam in that
it has been formed where a thin layer of loess overlies the till and gives the
surface layer of the soil a silt loam texture. The loess has not been deep
enough to provide material for the entire body of the soil profile, but it has
influenced the texture and composition of the uppermost horizons.

Marshall Silt Loam (Ms) (9)

Marshall silt loam occurs in large bodies in every township and occupies
62.8 percent of the area of Ida County. The proportion in the individual
townships ranges from approximately 35 percent in Corwin and Garfield to
as much as 87 percent in Griggs. In the townships of Corwin and Garfield,
there are additional large areas of the light-colored phase of Marshall which
occur on steeper slopes in association with the normal soil.

The topography of Marshall silt
loam in Ida County ranges from undulating to strongly rolling in some local
areas where streams have cut deeply
into the present plain. The smoother
areas of Marshall soils occur in the
northcentral and northeastern sections,
whereas the more rolling bodies are
located in the southwestern and south-
central parts of the county. The land
surface of Marshall silt loam is gener-
ally rolling with slopes normally rang-
ing between 5 and 12 percent but oc-
casionally reaching 15 percent.

The profile of Marshall silt loam
consists of three principal horizons.
The surface horizon on the more gen-
tle slopes is a dark grayish-brown silt
loam with a poorly defined granular structure extending to depths of 14 to 16
inches. It grades into yellowish-brown silty clay loam, which, in turn, merges
with the pale yellowish-brown silt loam of the loess or parent material at
depths of 38 inches. Lime nodules and finely divided carbonates are found
SOIL SURVEY OF IOWA

commonly at depths of 36 inches. In some locations, the loess is a pale grayish-yellow color in the layers immediately beneath the soil and may contain some fine sand and a few black stains. All of the upper layers of the soil profile are slightly acid, as a rule, whereas the parent loess ranges from neutral to slightly basic in reaction.

Variations in the profile of Marshall silt loam accompany changes in degree of relief for the most part. On the gently undulating areas, the surface horizon is darker in color and somewhat deeper than it is on gently rolling sites. Conversely, the upper layer is less deep and is lighter in color than normal on the steeper slopes and on sharply rounded ridge crests or shoulders. The surface soil on a number of these shoulders and steeper slopes is yellowish-brown rather than dark grayish-brown because of the removal of the dark-colored material by erosion.

Drainage of Marshall silt loam is good but not excessive; the soil absorbs moisture readily, and excessive quantities are carried away rapidly because of the generally sloping character of the land. Water-holding capacity of the soil material is high enough, however, to permit the storage of adequate amounts of moisture for plant growth in the usual seasons.

Crops grown on the soil type include corn, oats, hay and others that are common to the region. Average acre-yields are 30 to 50 bushels of corn, 30 to 50 bushels of oats, 25 to 45 bushels of barley and 1 to 4 tons of hay. Crops such as popcorn, grown especially in the eastcentral part of the county, yield about 1,500 pounds per acre. Hay crops include alfalfa, clover and timothy mixtures, soybeans and miscellaneous grasses. Clover and timothy mixtures can be grown on Marshall silt loam without previous applications of lime, and on many of the steeper slopes, alfalfa and sweet clover will also grow successfully without liming of the soil. On the more gentle slopes and on the undulating upland divides, applications of lime at rates ranging from 1 1/2 to 2 tons per acre will be found helpful in establishing seedings of alfalfa. As has already been indicated in an earlier section, soybeans should not be grown generally on Marshall silt loam and especially not on the more sloping areas. This crop leaves the soil in a loose condition which permits ready washing by late fall or next spring rains.

Clarion Silt Loam (Cs) (169)

Clarion silt loam is a minor soil type in Ida County and occupies only 2,176 acres or 1 percent of the county area. Most of the areas of the soil type are scattered along the Maple River in the northeastern part of the county and along Ashton Creek in Douglas Township. Bodies of Clarion silt loam, ranging generally from 5 to 100 acres in size, occupy lower valley slopes where much but not all of the loess has been removed. The position of the soil type is commonly between the Wabash or Wabash-Judson soils of the stream bottoms and the Marshall soils of the uplands. The slopes occupied by Clarion silt loam normally range from 7 to 10 percent.

The surface layer of the profile of Clarion silt loam is a dark grayish-brown silt loam, finely granular and mellow, extending to depths of 10 to 14 inches. This horizon becomes somewhat lighter in color in the lower part
and finally grades into yellowish-brown silty clay loam. The second horizon, approximately 10 inches thick, is transitional and overlies another transitional layer of yellowish-brown silty clay loam which contains some grit and sand. The sand and grit indicate mixing of loess and till materials, and the till itself usually appears at depths between 32 and 46 inches. The till is a grayish-yellow or gray, calcareous silty clay loam in which there are occasional gravels and boulders and appreciable quantities of sand. Lime concretions and some mottling can be seen in the till. The till is basic in reaction, and the upper horizons of the soil profile are slightly to moderately acid. The more common variations in the profile are in the thickness of the surface horizon which may range from 6 to 14 inches and in color which ranges from dark grayish-brown to dull yellowish-brown.

Crops grown and yields obtained on Clarion silt loam are comparable to the ones reported for Marshall silt loam. The utilization of the two soils is quite similar, except where occasional bodies of Clarion bordering the stream bottoms are used for permanent pasture. Special attention should be given to the control of erosion on Clarion silt loam which tends to wash because of its moderate slope and position in the landscape.

Clarion Loam (Cl) (138)

Most of the areas of Clarion loam, totalling less than 1 square mile in Ida County, occur on slopes along two short tributaries of the Little Sioux River in Douglas Township. The soil type is found where stream dissection has removed all of the loess blanket and exposed calcareous till to processes of soil formation. Individual bodies of Clarion loam are therefore small and occupy moderate to strongly sloping sites where dissection has been most active. Slopes of Clarion loam range from 5 to 15 percent but generally fall between 9 and 12 percent.

The surface layer of Clarion loam is a friable, dark brown to dark grayish-brown loam, usually between 8 and 12 inches in thickness. Below the surface layer, the soil material is a yel-
lowish-brown silty clay loam which becomes more gritty with increasing depths and grades into the grayish-yellow silty clay loam of the till between 38 and 50 inches. The glacial till is normally calcareous and contains lime both in a finely divided state and as nodules or concretions. Scattered mottlings of dull reddish-brown color are present in the till and in the soil horizons immediately above it. Coarse sand, occasional gravels and infrequent boulders are distributed throughout the soil mass. The surface horizon and the one beneath it are slightly to moderately acid in reaction, whereas the two deeper horizons of the soil profile are neutral or basic.

The areas of Clarion loam are generally used and farmed in conjunction with adjoining bodies of Marshall silt loam. Yields obtained are comparable on the two soils in the favorable years, but in the drier years the crop yields on Clarion loam are somewhat lower. Care must be exercised in farming Clarion loam to prevent erosion. The soil type is located on sloping sites above the drainageways and below the higher parts of the upland, which tends to make it readily subject to accelerated erosion.

Waukesha Silt Loam (Wt) (75)

Waukesha silt loam occurs in terraces along all of the larger streams in Ida County with the largest bodies scattered along the Maple River. The terraces are situated from 5 to 20 feet above the normal water levels of the streams, and they are either flat or slope gently away from the upland and toward the channel. Individual terraces of Waukesha silt loam range from less than 10 acres in size to 600 acres. The total acreage of the soil type comprises 3.1 percent of the area of Ida County.

The profile of Waukesha silt loam is very similar to that of Marshall silt loam. The surface horizon, extending to a depth of 12 to 15 inches, consists of friable, dark grayish-brown silt loam that grades into brown silty clay loam. The color of the soil becomes lighter with increasing depth, and between 18 and 22 inches it changes to yellowish-brown. The yellowish-brown horizon is relatively thick and extends downward to 48 to 54 inches before giving way to the faintly mottled parent material. Changes from one horizon to another are very gradual and usually consist of zones several inches in thickness. The two upper horizons of Waukesha silt loam, as it occurs in Ida County, are slightly to moderately acid, whereas the lower ones are often neutral. In most areas of its occurrence in Iowa, the soil type is acid in reaction throughout its entire profile.

Variations in the profile of Waukesha silt loam are not common. Along the
margins or shoulders of some of the terraces, the surface soil is shallow or absent and the upper layer is yellowish-brown. On a number of gently sloping terrace-like formations transitional between the upland and the stream bottoms, especially southwest of Battle Creek, the soil is deeper and darker than the normal Waukesha. This soil is comparable to Marcus silt loam mapped in Cherokee County, but it is not shown separately on the map because of its limited acreage.

Waukesha silt loam is all utilized as cropland, since the soil is one of the most productive in the region. Corn yields are 40 to 60 bushels per acre, oats yields 35 to 65 bushels and hay yields 1 to 4 tons. High levels of production are easily maintained on Waukesha silt loam.

**O’Neill Loam (Ol) (108)**

The total area of O’Neill loam in Ida County is only 320 acres distributed in the form of small terraces along the large streams. The terraces, which range in size from 5 to 40 acres, are scattered along the valleys of the Maple and Little Sioux Rivers, some of them west of Galva, others west of Ida Grove and a few in northwest Douglas Township. Most of these terraces have smooth surfaces, but a few of them are irregularly undulating. All bodies of O’Neill loam, situated well above the stream channels and resting upon sand or gravel beds, have excessive natural drainage.

The profile of O’Neill loam consists of three fairly distinct layers: a dark grayish-brown, gritty loam which is 8 to 10 inches thick; a yellowish-brown sandy loam or sandy clay loam, 12 to 14 inches thick; and the stratified sand or gravel that underlies the terraces. There are a few variations in the profile of the soil type as it has been mapped in the county. Occasionally the upper layers of the soil—those above the sand or gravel beds—are quite sandy. In such spots the soil is also lighter in color than in the more widely-occurring bodies with heavier-textured upper horizons. The upper horizons of O’Neill loam are slightly to strongly acid in reaction, whereas the lower horizons of the soil in Ida County range from slightly acid to neutral.

Most of the bodies of O’Neill are cultivated, even though crop yields are low in dry years and do not approach the yields on Marshall or Clarion soils except in extremely wet seasons. The range of corn yields is 15 to 25 bushels per acre, oats 15 to 35 bushels per acre and hay up to 1 1/2 tons. The higher yields of crops are obtained from areas where long rotations with little corn and more grasses and small grains have been followed and where liberal applications of organic matter have been made.
Nearly all areas of O'Neil silt loam in Ida County are located along the Little Sioux River. Three small terraces and two larger ones, all in the valley of the Little Sioux River where it cuts across the extreme northwestern corner of the county, comprise more than 90 percent of the total acreage of O'Neil silt loam. The soil type also occupies two small terraces along the Maple River, one of them north and the other southwest of Galva. Individual terraces range in size from 5 to as much as 100 acres. The total area of O'Neil silt loam in Ida County is only 320 acres, an acreage equal to that of O'Neil loam.

Terraces occupied by O'Neil silt loam are flat, as a rule, but a few have low wave-like ridges and shallow swales running across them from the upland. The swales serve as channels for small intermittent streams after heavy rains. After ordinary rains, runoff water from the upland tends to percolate downward through the soil profile and escape into the sand and gravel beds that underlie O'Neil silt loam. The porous nature of the underlying material makes the soil type drouthy; drainage is excessive in spite of the flat topography.

The surface horizon of O'Neil silt loam is a dark grayish-brown silt loam, 10 to 12 inches thick, which grades into a yellowish-brown sandy loam or gritty clay loam. The second layer is a transitional one in the profile and commonly rests upon stratified sand or gravel at depths between 20 and 28 inches. Variations in the texture of the surface layer occur locally throughout bodies of O'Neil silt loam, and the soil material in these local spots ranges from fine sand to fine sandy loam. The depth to stratified sand and gravel also varies from place to place and may range from 15 inches to as much as 42 inches. All of the layers in the soil profile are usually acid in reaction, but the underlying gravel or sand is sometimes neutral.

Bodies of O'Neil silt loam are usually cultivated, even though natural drainage is excessive. The rapid drainage permits early working of the soil type in the spring, and the lay-of-land is favorable for cultural operations. However, the water-holding capacity of O'Neil silt loam, which varies with the thickness of fine-textured material over sand or gravel, is generally low, and crops suffer from lack of moisture except in wet growing seasons. Crop yields obtained are 15 to 40 bushels of corn per acre, 15 to 20 bushels of oats and up to 2 tons of hay. The higher yields are secured when long rotations are followed and large quantities of organic matter are applied to the soil.
ID A COUNTY SOILS

UPLAND SOILS WITH EXCESSIVE NATURAL DRAINAGE

The group of upland soils with excessive natural drainage includes one soil type on sandy material and two phases which occur in regions with hilly topography. Marshall fine sand, occurring only to a limited extent, has been formed from scattered deposits of sand in the higher parts of the landscape. Marshall silt loam, light-colored phase, occupies the dissected portions of the county where the relief is either strongly rolling or hilly. It occurs in association with the normal Marshall which is found on the gently rolling or gently sloping positions. Clarion loam, steep phase, has been mapped on the steep slopes bordering stream valleys in the northwestern part of Ida County. The individual bodies of Marshall fine sand and Clarion loam, steep phase, are small whereas those of Marshall silt loam, light-colored phase, are large and often continuous for several miles. The combined acreages of the three soils, most of which is light-colored Marshall, make up 12.2 percent of the area of Ida County.

Special problems of soil management arise because of the excessive natural drainage of this group of soils. The porous nature and low water-holding capacity of Marshall fine sand limit its productivity, and the sandy nature of the soil permits it to blow readily unless special precautions are taken in farming it. The light-colored Marshall and the steep phase of Clarion are subject to accelerated erosion under cultivation. Their sloping to hilly relief promotes run-off and ready washing of the soil unless care is practiced in tillage operations, in the selection of rotations and in management of the soil in general.

Marshall Silt Loam, Light-Colored Phase (Ms-x) (257)

Marshall silt loam, light-colored phase, is found where the land surface of the county has been cut up to a large degree by streams. It occupies the sharply rounded hills and ridge crests and the steeper valley slopes in many different sections of Ida County. Slopes on which the soil is found range up to 30 percent in extreme cases, but most of the time they fall between 12 and 20 percent. The largest bodies of light-colored Marshall are west of the Maple River valley north of Ida Grove, west of the valley of Battle Creek, and in the central part of Garfield Township. Small areas are scattered through all of the other townships in Ida County but are most numerous in the southern half. Total acreage of Marshall silt loam, light-colored phase, ranks second among those of the different soils in the county and equals 11.9 percent of the land.

Marshall silt loam, light-colored phase, has a relatively shallow soil profile because it occurs on strongly sloping positions. In uncultivated areas the surface layer of the soil is a friable, dark brown silt loam, approximately 4 inches deep. Merging with the surface horizon in unplowed areas and sometimes replacing it in cultivated fields, there is a dull yellowish-brown silt loam that extends downward to 12 to 14 inches. With increasing depth the soil material becomes brighter in color without change in texture or other properties. The horizon of yellowish-brown to light yellowish-brown silt loam is usually thick and grades into the pale yellow or grayish-yellow,
floury silt loam of the loess between 20 and 60 inches. The loess itself is highly calcareous, and the upper layers of the soil profile may also contain lime. Lime (calcium carbonate) is normally present both in finely divided form and in concretions, either in spherical or cylindrical shapes. All of the horizons of the profile of Marshall silt loam, light-colored phase, are normally basic in reaction, but the surface layers may be neutral or slightly acid at times.

Variations in the profile of Marshall silt loam, light-colored phase, accompany changes in relief, as a rule. On the steeper slopes the surface horizon is light colored and shallow or it may be entirely absent, whereas on the gentler slopes a dark brown to dark grayish-brown surface horizon may be found. Exposures of the loess parent material or other evidences of accelerated erosion can be seen in a number of cultivated fields. Gullies that have cut into the loess also occur, especially on the steepest slopes. The soil on the steepest slopes mapped as Marshall silt loam, light-colored phase, would have been separated as Knox silt loam if the total acreage had been larger. Individual bodies of this soil in Ida County are usually small, the largest ones occurring in one area 3 miles north and in another 4 miles southwest of Battle Creek. On these steep locations the surface layer of the soil profile is grayish yellow in color and is highly calcareous. In addition to the shallow variations in the profile of the light-colored Marshall, there are narrow bands of soils where the surface layer is unusually deep along the toes of the slopes adjacent to drainageways. These are too narrow to be shown on the scale of the map used and have therefore been included with the adjacent upland soil.

Perhaps 98 percent of the area of Marshall silt loam, light-colored phase, is being used for crops or rotation pasture. In a few places, the soil is used for permanent pasture and much less frequently, it may carry a scattered growth of trees. Portions of the light-colored Marshall, particularly in the southwestern section of Ida County, once carried a thin stand of trees and shrubs among the prairie grasses, but the forest growth has been entirely cleared. At the present time, the acreage of permanent pasture is small. Crops grown on Marshall silt loam, light-colored phase, are primarily corn, oats and hay, with rotations similar to the ones used on the normal phase of Marshall. Yields of crops are distinctly lower on the light-colored Marshall unless special care is devoted to its management. Common acre-yields of crops are 20 to 40 bushels of corn, 20 to 35 bushels of oats and 1 to 1½ tons of clover-timothy hay.
The management of the light-colored phase of Marshall should differ from that followed on the deeper and darker colored soils. Rotations should include a smaller proportion of corn and higher proportions of close-growing crops such as alfalfa and the grasses. Alfalfa and sweet clover can be grown on the soil without previous applications of lime, and the growing of such crops will normally benefit subsequent corn crops. Further applications of organic matter, especially barnyard manure, are necessary to improve and maintain the content of organic matter in the soil. In most areas of light-colored Marshall, tillage operations should be along the contour, occasional buffer strips should be used and all waterways should be maintained permanently in close-growing vegetation.

Marshall Fine Sand\(^{11}\) (Mf) (265)

Small bodies of Marshall fine sand occur infrequently in the uplands, usually immediately east of drainageways, in the southern half of Ida County. Although most of the soil type is located south of the valleys of the Maple River and Odebolt Creek, there are two or three areas in the northern part of the county. All of the individual bodies are small, and their aggregate area is only 576 acres. Marshall fine sand seems to have been formed from a uniform, fine sand overlying loess or till materials where the relief is predominantly rolling.

Sandy materials, such as those of Marshall fine sand, do not give rise to well-developed soils profiles in Iowa. The supply of plant nutrients and water which the soil can provide for growing plants is too limited to permit the development of good vegetative cover. The quantities of minerals other than quartz (the dominant mineral in sands) in the soil material are too limited to allow the formation of clay and the other finely divided mineral matter that make up an essential part of the dark-colored, well-drained soils in Ida County. The surface layer of Marshall fine sand is a dark brown fine sand, sometimes loamy, 7 to 9 inches thick. Below the surface layer, the soil material grades through pale yellowish-brown fine sand into a brighter colored zone somewhere between 26 and 30 inches. None of the horizons is well defined, and the soil profile consists of a slightly darker-colored surface layer grading into bright fine sand. The surface soil is normally acid in reaction, and the deeper sand ranges from slightly acid to basic. Depth of the sand over loess or till ranges from 3 to 6 feet in the areas that have been delineated. The depth to heavier-

\(^{11}\) Since the map of Ida County was prepared, further study of the soil called Marshall fine sand has indicated that it differs from the other members of the Marshall series. In future reports, this soil will be designated as Thurman loamy fine sand.
textured material is usually less than 3 feet along the margins of the areas shown on the map.

Marshall fine sand occurs as small areas in larger bodies of other soils and is ordinarily cultivated in the same way as the surrounding types. In most instances it is cultivated with Marshall silt loam, and the same crops are grown on the two soils. Yields of corn, oats and hay are low on Marshall fine sand. The average production in acre-yields is 10 to 25 bushels of corn, 15 to 25 bushels of oats, and up to 1 ton of hay. The growth and comparative yields of small grain crops, especially rye, are usually better than that of corn on Marshall fine sand. Crops such as melons or other vegetable and truck crops are fairly well adapted to the sandy soil.

Additions of large quantities of organic matter, either in the form of barnyard or green manures, and care in selection of rotations and in tillage are necessary in the cultivation of Marshall fine sand. As a rule the individual bodies are too small to form an area that could be retired from cultivation without interfering with the operation of the surrounding Marshall silt loam. Cultivation of the sand is therefore a general practice, but it should include special precautions to improve water-holding capacity and to prevent blowing.

**Clarion Loam, Steep Phase (Cl) (151)**

Clarion loam, steep phase, occupies only 192 acres in Ida County and is the least extensive of all the soils. The soil is found only on the steeper slopes along the Little Sioux River in the northwestern corner of the county. Slopes on which the soil occurs range from 12 to as much as 25 percent, with most of them between 14 and 20 percent.

Where Clarion loam, steep phase, has not been cultivated, the surface layer is a dark grayish-brown loam to depths of 4 to 8 inches. The thickness of the surface soil is greater on gentler slopes, especially at the margins between the upland slopes and the terraces or bottoms, and thin on the shoulders of the hills. Below the surface layer, the soil material is a grayish-yellow to a yellowish-brown clay loam and grades into the grayish-yellow or gray silty clay loam of the till between 24 and 30 inches. The second horizon, a transitional one between the surface layer and the till, is usually darker in color in the upper part and becomes lighter as it approaches the till. Scattered nodules of lime and carbonates in a finely divided condition are present in the glacial till generally, and they sometimes occur in the other parts of the soil. All of the layers in the profile range from neutral to basic in reaction.

Variations in the thickness of the
surface layer, in the number of boulders and gravels present, and in the depth to carbonates are common in Clarion loam, steep phase. The surface soil is thinner and the depth to carbonates is less on the steeper slopes than on those that are moderate. The distribution of the gravel and boulders in the soil is erratic.

Most of the acreage of Clarion loam, steep phase, is utilized for pasture and grazing. Occasional areas are cultivated, and the crop yields obtained are low except on the narrow bands of deeper soil included along the margins of the bottom lands. Corn yields on the cropped acreage are approximately 10 bushels per acre, and the yields of other crops are also low. Cultivation of the soil is not generally desirable.

SOILS OF THE STREAM BOTTOMS

The soils of the bottom lands include four soil types and one complex, occurring in the flood plains and on low alluvial fans. Three of the soil types, Wabash silt loam, Wabash silty clay loam and Ray silt loam, occupy the wide bottoms along the creeks and rivers. Judson silt loam occurs on low alluvial fans and in bands along the toes of slopes where local wash and colluvial materials have accumulated. Wabash-Judson silt loam is a complex or geographic association of two soil types which occur together along the upland drainageways.

Wabash silt loam and Wabash-Judson silt loam occur widely in Ida County, each comprising approximately 10 percent of the entire acreage, whereas the other soils in the group are not extensive. Judson silt loam has been mapped over 1 percent of the county area, in addition to the part it makes up in the complex, but the remaining Alluvial soils cover only 1 square mile. The total acreage of Alluvial soils, i.e. the soils of the bottom lands, equals 20.5 percent of Ida County.

All of the soils in the Alluvial group have been developed from water-laid sediments that are fine textured. Wabash silt loam consists of dark-colored silty materials in the flood plains of the streams, and the silty clay loam occurs where the sediments include higher proportions of clay. Ray silt loam consists of light-colored alluvium overlying dark-colored sediments of similar texture. Judson silt loam, also consisting of silty alluvium, is found where local wash from the surface horizons of upland soils accumulates in gently sloping fans at the outer edges of the bottoms or in narrow bands at the toes of slopes.

Alluvial soils are normally smooth and very gently sloping so that natural drainage over the surface is slow. Most of them also consist of rather fine-textured material which does not permit water to percolate readily through the soil profile. Because of this slow drainage, many areas of soils in the stream bottoms of Ida County cannot be worked in the early spring. Drainage, though it is slow, is normally adequate to permit farm operations later in the spring and throughout the other seasons. Occasional bodies of Wabash silty clay loam are poorly drained to the extent that they have had to be tiled.

12 A complex is mapped where two or more soils occur together as individual bodies too small to be shown separately on the map with the scale being used. Wabash-Judson silt loam is one example of a complex.
or ditched before they can be cultivated. Areas where drainage has not been improved are used for permanent pasture.

The flood plains of streams are subject to overflow at irregular intervals. The larger bottoms in Ida County are occasionally flooded, but crops are not often damaged. Some of the smaller bottoms, particularly those along streams where water concentrates from bodies of sharply rolling or hilly upland, are flooded more frequently, and crops are subject to considerable damage. The latter type of areas includes some Wabash silt loam and Ray silt loam. A few of the alluvial fans occupied by Judson silt loam are occasionally subject to flood, but the land is sloping so that the volume of water spreads widely and is not usually destructive. Lands subject to flood should be kept in permanent pasture. The danger of occasional overflow and the need for improvement of drainage in local areas in the bottoms are the chief problems of management that apply directly to Alluvial soils but not to others in the region.

**Wabash Silt Loam (Wh) (26)**

Wabash silt loam, excluding that which has been mapped in the Wabash-Judson complex, occurs more extensively than any of the other soils in the stream bottoms. The total acreage of the soil type amounts to slightly more than 10 percent of the land in Ida County. Bodies of Wabash silt loam range in width from 5 to 10 rods in the valleys of small intermittent streams to as much as 1 mile in a few places along the Maple River. The largest individual body of Wabash silt loam is the one that extends along the course of the Maple River in Ida County and branches out in the valleys of the large tributary streams. Strips that extend up the valleys of these tributary streams are sometimes 6 or 8 miles in length, and they commonly branch again into numerous drainageways. Soils in the upland drainageways are usually represented as a complex of Wabash silt loam and Judson silt loam.

The flood plains occupied by Wabash silt loam are relatively flat and slope gently with the gradient of the stream. There are occasional small irregularities in the surface, particularly along the channel itself and wherever a small stream joins a larger one. Channels of the major streams are 15 to 30 feet deep, whereas the channels of smaller streams are usually less than 10 feet deep.

The profile of Wabash silt loam is somewhat variable in the texture and color of the separate layers, depending upon the kinds of sediments deposited in the local area. In general, however, the surface layer is a dark grayish-brown to black silt loam, 16 to 18 inches thick, that grades into a layer of dark grayish-brown silty clay loam marked by a few rust-brown stains.
The color of the soil material usually becomes lighter with increasing depth down to 20 or 24 inches, below which there is a gray silty clay loam with a variable degree of mottling. The mottlings become especially numerous at depths between 34 and 40 inches and seem to persist far down into the alluvium. The upper layers of the soil are slightly acid in reaction, whereas the deeper ones range from slightly acid to neutral.

The principal variations in the soil profile within areas of Wabash silt loam are in the texture of the surface layers. In slightly elevated areas near the stream channels the surface layer has a loam texture. These areas would have been indicated as Wabash loam if they had been extensive enough to warrant an additional separation on the map. Occasional small spots of silty clay loam in local depressions have also been included with Wabash silt loam because those spots were too small to be shown separately.

The larger bottoms of Wabash silt loam are generally cultivated, whereas the small flood plains are more often left in pasture. Approximately 60 percent of the entire acreage of the soil type is being used for the growing of crops, with corn as the principal one. Corn is planted for a number of consecutive years, sometimes as many as 5 or 6, on fields composed largely of Wabash silt loam. Oats or other small grains are occasionally sown, but hay crops are seldom grown on this soil type. Acre-yields of crops are 40 to 65 bushels of corn, 25 to 50 bushels of oats, 18 to 30 bushels of wheat and 1 to 2 1/2 tons of hay. Where bodies of Wabash silt loam are used for pasture, the land is kept permanently in bluegrass. Scattered clumps of trees occur in the permanent pastures, especially along the channels of the streams.

Slow natural drainage often delays farming operations on Wabash silt loam in the spring. The drainage can be improved by the addition of coarse organic residues such as corn stalks and by the growing of deep-rooted crops such as alfalfa and sweet clover. The introduction of more legumes and grasses into the cropping system is recommended for Wabash silt loam areas, even though the soil will produce higher yields of corn under continuous cropping than will other soils in the region.

Wabash Silty Clay Loam (Wa) (48)

Wabash silty clay loam covers little more than one-half of one square mile in Ida County. The soil type occurs in small isolated bodies in the stream bottoms, principally in the valley of the Maple River between Ida Grove and the north county line. A few additional areas occur in the flood plain of the Little Sioux River. Individual bodies of Wabash silty clay loam range in size from 10 to as much as 100 acres, though most of them are approximately 30 acres in extent. The areas are usually flat or slightly depressed with respect to the other parts of the stream bottoms and represent the land with the poorest drainage.

The surface layer in the profile of Wabash silty clay loam is a dark grayish-brown or black silty clay loam, which grades into a very dark gray silty clay at 10 to 12 inches. The second layer extends downward as far as 22 or 26 inches where it merges with a grayish-brown, mottled silty clay loam. Mottlings increase in number below depths of 38 to 42 inches but otherwise
the deeper soil materials remain essentially unchanged. All of the layers of the profile are commonly neutral to slightly basic in reaction, but the surface layer is sometimes slightly acid. Other slight variations in the soil exist in the transitional zones between Wabash silty clay loam and Wabash silt loam, all of which were included in the former soil type. These transitional areas consist of soil that has a texture intermediate between silty clay loam and silt loam.

Approximately one-half of the total area of Wabash silty clay loam is being cultivated and the other half is being used for pasture or for the production of wild hay. Only a few of the uncultivated areas support a growth of wild grasses that can be cut for hay. In the cultivated areas corn is the chief crop produced with yields ranging from 30 to 60 bushels per acre, depending upon the season and the drainage of the local area of the soil type. Yields of clover-timothy hay, which grows luxuriantly, range up to 8 tons per acre. Oats and other small grains tend to lodge on Wabash silty clay loam and the average yields are therefore low.

Drainage is either restricted or poor in most of the bodies of Wabash silty clay loam. There are a few areas, chiefly in the bottoms of the Little Sioux River, in which ponds persist during a part of each summer. All of the bodies of the soil type remain wet during seasons of heavy rainfall, and crops are damaged during such years. The drainage of Wabash silty clay loam could be improved by the incorporation of cornstalks and similar coarse organic materials with the soil and by the growing of sweet clover at regular intervals.

Judson Silt Loam (Js) (131)

The acreage of Judson silt loam, excluding areas mapped in the Wabash-Judson complex, ranks second to that of Wabash silt loam among the Alluvial soils, even though its total extent equals only 1 percent of Ida County. Judson silt loam occurs in the form of low alluvial fans which range in size from 5 to 40 acres, as a rule, but sometimes reach 80 acres. Most of the fans occupy positions along the margins of the flood plains where tributary streams enter a larger valley. The highest point in each fan is located immediately adjacent to the upland, and there is a gradual slope away from the upland toward the larger stream channel. Many of the fans lie at very slight elevations above the flood plains of the streams, and the boundary between Judson silt loam on the fan and Wabash silt loam in the bottom must be drawn arbitrarily in most instances. The gently sloping nature of the alluvial fans normally provides adequate natural drainage for the soil type.
The profile of Judson silt loam varies somewhat from one location to another. There are some changes in the depth and color of the surface layer, and the texture and color of the deeper layers may also vary from place to place. Most of these variations are of minor importance and do not materially alter the properties and productivity of the soil from that of the dominant profile. The dominant profile consists of four layers that are separated by broad transitional zones. The surface layer of the soil is a dark grayish-brown or black silt loam, 18 to 22 inches deep, and it overlies a dark gray, heavy silt loam that is 6 to 8 inches thick. Below depths of 26 to 28 inches the soil material is a yellowish-brown or brown silty clay loam which becomes more gray with increasing depth. Between 34 and 40 inches, mottlings of gray and reddish-brown become more numerous, and the soil mass appears grayish-brown. All of the layers in the profile of Judson silt loam in Ida County are neutral or basic in reaction. In most areas of its occurrence in Iowa, however, the soil type is slightly to moderately acid in the upper horizons and may become neutral in the deeper layers.

Judson silt loam is one of the most productive soils in Ida County, and almost all of it is under cultivation. Areas of the soil type are seldom large enough to include entire fields, and they are consequently farmed either with the soils of adjacent uplands or with those of the first bottoms. The crops grown include corn, oats and hay, with high proportions of corn being produced on most areas. Corn is often planted for 3 or more consecutive years after which the soil is seeded down to hay with oats as a nurse crop. Crop yields in favorable years are 50 to 70 bushels of corn, 40 to 60 bushels of oats and 1\(\frac{1}{2}\) to 3 tons of hay per acre.

Wabash-Judson Silt Loam\(^{13}\) (WJ) (26a)

Wabash-Judson silt loam, a complex of two soil types occurring together in an intricate pattern, is found along the upland drainageways in all parts of Ida County. The individual bodies of the soil complex are always narrow, commonly less than 200 feet wide, but they extend for as much as a mile in some instances. Each area consists of a strip of Wabash silt loam in the central part of the draw bordered by a narrow band of Judson silt loam on each side of the draw or along the toes of the upland slopes. Although the individual bodies of Wabash-Judson silt loam are not large, there are many of them, and their aggregate area equals 24,960 acres, 9 percent of the land in Ida County.

\(^{13}\) The soil now recognized as a complex association of Wabash silt loam and Judson silt loam was formerly mapped as Wabash silt loam, colluvial phase.
The profiles of both Wabash silt loam and Judson silt loam (described on pages 30 and 32, respectively) can be found in each body of the soil complex. The profile of Wabash silt loam occurs in the drainageway itself, whereas the Judson profile is located along the outer margins of Wabash-Judson areas. The two profiles are quite similar in many respects, and the differences between the two, although easily recognized, are not reflected in significant differences in productivity when the two soils occur together.

Natural drainage is adequate in most areas of Wabash-Judson silt loam. There is a slight slope from the upland toward the center of the drainageway, and the draws themselves normally have a slope of 2 or 3 percent downhill. Occasionally, natural drainage is not adequate where the draws penetrate a small basin-like depression in the highest parts of the uplands. Tile drains have been used in these small depressional areas to improve the drainage.

The major part of the total acreage of Wabash-Judson silt loam is under cultivation. Areas that are cultivated are usually farmed with surrounding bodies of Marshall silt loam. The yields of corn and hay are somewhat higher than those from Marshall silt loam, whereas the average yields of small grains are approximately equal. A few small areas, particularly where the natural drainage is slow, have been left in permanent grasses and are used for pasture.

**Ray Silt Loam (RI) (195)**

Ray silt loam is the least extensive of the soils found in the stream bottoms. There are no more than half a dozen individual bodies of the soil type in the county, and their entire area is less than one-half square mile. One small area occurs north of Ida Grove, another between Ida Grove and Battle Creek, two southwest of Battle Creek and one along an intermittent stream in Section 19 of Garfield Township. Most of these areas are situated along the margins of the stream bottoms where light-colored sediments washed down from rolling to hilly uplands have accumulated over darker colored alluvium. Ray silt loam is flat or slopes very gently downstream and toward the stream channel.

The surface layer of Ray silt loam is a friable, light yellowish-brown silt loam, 14 to 18 inches thick. The color becomes slightly darker below a depth of 14 to 18 inches, and the texture of the soil material is also a little heavier. There is an abrupt change from the light-colored soil material to dark grayish-brown or black silty clay loam at depths that commonly range between 20 and 36 inches. The thickness of the light-colored soil over the dark-
colored sediments may range from 6 to 8 inches to as much as 60 inches, but it falls predominantly between 20 and 36 inches. The light-colored layers in the profile of Ray silt loam are neutral to basic in reaction, whereas the dark-colored layers are slightly acid, as a rule.

Most of the areas of Ray silt loam are cultivated. Crops grown are similar to those produced on the adjoining Wabash soils, but the yields of corn and hay are slightly lower. Small-grain yields from Ray silt loam compare favorably with the ones obtained on Wabash silt loam. The average yields of crops are reduced by flood damage to standing grain, corn or hay when heavy rains bring down fresh sediments from the uplands. The reduction of flooding or overflow and the further application of organic matter will increase the average yields of crops grown on Ray silt loam.

MANAGEMENT OF SOILS IN IDA COUNTY

High yields of crops of good quality are desired by all farmers, but such yields are obtained only when all of the factors that govern productivity are favorable. Productivity depends upon a large group of factors, among which climate, topography, soil and management are important ones. Of these various factors, management is the one over which a farmer can exercise a large degree of control. Elements of climate or the character of the soils on a farm cannot be changed; they must be used as they are. Considerable differences in management are possible, however, and do occur within a group of similar farms on one type of soil. Such differences, especially those in the management of the soil, may bring about large differences in the amount and quality of the crops produced.

Much information regarding the yields obtained with different levels of soil management has been accumulated through the experience of farmers and the trials of experiment stations. Such information is not as yet complete, but it can form a basis for improving present methods of handling the soil on many farms. A number of desirable and undesirable management practices, particularly as they are related to the soils of Ida County, are therefore considered in this section of the report. Recommendations presented are based on information obtained from farmers as to their most successful practices, on field observations in Ida County and on the results obtained in field and laboratory studies of the Iowa Agricultural Experiment Station. The recommendations may be adopted on an ordinary farm with little difficulty, as a rule, and with the assurance of satisfactory results under average seasonal conditions.

Soil-management practices must be adapted to fit the organization of a farm unit as well as being designed to maintain soil productivity. There are usually several types of management suitable for maintaining the productivity of a given soil type, but not all of them will fit into the operating scheme of a given farm. A number of satisfactory alternatives are usually possible, and some one of these can be selected by the farm operator for his particular set of conditions. The choice of one or the other of several alternatives in soil management must be made at frequent intervals by the farm operator, and the need for such decisions cannot be eliminated by a group of recom-
mendations. It is felt, however, that a discussion of various ways of managing the soil will help to form a basis for the making of sound decisions. Different phases of soil management are discussed under the following headings: Crop Rotations, Maintaining Organic Matter, Tillage and Erosion Control, Liming and Drainage.

CROP ROTATIONS

The practice of alternating or rotating crops is one important measure in maintaining yields of crops and improving the fertility of the soil. It has long been recognized, for example, that alternating crops of corn and oats yield better than does either crop when grown continuously. Moreover, the continued production of an intertilled crop such as corn tends to lower the contents of plant nutrients and organic matter in the soils and bring about a gradual deterioration of soil structure. To offset these tendencies, particularly with respect to organic matter and structure, it is necessary to grow crops other than corn and small grains in the rotation being followed. Legumes and grasses, both of which represent types of close-growing vegetation, are used in rotations with corn and small grains. The former crops have beneficial effects upon the soil and, although they often provide smaller returns than corn, for instance, they leave the soil in better condition for the crops that succeed them.

The selection of a rotation or rotations for a given farm must be made on the basis of the nature and pattern of soil types and the organization of the farm unit. No one rotation is generally adaptable to all of the farms or soils in Ida County. A rotation that would be feasible on a well-stocked, well-equipped farm might not be at all satisfactory on a farm with less livestock and less machinery. Similarly, the rotations that could be followed on Wabash silt loam are not suitable for Marshall fine sand. On soil types such as Marshall silt loam there will be considerable differences in the present productivity because of differences in the past management of the land, and these must be taken into account in the choice of suitable crop rotations. Many other considerations are involved in the selection of the best rotations for a particular field or farm.

A number of rotations are suggested for the different groups of soils in Ida County. These rotations include the various alternatives that have been satisfactory; a relatively large number is given so that selections can be made to fit the particular conditions on a given farm. Modifications of the recommended rotations may be found necessary in some instances.
Rotations for Dark-Colored Soils of Level to Gently Undulating Areas

1. Six-year rotations
First year—Corn  
Second year—Soybeans  
Third year—Corn  
Fourth year—Small grain  
Fifth year—Mixed hay*  
Sixth year—Mixed hay

First year—Corn  
Second year—Corn or soybeans  
Third year—Oats  
Fourth year—Alfalfa†  
Fifth year—Alfalfa  
Sixth year—Alfalfa

2. Five-year rotations
First year—Corn  
Second year—Corn  
Third year—Small grain  
Fourth year—Winter wheat  
Fifth year—Clover

3. Four-year rotations
First year—Corn  
Second year—Corn  
Third year—Small grain  
Fourth year—Mixed hay

First year—Corn  
Second year—Small grain  
Third year—Mixed hay  
Fourth year—Hay or pasture

4. Three-year rotations
First year—Corn  
Second year—Soybeans  
Third year—Corn

Rotations for Dark-Colored Soils of Gently to Moderately Rolling Areas

1. Six-year rotations
First year—Corn  
Second year—Corn  
Third year—Small grain  
Fourth year—Alfalfa  
Fifth year—Alfalfa  
Sixth year—Alfalfa

2. Five-year rotations
First year—Corn  
Second year—Corn  
Third year—Small grain  
Fourth year—Alfalfa  
Fifth year—Alfalfa

3. Four-year rotations
First year—Corn  
Second year—Corn  
Third year—Small grain  
Fourth year—Mixed hay  
Fifth year—Hay or pasture

4. Three-year rotations
First year—Corn  
Second year—Small grain  
Third year—Mixed hay

*Mixed hay is meant to include all legumes and grass mixtures. Such seedings can be used for hay or as rotation pasture.
†Alfalfa seedings should ordinarily include some grass seed with the alfalfa.
Rotations for Upland Soils with Excessive Natural Drainage

1. Six-year rotations
   - First year—Corn
   - Second year—Small grain
   - Third year—Mixed hay
   - Fourth year—Mixed hay
   - Fifth year—Mixed hay
   - Sixth year—Alfalfa

2. Five-year rotations
   - First year—Corn
   - Second year—Small grain
   - Third year—Alfalfa
   - Fourth year—Alfalfa
   - Fifth year—Alfalfa

Rotations for Soils of the Stream Bottoms

1. Six-year rotations
   - First year—Corn
   - Second year—Corn
   - Third year—Small grain
   - Fourth year—Mixed hay
   - Fifth year—Mixed hay
   - Sixth year—Mixed hay

2. Four-year rotations
   - First year—Corn
   - Second year—Corn
   - Third year—Small grain (sweet clover)
   - Fourth year—Sweet clover pasture
   - Fifth year—Mixed hay
   - Sixth year—Mixed hay

Maintaining Organic Matter

The nature and amounts of organic matter in the soil are important for a number of reasons. Organic matter acts as a storehouse for the nitrogen needed by growing plants, and it also contains appreciable quantities of other plant-nutrient elements, particularly phosphorus. It serves as an energy source for microorganisms, and some forms of organic matter have a beneficial effect upon the physical condition (structure, permeability, etc.) of the soil. Because of the numerous ways in which organic matter may improve the condition of the soil, the need for maintaining an adequate supply as part of a program for long-time, high production is readily apparent.

Most of the soils in Ida County contained large quantities of organic matter when they were first brought under cultivation. The amounts were especially high in soils such as Wabash silty clay loam and Wabash-Judson silt loam, whereas they were relatively low in Marshall fine sand. Poorly drained soils and soils of finer texture generally contain larger quantities of organic matter than do well-drained soils or those of a sandy nature.

Under the natural conditions which prevail before the breaking of the prairie or the clearing of forest, there is a balance established between the amounts of organic matter added by the native vegetation and that which is decomposed by microorganisms. The quantities of organic matter and humus in the soil, therefore, tend to remain the same after the soil type has come into equilibrium with its climatic environment. When the dark-colored soils
of grasslands are brought under cultivation, the content of organic matter usually decreases for a number of years. Crops are present and grow on the soils during a smaller part of the year than did the native vegetation, and part of each crop is removed from the land. Furthermore, the cultivating of the soil tends to promote more rapid decay of organic residues. Steps must therefore be taken by the farmer to replenish the supply of organic matter and humus in the soil so as to maintain levels which will allow satisfactory crop production.

Organic matter may be added to the soil by plowing down crop residues, by adding barnyard manure, by using green manure crops and by growing grass-legume mixtures for a period of time in each rotation. All of these different methods of keeping up the supply of humus may be found useful on a single farm, but some one or two perhaps will be utilized more often than the others. The methods followed in maintaining the supply of organic matter in the soils of a farm must be adapted to the nature of the soils and to the organization of the farm unit.

Among the various ways of adding organic matter to the soil, the plowing under of crop residues is perhaps the most common. Although the plowing under of crop residues will not maintain the content of organic matter at desirable levels in the soils of Ida County, the practice will help to keep an adequate supply in the soil. Care should therefore be taken to conserve and utilize all crop residues except where diseases or insect pests are present in such residues. Practices such as the burning of cornstalks, for example, are not desirable from the standpoint of soil fertility maintenance and should not be followed except where absolutely necessary. Furthermore, the addition of such types of organic matter as cornstalks is especially helpful in improving the physical condition of heavy-textured soils and in the prevention of erosion.

Barnyard manure is one of the most valuable forms in which organic matter can be added to soils. It supplies larger quantities of nitrogen than do other kinds of organic matter generally available, and it has a number of other beneficial effects. Where considerable quantities of manure are available, as on a livestock farm, the conservation and proper use of barnyard manure is a most important step in maintaining an adequate supply of organic matter in the soil. It often happens, however, that manure is not well handled and thus loses much of its value before it can be applied to the land. The use of large quantities of bedding to absorb the urine, storage of the manure where it will be kept moist but will not be exposed to leaching, and plowing it under as soon as possible after spreading are precautions that should be taken if maximum benefits are to be obtained.

Sufficient quantities of manure to permit necessary applications on all fields are not available on many livestock farms, and even smaller amounts are produced on grain farms where fewer animals are kept. The growing of green manure crops and the use of grasses and legumes in long rotations to supplement the organic matter supplied as barnyard manure and crop residues is therefore necessary on most farms. The best green manure crops for general use are legumes, though other crops may be more desirable in special
cases. Legumes, when they are well inoculated and thrifty, obtain a large proportion of their nitrogen from the air, thus adding considerable quantities to the soil as they are plowed under. The growing of crops such as sweet clover also improves the physical condition of soil types such as Wabash silty clay loam. Good stands of legumes such as sweet clover and alfalfa can be obtained on some of the soil types in Ida County without prior applications of lime. Better catches will be obtained on many of the soils, however, if lime is applied one year ahead of the seeding. Lime requirements of the different soils in the county are discussed in a subsequent section of this report.

The use of close-growing crops such as the grasses and legumes, especially the former with their fibrous root systems well distributed through the upper part of the soil mass, helps to maintain the supply of organic matter in the soil. Grasses also seem to have beneficial effects upon the structure of the soil, making it more porous and providing better aeration and water absorption. More general use of grasses, especially in grass-legume mixtures, would be helpful in the maintenance of soil fertility in Ida County.

Increased applications of organic matter in some form would benefit crops on many of the soils in Ida County at the present time. Such additions are particularly desirable on Marshall fine sand, the O'Neill soils, and the steeper Marshall and Clarion soils under cultivation. The Wabash and Judson soils, on the other hand, contain relatively large amounts of organic matter and humus, and further applications would not be generally beneficial. In the heavy-textured Wabash soils with slow natural drainage, the addition of coarse organic residues such as cornstalks or sweet clover stems and the mixing of such residues with the soil would be helpful. The dark-colored soils of the undulating to gently rolling land (Marshall, Waukesha, Clarion) contain more organic matter than do the sandy or steep soils and less than the soils of the stream bottoms. The need for applications of organic matter is less urgent on such soils than on the sandy or steep ones, but provision should be made in the methods of managing these soils to add somewhat larger quantities of organic residues in the form of barnyard manure, as green manure or by the greater use of grass-legume mixtures in the rotation.

**LIMING**

The principal crops of Ida County make their best growth on soils that are neutral or slightly acid in reaction. Some crops, such as soybeans, are tolerant of moderately acid conditions, but others such as alfalfa and sweet clover, of particular importance in a program for maintaining soil fertility, do not thrive on soils that are even moderately acid. Since many of the soils in humid regions are acid, it is generally necessary to neutralize this acidity before the best crops can be produced. The application of lime, commonly in the form of finely ground limestone, is the usual practice in correcting soil acidity. Applications of lime should be made according to the degree of acidity of the soil, the nature of the crop to be grown and the general needs of the farm as a whole. Heavier applications must be made on the more acid soils or when the crop to be grown is intolerant of acid conditions.
The acidity of soils in Ida County ranges from moderately acid in the surface horizons of such types as the Waukesha and O’Neill to basic in the entire profile of Marshall silt loam, light-colored phase. A number of the soil types such as Marshall silt loam, Clarion silt loam and Wabash silt loam are acid in the surface horizons but are either neutral or basic in reaction in the deeper layers. Very few of the soils in Ida County are acid throughout their entire profiles, although the O’Neill loam and O’Neill silt loam are occasionally acid down to and including the upper part of the underlying sand and gravel beds. The steeper Clarion and Marshall soils and those of the stream bottoms with the exception of Wabash silt loam are generally neutral or basic in the upper layers and basic in the deeper ones. Variations in the degree of acidity commonly exist within areas of Marshall silt loam, Marshall fine sand and the Clarion soils. The gently undulating portions of Marshall silt loam are generally more acid in the surface layers than are the steeper bodies of the same soil type. Similar conditions can be found in the Clarion soils, whereas soil acidity varies locally within Marshall fine sand.

Because of local variations in the degree of acidity and lime requirement, it is generally desirable to determine, in advance of application, the amounts of lime that are needed on the different parts of a field. Samples of the soil, especially the plow layer, should be selected to represent soil conditions in the various parts of a field. These samples then can be tested for their lime requirement by the county agricultural agent, or they can be sent to the Soils Subsection of the Iowa Agricultural Experiment Station. After the tests have been completed, the applications of limestone should be made in the amounts needed to neutralize soil acidity in the different parts of a field. When the tests indicate that lime need not be applied, as for example on soils which are neutral or basic in reaction, additions would not be beneficial to crops. Liming is not recommended for soils that are neutral or basic in reaction as are most of the soils of the stream bottoms and the light-colored Marshall soils in Ida County.

The rates of application of lime are governed chiefly by the acidity of the surface layers of the soil, but consideration should also be given to the lime requirements of the deeper horizons in the profile. Less lime needs to be added to a soil which is acid in the upper layer if the deeper ones are neutral or calcareous. Smaller applications of lime are also needed to neutralize the acidity of a sandy soil than of one which is heavy in texture such as a clay or clay loam. Liming at the rate of 1 1/2 to 2 tons per acre would generally promote better growth of alfalfa and sweet clover, particularly during the first year, on the undulating to gently rolling Marshall silt loam, on Waukesha silt loam and on the smoother bodies of Clarion soils.

TILLAGE AND EROSION CONTROL

Problems of tillage and erosion control in Ida County will be considered together since questions that arise are closely related. Land that is not being cultivated, other things being equal, is less susceptible to harmful erosion than land which is being tilled. In Ida County, as much as 80 percent of the land is used for the production of crops in a single year, and much of the
remaining 20 percent is plowable or rotation pasture. Questions of controlling accelerated erosion arise primarily on these cultivated lands, and most of the harmful erosion is due to the action of water. Only the local spots of Marshall fine sand are affected by wind, whereas 75 percent of the area of Ida County consists of undulating to rolling upland areas that are subject to varying degrees of water erosion. The control of accelerated erosion on these undulating to rolling lands depends upon care in the management of the soils, including tillage operations, and the use of supplementary mechanical measures in a number of instances.

Some problems of tillage, such as the maintenance of good tilth in Wabash silty clay loam, are not related to the control of accelerated erosion because of the conditions of soil and relief. Areas of Wabash silty clay loam are flat, sometimes slightly depressed portions of the stream bottoms. They occur in association with Wabash silt loam, a soil which is more easily maintained in a favorable physical condition. Care should be exercised in the cultivating of the Wabash soils, especially the silty clay loam, so that they are not plowed either when too wet or too dry. Tilling these soils under either extreme of moisture conditions (too dry or too wet) will result in a cloddy condition that cannot be easily altered to form a satisfactory seedbed. Fall plowing of Wabash silty clay loam, thus exposing the furrow slice to alternate freezing and thawing over the winter, is recommended, and the practice can also be applied to Wabash silt loam from time to time. Fall plowing is not recommended for the soils of undulating to rolling areas; the beneficial effects on soil structure would be more than offset by the damage through erosion while the land was without vegetative cover.

Approximately three-fourths of Ida County consists of land that is subject to some degree of accelerated erosion under cultivation. The remaining one-fourth is composed of lands, either in the form of flood plains or terraces, that are level and on which erosion does not occur because of the lack of relief. Variable amounts of erosion have occurred on the sloping lands; the degree of accelerated erosion ranges from insignificant amounts on some of the undulating uplands to serious proportions on bodies of Marshall silt loam, light-colored phase. Many cultivated fields, particularly in the sections that are rolling to hilly, show evidences of sheet erosion in the form of light-colored patches on the slopes and shoulders of ridges. Other areas, less widely distributed, have been damaged by a combination of sheet and gully erosion. Damage through erosion and the problems of controlling it are more common in the steeper areas occupied by Marshall silt loam and those of Marshall silt loam, light-colored phase.

Among the various practices needed for the control of accelerated erosion, measures that are a part of a program of good soil management are most important. In the region of Ida County, as in other portions of Iowa, the selection of proper rotations, the application of manure, the growing of green manure crops and the addition of limestone to acid soils are essential to the maintenance of soil fertility. These practices are equally important to the control of erosion. Where soils are well farmed there is less danger of harm-
ful erosion than in regions where the soils are not well handled. Crops growing on fertile soils are more vigorous; the soils themselves are more permeable to water and less susceptible to movement by water and wind. Where the soils of sloping lands are not well farmed, accelerated erosion often does occur, and special measures are then needed to combat it. Certain supplementary practices, especially in the systems of planting crops and in tillage practices, are helpful in conjunction with programs of good soil management in the control of accelerated erosion on sloping lands such as those of Ida County. The landscape of Ida County is generally rolling with a well-developed network of intermittent streams. In this type of rolling landscape, practices such as the seeding down of waterways, contour cultivation and strip cropping are supplementary measures of considerable value in reducing erosion.

**Grassed Waterways**

The seeding down of waterways to grass and their maintenance in permanent vegetation is especially important among the various measures for the control of erosion. Grassed waterways prevent the development of gullies in the channels of the intermittent upland streams. Such gullies would, as they grow, interfere more and more with the farming of an entire field as one unit. Moreover, it is far simpler to maintain a grassed waterway than it is to control and reclaim a gully, once the latter has reached a size that interferes with farm operations. In the seeding down of a waterway, the grass should extend far enough up the slopes beside a draw so that cutting cannot begin along the edges of the grassed area. Where a small gully has already developed, it may be necessary to use sod checks (strips of sod placed across the gully) to help stabilize and control the gully until the seeding becomes established. Measures for the control and reclamation of established gullies are discussed in a later paragraph; grassed waterways are one of the measures for the prevention of gullies in the channels of intermittent streams.

**Contour Cultivation**

Contour cultivation is the practice of plowing, planting and cultivating around the slope so as to stay at the same level. In order to cultivate around the slope, contour lines must first be established, and this can be done by rather simple methods. Contour lines are simply lines drawn through those points on a slope which lie at the same elevation. After contour lines have been located, corn is planted along and parallel to this line and cultivated in the same way. The practice of contour cultivation helps to restrict water movement and thus aids in the control of accelerated erosion in rolling and gently rolling lands. Long, relatively unbroken slopes that are a part of a system of distinct ridges and valleys lend themselves well to contour cultivation. There are a number of such slopes in Ida County, and more planting of corn on the contour is desirable.

Strip Cropping

Strip cropping, as the name suggests, is the planting of crops in variable but suitable widths. Alternate strips usually consist of a close-growing crop and an intertilled crop. For example, there may be a strip of hay and a strip of corn, another of hay and another of corn, and so on. Strips are usually laid out to follow the contour, although they are sometimes planted across the general slope of the field. Contour strips will be found more generally useful in Ida County; field strips are adapted to regions in which long and uniform slopes make up an entire field. Buffer strips (permanent narrow bands of grass along the contour at intervals across a field) have been used widely instead of alternate strips of corn and hay, or corn and small grain. Buffer strips permit the operation of a field as a unit, either for corn, hay or pasture, but they do not afford as great a degree of protection against washing during heavy storms as do wider strips of close-growing vegetation. The proper width and arrangement of strips in a field depends upon the type of soil, its present condition with respect to fertility and tilth, the topography and the kinds of crops to be grown. The strips of intertilled crops can be wider on the more permeable soils and on more gentle slopes, and they must be narrower, generally, as the degree of slope increases.

The establishment of a system of strip cropping usually requires the changing of field boundaries and the relocation of fences. When such changes are made, steep or badly eroded areas and land otherwise not suitable for cultivation should be left out of the new field and planted to grasses or trees.

Terraces

Terraces are a more expensive but more certain device for the control of erosion than are contour cultivation and strip cropping. The building and maintenance of earth structures such as terraces is costly, however, and consideration should be given to the probable benefits as compared to expenses of construction and upkeep. Terraces are not generally adaptable to strongly sloping or hilly lands in Ida County, but they can be used on fields that have more gentle slopes. The kind of terrace commonly used consists of a broad, gently rounded ridge which follows the contour rather closely but has a slight grade downhill. There is a shallow channel along the upper side of the terrace that serves to carry runoff water around the slope to a protected or grassed waterway which can then transfer it to lower levels. Terraces should be used in connection with such measures as good crop rotations, application of organic matter, liming and fertilization.

Control of Gullies

The areas that have been severely damaged by erosion in Ida County are commonly marked by occasional or frequent gullies. The gullies found in the uplands are generally shallow, ranging from a few inches to 1 or 2 feet.

in depth. There are occasional deeper gullies that extend into the upland, and there are other deep gullies in the channels of the intermittent streams. The largest gullies, usually found in the stream valleys, may be as deep as 15 to 20 feet in some instances, but the more common depths fall between 3 and 7 feet.

Various measures have been used for the control of gullies and for the reclamation of gulled areas. Relatively simple measures are usually adequate to provide control over small gullies, those for example which are less than $1\frac{1}{2}$ feet deep. Such gullies often can be controlled by changing cultural practices or by plowing in and seeding them down as grassed waterways. Sod checks or temporary dams constructed with brush, woven wire or sod bags are sometimes necessary to allow a seeding of grass to become established.\footnote{Jepson, Hans G. Prevention and control of gullies. U. S. D. A. Farmers' Bul. 1813. 1939.}

In the control of large gullies, temporary check dams are sometimes successful, but additional measures are commonly necessary. The deeper gullies which extend into the uplands and which cannot be controlled by means of changes in cultural practices or by check dams may need to be planted to trees.\footnote{Ayres, O. G. Recommendations for the control and reclamation of gullies. Iowa Eng. Exp. Sta., Bul. 121. 1935.} Tree plantings, if they are to be successful, must be fenced so that livestock cannot disturb or harm the young trees. Some of the large gullies, especially those in the channels of intermittent streams, may require permanent structures for their control. Permanent dams, whether of earth or concrete, are expensive, and gullies should be controlled by some other means at an earlier stage of development if at all possible. A number of different types of dams have been used for the control of large gullies.\footnote{Ramsey, Guy R. Trees to control soil erosion on Iowa farms. Iowa Agr. Ext. Serv., Cir. 223. 1936.}

In the preceding discussions of supplementary measures for the control of erosion, stress has been laid on the need for good soil management to maintain fertility and a favorable physical condition. It might be well to reemphasize the fact that the important steps in preventing erosion constitute good farming from a long-time point of view. Cultivating the smoother bodies of land and the more permeable soils while devoting the more rolling and hilly lands to pasture and forest—parts of good farm practice—greatly aids in the control of erosion. Soil-management practices such as applications of manure, the use of lime and fertilizer as needed and good crop rotations are all essential for the maintenance of soil fertility, and they are also necessary for the control of erosion.

**DRAINAGE**

The network of intermittent streams in Ida County, illustrated in fig. 2, reaches into every square mile of the region and provides adequate natural drainage for nearly all of the upland. There are a few areas of Marshall silt loam in the northeasterm part of the county where the natural drainage is inadequate for the satisfactory production of crops. Additional areas with restricted drainage occur in the flatter portions of the larger stream bottoms and in some of the swales that comprise the intermittent drainageways. The
SOIL SURVEY OF IOWA

total acreage affected by imperfect or restricted drainage in Ida County is small, however, and does not amount to as much as 1 percent of the land.

Tile drains have been used in the uplands in the northcentral part of Ida County and in the Wabash-Judson areas or swales in a number of different places. Such drains have generally been successful; the soils of the uplands and of the upland drainageways are relatively permeable so that tile will draw for considerable distances. Drainage problems in the uplands of Ida County are of distinctly minor importance.

All bodies of Wabash silty clay loam have restricted natural drainage, but the total acreage of this soil type is less than one-half square mile. Furthermore, most areas of Wabash silty clay loam are small and they can be utilized as pasture while adjacent, better-drained soils are used for the production of crops. Where Wabash silty clay loam is being used for crop production, the natural drainage has been improved by means of ditches or by the use of tile drains. Tile drains are usually not successful in Wabash silty clay loam; the soil mass is heavy and rather compact so that water movement toward a drain is slow. Shallow ditches have been dug in a number of areas of Wabash silty clay loam, especially where intermittent streams from the uplands empty into the Wabash flats. These ditches help with the removal of water but seldom provide good drainage for the heavier Wabash soils. The position of the Wabash soils in the stream bottoms tends to prevent satisfactory drainage and makes the soils subject to overflow from time to time.

Floods along the streams, especially the larger ones, do not occur frequently. Some of the small bottoms are flooded every 3 or 4 years, whereas the larger ones are under water only once in 8 or 10 years. The channels of the major streams are relatively deep, and most of them have considerable fall so that large volumes of water can be carried away rapidly. In a few places near the Cherokee-Ida County line, the channel of the Maple River has been deepened and straightened. Otherwise, very little ditching has been done along the major stream channels. Small ditches, ranging from 2 to 4 feet in depth, have been dug across the flood plains of the larger streams in a number of places to carry flood waters from intermittent drainageways directly to the larger channel. Flood waters damage crops in occasional years, but such damage is seldom extensive.

USE OF COMMERCIAL FERTILIZERS

Nitrogen, phosphorus and potassium, among the elements necessary for the growth of plants, are used rather heavily in crop production and often become deficient in the soils of humid regions. Where deficiencies arise, both the total yield and the quality of crops are affected adversely. Steps must then be taken to correct the deficiency by adding the lacking element or elements to the soil.

Nitrogen can be added to the soil in large quantities by the application of manure, by the growing and plowing under of green manure crops or by applying commercial fertilizer. Phosphorus and potassium are present in appreciable quantities in manure, and they are available in various forms
as commercial fertilizers. Applications of these three elements to the soils of Ida County have, in the past, been restricted largely to the amounts present in barnyard manure, the nitrogen in green manures, and some commercial fertilizers applied on scattered farms and on special crops. The quantities of commercial fertilizer used in Ida County have been relatively small.

The soils of Ida County, considered as a group, are relatively fertile, most of them being members of the Prairie group or being Prairie-like in nature. A few soils such as Marshall fine sand or the steep Marshall and Clarion are much less fertile than the dark-colored soils of gently rolling or undulating lands. Fertile soils contain relatively large quantities of the essential plant nutrient elements, and most of them are also marked by a favorable physical condition. Care in the handling of fertile soils is necessary, however, if that fertility is to be maintained under the long-time production of crops. Where soil fertility is originally low, that is where the stores of plant nutrients are small, more care is necessary in farming the land if the soil is to remain productive.

Deficiencies of one or more of the three common fertilizer elements, from the standpoint of maximum crop production, are apparent in some of the soils of Ida County, especially the light-colored, steep ones and the sandy areas. Fields on the more fertile soil types such as Marshall silt loam which have been carelessly handled in the past also give indications of deficiencies of nutrient elements. Beneficial effects on crops such as legumes or legume-grass mixtures would therefore be obtained from fertilization, particularly with forms of phosphorus, on a number of fields in Ida County. In estimating fertilizer needs, not only the present deficiencies should be considered. It should be kept in mind that ample supplies of essential nutrient elements must be maintained in the soil for the long-time production of large crops of satisfactory quality.

Generally speaking, the nitrogen supply in the soils of Ida County can be maintained economically by the proper use of barnyard manure and the growing of enough legumes in the rotation. Applications of manure and the growing of inoculated and thrifty legumes such as alfalfa also have beneficial effects upon the physical condition of the soil. Such effects are important and desirable, even though the principal reason for the use of manure, for instance, might be the addition of nitrogen. If applications of barnyard manure and the growing of legumes are made a part of regular farm practice, the addition of nitrogen in the form of commercial fertilizer does not seem necessary except as side-dressing or top-dressing for special crops or for local soil conditions. The areas of sandy soil are generally low in nitrogen, and the same condition, though to a lesser degree, will hold for a number of the light-colored, steeper soils. Applications of nitrogen fertilizer to local areas of such soils where corn is being grown would benefit the crop in a number of instances. Applications would not be generally beneficial on the undulating Marshall, on Waukesha and on the soils of the stream bottoms.

Applications of phosphate fertilizers would increase the yields of crops such as the legumes on a number of the soils in Ida County, though the in-
creases would seldom be large. As with nitrogen, the supplies of phosphorus are generally low in the sandy soils and the amounts of phosphorus available to crops other than legumes is also low in the steeper, light-colored soils such as the Marshall and Clarion. However, deficiencies will not occur where fields or parts of fields have received large quantities of barnyard manure and have thus received considerable amounts of phosphorus. Crops grown on such fields would not respond to additional phosphorus fertilization at the present time. The application of phosphate fertilizer will, in some instances, have beneficial effects upon the quality of the crops without increasing the quantity produced. The amounts of phosphorus available to plants during the growing season affects the quality of the crops grown as much as it does the total quantity or yield. Moreover, phosphate fertilizers are especially helpful in obtaining stands and satisfactory growth of legumes such as alfalfa and red clover, crops that are of particular importance in keeping up the supply of nitrogen in the soil.

Phosphorus can be applied to soils in a number of different fertilizers, among which superphosphate, rock phosphate and mixed fertilizers\footnote{These are also called “complete fertilizers” at times.} (mixtures containing more than one of the three common fertilizer elements and usually including superphosphate as the carrier of phosphorus) are most commonly available. All of these fertilizers have been tried in field experiments carried on by the Iowa Agricultural Experiment Station in various parts of the state. From the results of these trials, superphosphate appears to be the most economical form to apply for the common crops grown in Ida County. The content of phosphorus in superphosphate is normally lower than that of rock phosphate, but the form present in superphosphate is more readily soluble and more generally available to plants. Superphosphate appears to be the more economical form for general use, and definite superiority is indicated for the more soluble phosphate when it is applied in the hill or row, as with corn. Where rock phosphate is to be used, heavier applications are necessary. Furthermore, rock phosphate has given less satisfactory results in those sections of the state where the soils are predominantly neutral or alkaline than in the regions where the soils are acid in reaction. In the selection of phosphate fertilizer, the kind of crop to be grown, the past management of the soil and the comparative costs of the different fertilizer forms should be taken into account before purchase. Leaflets giving more complete information as to fertilizer recommendations for various crops and soil conditions can be obtained by writing to the Soils Subsection of the Iowa Agricultural Experiment Station.

Potassium seems to be present in sufficiently large amounts and available forms in most of the soils of Ida County to meet the needs of crop plants for some time to come. General application of potassium fertilizers, more commonly known as potash fertilizers, does not seem necessary. Local additions on the sandy soils and for special crops would improve the yields and the quality in those instances, but general applications for the common field crops is not necessary.
APPENDIX

PURPOSE AND METHODS OF SOIL SURVEY

The chief purpose of soil surveys is to provide accurate soil maps which can be used to help classify, interpret and apply data regarding agricultural production. In agronomic work, for example, it is not possible to carry out experiments on each different soil in every field in the state; trials can only be made on a limited number of fields. Consequently, there must be some way in which the information obtained from experiments or experience on a given area of a certain soil can be extended to other areas of similar soils. Such means exist when the different kinds of soils and their locations are known; accurate soil maps and descriptions provide this type of information.

Soil maps, if they are to serve their purpose, must show the location and extent of the different kinds of soil with sufficient detail and enough precision to indicate those differences that are important in using the land for the growth of plants. Since the number of important differences in soils is not identical in all landscapes, maps vary as to the detail which is represented. Obviously a map of an irrigation project will have to be much more detailed than will one of grazing country; smaller areas of land and smaller differences in the nature of the soil will have profound effects upon the success or failure of farmers in an irrigation project. The soil map should indicate such differences and others that are important. Briefly, the chief function of a soil map is to aid in the classification and extension of knowledge regarding the use-suitabilities of different kinds of soil. In addition to providing a basis for the classification of information gained from experience and experiments with soils, a soil map also provides an inventory of the soil resources. It is helpful in many cases to know the exact acreages of particular kinds of soil, but it is commonly more important to know the locations and distribution patterns of soil types.

Soil maps are prepared by means of soil surveys which consist of the examination, classification and mapping of soils in the field. The maps are commonly made for areas of one county, but at times, parts of one or more counties may be selected, as for example, in irrigation projects or in demonstration watersheds.

The first step in the making of a soil survey of an area is the examination of its soils in a number of different locations. Test pits are dug, borings are made, and the soil is studied in available exposures such as road and railroad cuts. Description of soil profiles are obtained and samples are often collected for laboratory study. Each horizon of a soil profile, down to and including the parent material, is described as to color, structure, texture, porosity, consistence and the presence of roots, gravel or stones. The reaction (degree of acidity) and the content of lime or other salts is noted in each of the different layers. The relief or lay-of-land and drainage, both internal (through the soil) and external (over its surface), are noted and described. Attention is also given to any observable relationships between the soil and the vegetation.

After the soils have been examined in a number of different locations, they are classified according to the observed characteristics, both internal and external, with special emphasis being given to those features which influence the adaptation of the land to the growing of crop plants, grasses and trees. In the classification of soils in county areas, the most important group is the soil series. A series consists of those soils which have similar genetic horizons, alike in arrangement and important characteristics, and which have developed from a particular type of parent material. The profiles of the soils within a series consist of horizons that are essentially alike in color, thickness, arrangement, structure, etc. The texture of the upper part of the soil, corresponding to that part which is commonly plowed, may vary significantly within a series, thus giving rise to soil types. Except for the variation in texture in the surface layer, the soils within a series should be essentially alike both in internal characteristics and in such associated external features as drainage and range in relief. Soil series are given place names selected from the geographic regions in which they were first identified and mapped: Marshall, Clarion and Wabash are names of important series in Ida County.

Soil types are subdivisions within a series, the separations being based on the texture of the surface layers of the profile. The name of each soil type consists of a combination of the series name with that of the class name of the soil texture (sand, sandy loam, loam, clay loam, silty clay, etc.). Thus, Wabash silt loam and Wabash silty clay loam are two soil types within one soil series. Except for the differences in the texture of the upper soil layers, the profiles of the two soil types are approximately the same. The soil type is the principal unit used in mapping, and because of its specific character, it is usually the one to which agronomic data are definitely related.

At times, different areas of one soil type may differ in some characteristic that has important practical significance. Features not reflected in the character of the soil but highly important in cultivation, such as stoniness, relief or accelerated erosion, sometimes vary enough within one soil type so that portions are not well suited for cultivation while others are. Such variations are indicated as phases. For example, Clarion loam, steep phase, has been mapped in Ida County to indicate areas of soil similar to Clarion loam but occurring when the land is steeper than usual.

After a legend has been prepared to name and describe the different units which are to be shown on the soil map, a suitable base map must be obtained or prepared before field work can progress. Aerial photographs constitute the most satisfactory base map and are used wherever they are available. Geological survey quadrangles are also good base maps. In a number of areas or parts of areas, satisfactory base maps are not available, and the soil surveyor must prepare one. Base maps, after they have been obtained or prepared, should be carefully checked against the land survey, especially in sectionized regions.

When both the legend and the base map are ready, the boundaries of the different soil types, phases, etc., can be located and indicated on the map by means of symbols. In locating the boundaries of the mapping units, the surveyor traverses the landscape at intervals of $\frac{1}{4}$ mile, $\frac{1}{2}$ mile or whatever
interval will allow him to observe each boundary throughout its entire course. It is sometimes necessary to go out from the line of traverse to make sure of the location of a boundary, but it is seldom necessary to follow a boundary through its entire course to see where it is located. After the field sheets for the map are completed, they show the location of the soils and miscellaneous land types with respect to houses, roads, railroads, streams, lakes, section and township lines, and other natural and cultural features of the landscape.

Field work in the soil survey of Iowa has been carried on cooperatively between the Bureau of Chemistry and Soils21 of the United States Department of Agriculture and the Soils Subsection of the Iowa Agricultural Experiment Station. After the field work is completed for an individual county, a colored map on a scale of 1 inch to the mile is prepared by the Bureau of Chemistry and Soils. An accompanying text to describe the soils, agriculture and other important features of the county area is also prepared, and this is published together with the colored map as a report of the survey.

21 The Division of Soil Survey, which was part of the former Bureau of Chemistry and Soils at the time of the field work in Ida County, is now in the Bureau of Plant Industry.
24 maps
Monroe County missing 7/22/50
DECATUR 10/7/16
MARION 10/7/16