UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
In cooperation with the Michigan Agricultural Experiment Station

SOIL SURVEY
HILLSDALE COUNTY, MICHIGAN

BY
J. O. VEATCH, in Charge, JAMES TYSON, and P. R. BIERESHEIMER
Michigan Agricultural Experiment Station
and J. W. MOON, U. S. Department of Agriculture

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## CONTENTS

<table>
<thead>
<tr>
<th>County surveyed</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate</td>
<td>1</td>
</tr>
<tr>
<td>Agriculture</td>
<td>3</td>
</tr>
<tr>
<td>Soils</td>
<td>4</td>
</tr>
<tr>
<td>Miami silt loam</td>
<td>11</td>
</tr>
<tr>
<td>Miami loam</td>
<td>12</td>
</tr>
<tr>
<td>Hillsdale sandy loam</td>
<td>13</td>
</tr>
<tr>
<td>Fox sandy loam</td>
<td>14</td>
</tr>
<tr>
<td>Fox loam</td>
<td>15</td>
</tr>
<tr>
<td>Fox stone loam</td>
<td>16</td>
</tr>
<tr>
<td>Plainfield loamy sand</td>
<td>16</td>
</tr>
<tr>
<td>Belleville sandy loam</td>
<td>17</td>
</tr>
<tr>
<td>Coloma loamy sand</td>
<td>18</td>
</tr>
<tr>
<td>Berrien sandy loam</td>
<td>19</td>
</tr>
<tr>
<td>Brady sandy loam</td>
<td>20</td>
</tr>
<tr>
<td>Newton loamy sand</td>
<td>20</td>
</tr>
<tr>
<td>Brookston loam</td>
<td>20</td>
</tr>
<tr>
<td>Brookston clay loam</td>
<td>21</td>
</tr>
<tr>
<td>Griffin sandy loam</td>
<td>21</td>
</tr>
<tr>
<td>Griffin silt loam</td>
<td>22</td>
</tr>
<tr>
<td>Organic soils</td>
<td>22</td>
</tr>
<tr>
<td>Carlisle muck</td>
<td>22</td>
</tr>
<tr>
<td>Greenwood peat</td>
<td>23</td>
</tr>
<tr>
<td>Rifle peat</td>
<td>23</td>
</tr>
<tr>
<td>Summary</td>
<td>23</td>
</tr>
</tbody>
</table>

## ADDITIONAL COPIES  
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SOIL SURVEY OF HILLSDALE COUNTY, MICHIGAN

By J. O. VEATCH, in Charge, JAMES TYSON, and P. R. BIEBESHEIMER
Michigan Agricultural Experiment Station, and J. W. MOON, United States
Department of Agriculture

COUNTY SURVEYED

Hillsdale County is in the south-central part of Michigan and
borders Ohio and Indiana. The county includes 601 square miles or
384,640 acres.

Hillsdale County lies in that part of the lower peninsula of
Michigan known as Thumb Upland. This is a broad glaciated
upland extending from the Ohio-Indiana line northeastward to Huron County. In
elevation it ranges from about 800 to a
maximum of a little more than 1,300 feet
above sea level.

The county as a whole is gently rolling
or moderately hilly. The relief is largely
constructional, due mainly to the uneven
disposition of a thick layer of glacial
material. The county has the rolling or
billowy surface, smooth rounded slopes,
sandy or gravelly knobs and ridges, nu-
merous lakes and swampy depressions,
sandy and gravelly plains, and nearly
level clay plains characteristic of land of
glacial origin. In the southeastern part
of the county there is a gently sloping or
nearly level clay plain which includes long, narrow winding strips
and small nondescript areas of wet land. The central, western,
and northern parts are, on the whole, more diversified and com-
prise rolling country with a great number of lakes and peat
swamps, patches of dry sandy and gravelly plains pitted by dry de-
pressions, lakes, and swamps. Smoother country occurs in the north-
western part of the county, and more strongly rolling or hilly land
occurs in parts of Somerset, Moscow, and Wheatland Townships,
in the northeastern part of the county. Although there are a few
rather prominent ridges and isolated hills, most of the land is
characterized by long, smooth slopes and slight relief. Very little
of it is so excessively choppy or steeply sloping as to be nonarable.
The greater part of the county has an elevation varying from 1,000
to 1,200 feet above sea level. Bundy Hill, in Somerset Township,
reaches an elevation of 1,284 feet, and the lowest levels, in the
southwestern part of the county, are near 800 feet.

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1 This report was written by Mr. Veatch, assisted by Mr. Tyson. The detailed field
mapping was in charge of Mr. Tyson, assisted by Mr. Biebesheimer.
The streams are all small, originate in lakes and swamps, and carry clear water. They are eccentric in direction, as they flow, for the most part, in constructional depressions, and their courses have been governed by accidents of glacial deposition. There has been comparatively little stream erosion and consequently little development of small tributary streams and dendritic forms common on older land surfaces. The streams constitute headwater tributaries of Raisin and Maumee Rivers which flow into Lake Erie, and of St. Joseph, Kalamazoo, and Grand Rivers which flow into Lake Michigan.

Lakes are numerous. They vary in size, outline, vegetation, and shore line from small circular ponds to narrow, elongated lakes covering 200 or 300 acres, and from lakes with clean shores to others exhibiting all stages of filling by vegetation.

Most of the swamp and wet land occurs in small, separate areas. Although this land is mainly peat or muck which marks the sites of former lakes, now filled by vegetation, in some irregular areas of flat land the water is held by the underlying rather impervious clayey drift. The total area of swamp or permanently wet land amounts to only a small percentage of the county. In addition to swamp areas, however, a considerable acreage of land requires artificial drainage to make it fit for agricultural use.

At the time of settlement by white men the county was entirely covered by forest, except for a very small total area of marshy land about the borders of lakes and for a few open peat bogs. The forest growth on the heavier and on the wetter mineral soils consisted of an association of hardwoods, mainly elm, ash, soft maple, hickory, basswood, and swamp white oak. On the drier clay soil and on the sandier soils, red, white, and black oaks, beech, and sugar maple were more numerous. Black walnut, butternut, sycamore, aspen, red cedar, wild cherry, and tulip poplar were minor components of some of the forests. Tamarack is the principal tree growth in the wetter muck or peat swamps, but shrubs such as red osier (Cornus stolonifera), dwarf birch, willow, and winterberry (Ilex verticillata) also thrive. In the marshy areas the principal growth consisted of wire grass (Carex filiformis) and bluejoint grass (Calamagrostis canadensis); in the bogs, of such shrubs as blueberry (Vaccinium sp.) and Cassandra, and Hypnum and Sphagnum mosses. The greater part of the tree growth, except that in swamps, has long since been removed either in farming operations or by lumbering, although a considerable aggregate of wood lots and small patches of original forest remain.

An abundant supply of healthful water may be obtained from comparatively shallow wells, and in a few places artesian flowing wells are found. The lakes and streams, all of which are perennial, afford water for livestock and for other purposes.

The population of the county, according to the 1920 census, is 28,161. Hillsdale, the county seat and the largest city, has a population of 5,476. The inhabitants are dominantly native white.
Agriculture is the principal industry. In 1919 the total value of all crops, according to the census, was $7,405,458, and the value of farm land and buildings was $31,477,236. There are flour mills at Hillsdale, Litchfield, Jonesville, Mosherville, and North Adams, and other small industries are at Hillsdale and Reading.

The New York Central Railroad and the Michigan Central Railroad enter the county and provide excellent transportation facilities by rail. Paved State trunk line highways traverse the county, and other roads are well improved, so that all localities are accessible to automobiles.

Detroit and Chicago are the principal city markets for agricultural products shipped from the county.

CLIMATE

The climate of Hillsdale County is characterized by fairly cold winters and mild summers. Annual precipitation is about 35 inches, including melted snow. Yearly snowfall averages about 40 inches. Wind movement and evaporation are low and humidity is moderately high. The county receives about 50 per cent of the possible sunshine.

The mean annual temperature is 47.4° F. The mean winter temperature is about 23° and that of summer about 69°. The average length of the frost-free season is nearly five months and is ample, at this latitude, for the maturity of the staple crops grown. Although frosts sometimes occur as late as June and as early as September, crops are seldom seriously damaged except in the lower or wetter areas.

The precipitation is fairly evenly distributed throughout the year and is sufficient for a high crop production. Although there is considerable annual and seasonal variation and marked differences exist in the moisture-holding capacity of the soils receiving the same amount of precipitation, crop failures seldom result from a deficiency or excess of water. Snowfall may be depended on every winter to give fall-sown grain crops some protection, but a continuous cover may not be present, and occasional damage from freezes is to be expected. Hailstorms sometimes occur during the summer, but they seldom cause much damage to crops.

The prevailing winds are westerly. They rarely attain high velocity and are, therefore, rarely destructive to crops and cultivated soils.

The climate probably does not present any very marked differences within the limits of the county, as there are no great differences in altitude and no very large bodies of water. Purely local differences in susceptibility of crops to damage from frost are observed, and some slight differences may be observed in relation to fruit growing, depending on the situation and the direction of the slope of the land.
Weather data of value in relation to agriculture are presented in the following table compiled from the records of the United States Weather Bureau from observations at Hillsdale:

**Normal monthly, seasonal, and annual temperature and precipitation at Hillsdale**

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature</th>
<th>Precipitation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Absolute maximum</td>
</tr>
<tr>
<td></td>
<td>°F.</td>
<td>°F.</td>
</tr>
<tr>
<td>December</td>
<td>25.8</td>
<td>60</td>
</tr>
<tr>
<td>January</td>
<td>22.8</td>
<td>61</td>
</tr>
<tr>
<td>February</td>
<td>21.5</td>
<td>63</td>
</tr>
<tr>
<td>Winter</td>
<td>23.4</td>
<td>63</td>
</tr>
<tr>
<td>March</td>
<td>34.4</td>
<td>82</td>
</tr>
<tr>
<td>April</td>
<td>45.9</td>
<td>88</td>
</tr>
<tr>
<td>May</td>
<td>57.4</td>
<td>94</td>
</tr>
<tr>
<td>Spring</td>
<td>45.9</td>
<td>94</td>
</tr>
<tr>
<td>June</td>
<td>65.5</td>
<td>98</td>
</tr>
<tr>
<td>July</td>
<td>71.7</td>
<td>102</td>
</tr>
<tr>
<td>August</td>
<td>65.4</td>
<td>104</td>
</tr>
<tr>
<td>Summer</td>
<td>69.2</td>
<td>104</td>
</tr>
<tr>
<td>September</td>
<td>62.9</td>
<td>98</td>
</tr>
<tr>
<td>October</td>
<td>51.6</td>
<td>89</td>
</tr>
<tr>
<td>November</td>
<td>38.3</td>
<td>72</td>
</tr>
<tr>
<td>Fall</td>
<td>50.9</td>
<td>98</td>
</tr>
<tr>
<td>Year</td>
<td>47.4</td>
<td>104</td>
</tr>
</tbody>
</table>

Killing frost: Average last in spring, May 8; average first in fall, Oct. 6; latest in spring, June 9; earliest in fall, Sept. 8.

**AGRICULTURE**

The first settlement by white men for the purpose of cultivating the soil and making permanent homes began about 1830. The pioneers came mainly from New York, Pennsylvania, and Ohio. As in most pioneer farming in the Middle Western States, the farmers, of necessity, followed a mixed system of agriculture and produced the things required for domestic use and home consumption to a much greater extent than they were produced in subsequent years. In addition to the products of the farm, cattle, furs, alkaline salts from wood ashes, and later lumber were sources of cash.

The influx of settlers was steady, and there was a high percentage of increase in the acreage of land placed under cultivation until about 1890. Since that time the rate of increase has been slow, and according to the 1925 census there has been an actual decrease in the acreage of land under cultivation as compared with the acreage of cultivated land in 1920.

Corn, wheat, and potatoes were staple crops during the early period of farming. Since about 1880 oats and rye have shown a greater proportional increase in acreage than wheat and corn, and the acreage
of red clover has shown a decline. Changes in the livestock industry have been marked by a decrease in the number of beef cattle and sheep and an increase in the number of milk cows. As in other parts of Michigan, the agriculture has been greatly influenced by the marked industrial expansion and growth of cities in this and adjoining States. This urban growth has been the cause of the abandonment of some farms, but, on the other hand, it has increased the diversity of farm products and the development of specialized farming and dairying to meet the demands of the near-by industrial population.

Agriculture at the present time consists of the general farming common to this region, namely, the growing of corn, oats, hay, and the keeping of livestock, and of a less distinct type of agriculture which consists of general farming combined with the production of various special income crops. A few farms are given over entirely to the production of such specialties as poultry, fruit, and truck crops, but in general this kind of intensive, specialized farming is not highly developed. The general farming is of the conservative type and is neither highly intensive nor, on the other hand, extensive. The farms range in size from 80 to 200 acres; the farmer depends on average results for his profit; and pretty much the same methods are followed and the same crops grown from year to year. The farmers still rely mainly on the inherent productiveness of the soil, although farming is passing from the purely exploitive stage to the stage where measures are being taken to maintain productiveness and to increase yields. For these purposes lime and commercial fertilizers are being used and more careful and intensive tillage methods are being practiced.

The following table gives the important crops, their acreage, and their yields in 1919 and 1924:

<table>
<thead>
<tr>
<th>Crop</th>
<th>1919</th>
<th>1924</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acres</td>
<td>Tons</td>
</tr>
<tr>
<td>Hay, all kinds</td>
<td>54,276</td>
<td>60,665</td>
</tr>
<tr>
<td>Bushels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>39,890</td>
<td>1,414,357</td>
</tr>
<tr>
<td>Oats</td>
<td>25,959</td>
<td>688,300</td>
</tr>
<tr>
<td>Wheat</td>
<td>26,798</td>
<td>542,003</td>
</tr>
<tr>
<td>Rye</td>
<td>24,311</td>
<td>397,843</td>
</tr>
<tr>
<td>Barley</td>
<td>11,698</td>
<td>155,781</td>
</tr>
</tbody>
</table>

In addition to the crops listed in the table, alfalfa, buckwheat, potatoes, beans, and sugar beets are grown either less extensively or in a more or less intermittent way. Cabbage is the principal truck crop grown, but other vegetables, such as cucumbers, onions, lettuce, and squash, are grown to a small extent, usually in home gardens.

Apples are the main orchard fruit, but peaches, pears, plums, and cherries are grown with some measure of success. The principal small fruits are raspberries and strawberries. This county, however, is much less favorably situated for fruit growing than that part of the State bordering Lake Michigan, and this industry is not, therefore, extensively developed.
Dairy cattle greatly exceed in number the beef cattle. Hog feeding is important, but sheep grazing and feeding are minor industries.

The type of soil, along with other factors, such as surface features and geographic location, has had a considerable influence in the distribution of certain crops, in effecting variations in the common type of general farming, and in the distribution of woodland and unused land. On the uniformly heavier soils, the Miami and Brookston, and on the less rolling soils in the southeastern part of the county, a greater proportional acreage of hay and small grain is grown. A small acreage of sugar beets and a proportionally greater acreage of red clover and timothy and clover are grown on the heavier soils. In Moscow Township, where the dominant soil is Hillsdale sandy loam and the relief is hilly or strongly rolling, fruit growing and the grazing of sheep and cattle are carried on more extensively. On the sandy loam soils of the northwestern part of the county, in addition to the usual general farm crops, special crops such as cabbage, cucumbers, and potatoes and most of the buckwheat are grown. On the areas of Fox loam, Fox sandy loam, and Plainfield loamy sand, in the vicinity of Hillsdale and Jonesville, orchard fruits, small fruits, and market-garden crops are grown extensively.

The soils most largely abandoned for farming are principally Plainfield loamy sand and Coloma loamy sand, Bellefontaine sandy loam, and the rougher areas of Hillsdale sandy loam. The muck and peat, or organic soils, constitute the greatest proportion of unused virgin land. The greatest acreage of woodland is on muck and peat, on the poorly drained mineral soils, such as the Brookston, Brady, and Newton soils, and on the steepest slopes of other soils which are naturally least suitable for cultivated crops.

The use of fertilizers is not general, but is on the increase. In general farming, barnyard manure is still largely depended on to maintain productiveness, but for grain a considerable percentage of the farmers apply from 200 to 300 pounds to the acre of superphosphate (acid phosphate) or of some complete fertilizer, such as 2-12-2 mixture. Potash, or higher potash in mixtures, is used to some extent for truck crops, such as cabbage, and for potatoes. There is very little or no fertilization of orchard fruits.

Lime is now used to a small extent and is coming into more general use, especially on soil to be planted to alfalfa or on soil on which red clover has failed. The more common forms used are ground limestone and hydrated lime.

According to the 1925 census, the number of farms in the county was 4,092, and the average size was approximately 87 acres. The total acreage of cultivated land in 1925 was 201,886 acres out of a total of 357,644 acres in farms. The greater part of the uncultivated land is in pasture. There is a total of nearly 39,000 acres of woodland in the county.

SOILS

The soils of Hillsdale County vary greatly in texture, structure, chemical nature, fertility, and moisture relations, all of which bear

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² Percentages, respectively, of ammonia, phosphoric acid, and potash.
a relation to plant growth, tillage, and agricultural use. They also exhibit a lack of uniformity, a variation within very short distances, which is a condition common to the State as a whole.

In texture, the surface soils vary from loose, incoherent, nearly pure sands to moderately heavy silt loams and clay loams. The greater part of the soils, however, are sandy loams and loams. The sands comprise less than 5 per cent of the soils, and clay loams are almost negligible. The greater part of the land, probably as much as 75 per cent, is loamy or free working; probably 15 or 18 per cent is moderately heavy; and only a very small percentage is refractory or difficult to manage because of extreme stickiness and toughness, extreme stoniness, or other unfavorable tilth conditions. About 10 per cent of the soils consist of muck and peat which have their own peculiar tilth characteristics.

It is estimated that from 5 to 10 per cent of the soil is poorly supplied with humus or organic matter; that from 80 to 85 per cent of it contains from 2 to 4 per cent of organic matter in the surface horizon; that about 5 per cent is comparatively well supplied; and that muck and peat comprise an additional 10 per cent of the soil. In virgin areas of well-drained soils the humus layer is or originally was nearly everywhere thin, not exceeding 3 or 4 inches in thickness, and in the cultivated soil there is very little tint or coloring from organic matter below a depth varying from 5 to 7 inches or the ordinary depth of plowing. The soils are deep from the point of view of penetrability, since the parent soil material is unconsolidated glacial drift to a depth greater than that of root penetration.

About 80 or 90 per cent of the soils are acid in reaction in the natural surface horizon and in the soil that is stirred by the plow. It is estimated that about 40 per cent of the acid soils are acid to a depth varying from 30 to 40 or more inches, and that 60 per cent contain sufficient calcium and magnesium carbonates or other bases to give an alkaline reaction at a slight depth.

The greater part of the soil is naturally fairly well drained. The water table is not high and there is sufficient slope to provide free run-off of rain water. It is estimated that 10 per cent of the county is characterized either by a high water table or by a permanent swampy condition and is therefore unsuitable for agricultural use unless it is ditched and tiled.

The fertility and productivity of the soils, according to the standards for the southern part of Michigan, vary from fair to high. Analyses of the soils do not show any evidence of abnormally high or, on the other hand, of unusually small quantities of the mineral constituents ordinarily determined. Probably from 5 to 10 per cent of the soil is poor because it is poorly supplied with plant nutrients and is deficient in moisture, as are the sands; because of erosion; because of highly acid conditions; and because of a poor supply of mineral plant food, as is the case with some of the muck and peat.

From the point of view of composition, there are in the county two great taxonomic classes—mineral soils and organic soils. Both of the two great groups, which include soils developed under conditions of good drainage and with low or intermediate quantities of moisture and those developed under conditions of poor drainage or excessive moisture, are represented.
In this region the comparatively old or mature soils of the first group have been developed under forest cover in a cool, only moderately humid climate. These soils, in general, are characterized by (1) a grayish-brown surface layer; (2) a layer of lighter grayish-brown or pale-yellowish slightly leached soil; and (3) a yellow or reddish layer which contains more clay or a higher content of colloids and at the same time exhibits the maximum intensity of coloring from the oxidation of iron oxides. The color given by the humus present does not, in general, continue to a depth greater than 5 inches; leaching out of carbonates and colloidal matter is effective to only a slight depth; the layer of maximum clay is obscure in the sands, and in the case of the heavier soils does not, in general, attain the degree of firmness, cementation, or imperviousness which characterizes the subsoils of some of the soils of the subhumid, semiarid, and arid parts of North America.

The soils of the second group are characterized by (1) dark-gray or black surface layers which contain a comparatively large percentage of organic matter, (2) a layer of grayish or drab material, and (3) a layer mottled with rust brown or yellow and containing blackish iron-oxide accretions or other evidence of water logging or poor aeration. These soils do not contain a high percentage of soluble salts or alkali as do soils of the drier regions, nor, on the other hand, are they characterized by excessive leaching as are the soils of the more humid and warmer regions.

In addition to these two major groups, there are the alluvial soils and the muck and peat soils. The alluvial soils are of small total extent, consist of very recently deposited alluvium, are incomplete in profile, and, from the broader viewpoint of soil, are equivalent to a geologic formation. Peat and muck are composed dominantly of organic matter in various stages of decomposition and have developed under a permanently wet condition or as accumulations of dead plant matter in shallow bodies of water.

On the bases of mechanical composition, consistence, and structure there are three important subfamilies or major groups in the mineral soils: (1) Soils underlain at a slight depth by clayey or comparatively impervious layers and by clayey parent material or substrata; (2) soils underlain by coarse or pervious material; and (3) soils underlain at a slight depth by a comparatively clayey or impervious layer but at a greater depth by a deeper substratum of coarse or pervious unconsolidated sand or gravel. These broad differences have a bearing on the content of moisture, the chemical nature, and root development, and are, therefore, of pedological and agricultural significance.

A great number of other groupings are possible on the basis of some single chemical or physical peculiarity or environmental condition, and each may have a value for a particular purpose or study. However, for the highest scientific value and comprehensiveness, the classification must be based on a combination of a large number of intrinsic characteristics.

For the purpose of mapping and correlation, soils are grouped in series on the bases of common characteristics of color, consistence, and chemical nature of the mass. The soil type, or unit of mapping, is distinguished on the basis of the texture of the surface or plow layer of mineral soil. Each series is given a geographic name for
convenience of reference and description. The series and types recognized in Hillsdale County are briefly described here from a classificational point of view and will be described in detail and in their relations to agriculture in following pages of the report.

The well-drained mineral soils with comparatively heavy subsoils and substrata are grouped in the Miami soil series. The Miami soils have light-brown surface soils and yellowish-brown, moderately firm but coarsely granular and gritty clay loam subsoils. Sufficient calcium carbonate or magnesium carbonate is present, at a depth varying from 24 to 36 inches, to give an alkaline reaction.

The Hillsdale and Bellefontaine soils are characterized by light-textured friable surface layers, clayey subsoils, and light-textured sandy or gravelly substrata. The Hillsdale soils are yellowish brown in the subsoils and the Bellefontaine are reddish brown. An acid reaction to a depth ranging from 36 to 48 inches and considerable sandstone in the substrata are characteristics of the Hillsdale soils.

The soils characterized by a clayey subsurface layer underlain by loose sand and gravel are grouped in the Fox series. These soils are distinguished by a reddish-brown or dark-reddish sand, gravel, and clay mixture, below a depth ranging from 12 to 24 inches, which is underlain, at a depth ranging from 24 to 40 inches, by pervious, unconsolidated sand and gravel containing limestone.

The lighter and sandier soils are represented by members of the Plainfield and Coloma series. The Plainfield soils are underlain by yellowish sand which becomes lighter in color with depth. The sand is acid to a depth of 3 or more feet and is pervious and incoherent to a depth of several feet. The Coloma soils are sandy throughout and are loose and pervious to a depth of several feet. The substrata differ from those of the Plainfield soils in being more heterogeneous. They consist of sand containing a variable quantity of clay, gravel, and bowlders. The soils are acid to a depth of 3 or more feet. They have a slightly higher moisture-holding capacity than the Plainfield soils.

The mineral soils developed under conditions of poor drainage are grouped in the Brookston, Newton, Brady, and Berrien series. The Brookston soils have dark-colored surface soils underlain by grayish or mottled clay. The dark color continues to a depth varying from 6 to 12 inches, and the soils are nearly neutral or alkaline in reaction. The Newton soils are similar to the Brookston in profile but are underlain by sand or much sandier clay to greater depths.

The Brady soils are characterized by grayish surface soils poorly supplied with organic matter for this group of soils; by grayish-yellow or rust-colored mottled sandy clay subsoils, and by substrata of water-soaked sand and gravel. They are distinguished from the Newton soils by their lighter-colored surface layers, which contain a smaller percentage of organic matter, and from the Brookston by their more sandy and gravelly subsurface layers and substrata.

The Berrien soils are sandy and friable to a depth of 3 or more feet. They are characterized by brownish or yellowish surface soils similar to those of the Plainfield or Coloma soils but mottled, at a slight depth, with gray or rust color indicative of higher average

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moisture conditions. The average supply of moisture is less than that under which the Newton soils have developed, the water table lies at a greater depth, and the quantity of organic matter and the intensity of the dark color at the surface are less.

The soils composed of recently deposited alluvium have not developed a complete or definite soil profile but, in their lithologic nature, are practically the same as when they were deposited by stream flood waters. The alluvial soils of this county are grouped in the Griffin soil series. Their surface layers vary from light brown to dark, they are fairly well supplied with organic matter, are comparatively high in fertility, and show rust-colored or yellowish mottles and other evidence of a water table which lies only a few inches below the surface.

The soils existing under permanently wet conditions or in swamps are mainly organic soils (muck and peat). The organic soils differ according to and are capable of subdivision into groups and types on the bases of age; depth of the water table; color, texture, and structure, or stage of decomposition of the organic matter; thickness; soil reaction; and character of the mineral substratum. A definite soil profile is not so plainly evident as in the mineral soils, and in some places soil and a peat deposit considered as a geologic phenomenon are practically equivalent.

The organic soils, or muck and peat, are grouped in three broad groups. The Carlisle group includes the darker-colored, more loamy, more finely decomposed and disintegrated muck, alkaline or not highly acid in reaction. The Greenwood group includes the raw, coarse-textured, yellowish or brownish, most highly acid peat, characterized by a very high water table. The Rifle group is intermediate between the Carlisle and the Greenwood.

In the following pages of this report the soils of Hillsdale County are described in detail and their relation to the agriculture of the county is discussed. The accompanying map shows their location and distribution throughout the county. In interpreting, or drawing conclusions from, the soil map it should be understood that soil types are rarely sharply separated from each other in nature, so that mathematically accurate lines of demarcation are not to be expected on the map. Each color, or pattern, represents a dominant soil condition, the type described in the text of the report, but there are slight variations and inclusions of small areas of other soils. The following table gives the acreage and proportionate extent of the soils mapped:

<table>
<thead>
<tr>
<th>Type of soil</th>
<th>Acres</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miami silt loam</td>
<td>32,320</td>
<td>8.4</td>
</tr>
<tr>
<td>Miami loam</td>
<td>55,305</td>
<td>22.2</td>
</tr>
<tr>
<td>Hillsdale sandy loam</td>
<td>117,504</td>
<td>30.5</td>
</tr>
<tr>
<td>Fox sandy loam</td>
<td>8,768</td>
<td>2.3</td>
</tr>
<tr>
<td>Fox loam</td>
<td>29,168</td>
<td>6.0</td>
</tr>
<tr>
<td>Fox stony loam</td>
<td>7,424</td>
<td>1.9</td>
</tr>
<tr>
<td>Plainfield loamy sand</td>
<td>12,928</td>
<td>3.4</td>
</tr>
<tr>
<td>Bellefontaine sandy loam</td>
<td>8,528</td>
<td>1.7</td>
</tr>
<tr>
<td>Coloma loamy sand</td>
<td>2,360</td>
<td>.8</td>
</tr>
<tr>
<td>Berrien sandy loam</td>
<td>806</td>
<td>.2</td>
</tr>
<tr>
<td>Brady sandy loam</td>
<td>2,696</td>
<td>.7</td>
</tr>
<tr>
<td>Total</td>
<td>384,640</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of soil</th>
<th>Acres</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newton loamy sand</td>
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<td>0.6</td>
</tr>
<tr>
<td>Brookston loam</td>
<td>14,272</td>
<td>3.7</td>
</tr>
<tr>
<td>Brookston clay loam</td>
<td>13,888</td>
<td>3.6</td>
</tr>
<tr>
<td>Griffin sandy loam</td>
<td>5,248</td>
<td>1.4</td>
</tr>
<tr>
<td>Griffin silt loam</td>
<td>7,690</td>
<td>2.0</td>
</tr>
<tr>
<td>Carlisle muck</td>
<td>22,396</td>
<td>5.8</td>
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<tr>
<td>Greenwood peat</td>
<td>192</td>
<td>.1</td>
</tr>
<tr>
<td>Rifle peat</td>
<td>14,112</td>
<td>4.7</td>
</tr>
<tr>
<td>Total</td>
<td>384,640</td>
<td></td>
</tr>
</tbody>
</table>
In virgin areas, Miami silt loam shows the following layers from the surface downward: (1) Dark-gray silt loam, 2 or 3 inches thick; (2) a layer, from 4 to 8 inches thick, of light-gray or grayish-yellow silt loam, floury or pulverulent when dry; (3) a layer, varying in thickness from 18 to 24 inches, of yellowish or yellowish-brown compact, more clayey or more colloidal material, plastic and impervious when moist and jointed and coarsely granular when dry; and (4) the parent material of massive, compact, moderately sandy and stony but comparatively impervious bluish-gray heavy glacial till which continues to a depth of several feet.

The cultivated soil, generally to a depth varying from 5 to 7 inches, is light grayish brown when dry. The content of organic matter is not high, but the supply is fairly durable. The soil can be maintained in a good state of tilth if it is managed under proper moisture conditions, but otherwise it may become excessively cloydy or coarse. The average content of moisture is comparatively high, since both the subsurface layer and substratum are rather impervious and highly retentive of moisture. The fertility of this soil is considered medium or high, depending on local standards. In general, in the virgin soil the surface soil exhibits slight or medium acidity; the second layer is medium or strongly acid; and with depth acidity decreases until an alkaline reaction is obtained at a depth ranging from 20 to 36 inches. Apprreciable percentages of calcium or magnesium carbonates are present in the lower part of the third layer and in the substratum.

The areas of this soil, as shown on the soil map, are not entirely uniform, but the soil condition described is dominant. Areas grade to the closely related Miami loam, and very small patches of other associated soils, particularly of Brookston loam or Brookston clay loam, may be present.

Miami silt loam is one of the more extensive soils. The largest areas are in the southeastern quarter of the county. This land is smooth or level for the most part, although a few areas are moderately rolling. Surface drainage is fair in the more rolling areas, but elsewhere the run-off is not rapid, and excessive quantities of water may be held because of the retentiveness of the underlying material.

Miami silt loam was originally forested with a heavy stand of elm, hickory, hard maple, beech, ash, and basswood, and probably some walnut. In a few small wood lots the original growth is partly preserved, but the greater part of the land has been cleared for agricultural purposes.

Miami silt loam is recognized as one of the more durable and productive soils for general farming. In this county the principal crops are hay (timothy and red clover), corn, oats, and wheat. Minor crops are alfalfa and sugar beets. Dairying and the raising and feeding of hogs are extensively carried on.

Crop rotation and the use of barnyard manure are mainly depended on to maintain productiveness. It has been found, however, that this soil responds to applications of superphosphate (acid phosphate) for the grain crops, and complete fertilizers, such as 2-12-2
or 3-12-4 mixtures, in applications ranging from 150 to 250 pounds to the acre, are used to some extent.

Liming apparently is not so essential for alfalfa and red clover as it is on the sandy soils, although beneficial effects upon tillth and plant growth are obtained from its use. This soil, on account of its tendency to clod, presents some tillage difficulties unless it is managed with care. Plowing in the fall is generally considered advisable. Frequently some difficulty is experienced in seeding oats during wet springs and corn may be late in starting growth. Tile drainage is advisable in most places. Small tractors are practicable over most of the soil.

**MIAMI LOAM**

The surface layer of Miami loam consists of grayish-brown loamy material 3 or 4 inches thick. Below this is yellowish or grayish leached material, more gritty or less loamy than that of the surface layer, which, at a depth varying from 6 to 10 inches, grades to yellowish-brown, compact, gritty, coarsely granular clay loam or more colloidal material which continues to a depth varying from 36 to 40 inches. The substratum or parent material is massive, comparatively impervious glacial till which continues to a depth of several feet. The chief distinctions between this soil and Miami silt loam are the stronger yellow or brown tint in the substratum and the slightly higher percentage of coarse matter present in the parent material and throughout the soil, with a corresponding lower degree of plasticity and imperviousness.

The dry cultivated or plow soil is a light shade of brown, and for the most part, to a depth of 6 or 7 inches, contains a fairly large and durable supply of organic matter. The average content of moisture is comparatively high, and the fertility is considered medium or high, depending on local standards. The subsoil, although moderately compact, does not prevent root penetration. Most of this soil exhibits slight or medium acidity, both in the virgin and cultivated soil, to a depth varying from 24 to 36 inches. Below this depth considerable carbonate of calcium or magnesium is present.

Areas of Miami loam shown on the soil map are not entirely uniform, but the profile described represents the dominant soil condition. There is a gradation to Hillside sandy loam on the one hand and to Miami silt loam on the other. Small patches of associated soil, too small for separate mapping, are included with mapped areas of this soil. In a few places areas have a light-gray or pale-yellowish surface soil, largely the result of erosion and loss of organic matter.

Miami loam is one of the more extensive soils. It covers 22.2 per cent of the total area of the county. The principal areas are in the eastern, central, and southern parts of the county and are comparatively large.

Areas of Miami loam vary from smooth or nearly level to rolling or even moderately choppy. The slope in most places is sufficient to carry off the rainfall. On the steeper slopes there has been considerable erosion or gullying, although this is not a general condition. All the land was originally forested with a heavy growth of hardwoods, chiefly hard maple, beech, ash, hickory, basswood, elm, and white, red, and black ash. The greater proportion of oaks on this
soil constituted, probably, its chief difference in forest vegetation from Miami silt loam.

Miami loam is a fairly productive and durable soil and is well adapted to general farming. Hay (timothy and clover or red clover), corn, wheat, and oats are the principal crops. Minor crops are alfalfa and potatoes. Orchard fruits, such as apples, pears, plums, and cherries, yield fairly well. Most farmers on this soil either carry on dairying or feed hogs and cattle for the market. Representative average yields on the better farms on this soil are: Corn from 40 to 50 bushels to the acre; timothy and clover hay, 11/2 tons; wheat, 18 or 20 bushels; and oats from 35 to 40 bushels. The land is less valuable than Miami silt loam, and yields, on the whole, are probably slightly less. This difference between the two soils is in part the result of a slight difference in the soil but principally of less favorable surface features. Crop rotation and barnyard manure are chiefly depended on to maintain productiveness. It has been found, however, that this soil responds well to applications of commercial fertilizers. Superphosphate (acid phosphate) alone apparently gives increased yields of grain, and complete fertilizers, such as 2-12-2 and 3-12-4 mixtures, in applications ranging from 150 to 250 pounds to the acre, are also used to some extent. Liming is beneficial, particularly on the less productive land, but it does not appear to be so essential for alfalfa and red clover as on the sandier, better-drained soils.

This soil offers no especial tillage difficulties if it is managed with ordinary care. Plowing may be done either in the fall or in the spring, but during wet springs some difficulty is experienced in obtaining a good seed bed. The more level land requires tile drainage for best results.

HILLSDALE SANDY LOAM

In the virgin condition Hillsdale sandy loam has a surface layer, 3 or 4 inches thick, of grayish-brown light loam or sandy loam. Below this is pale-yellowish friable sandy loam 10 or 15 inches thick which exhibits evidence of leaching. This grades to yellow and yellowish-brown (faintly reddish yellow when wet and in place) material, from 18 to 24 inches thick, which contains large quantities of clay and colloids but which is sandy, finely granular, and friable. The substratum of sandy clay material may be moderately stony.

The content of organic matter, although not high either in the virgin or cultivated soil, is sufficient to effect a brown tint and is fairly durable. The soil contains sufficient clay to make it moderately retentive of moisture, but it is permeable and penetrable to a depth of several feet. In most places it exhibits medium acidity to a depth of 48 or more inches. The unaltered parent material exhibits an alkaline reaction but contains a larger quantity of sandstone fragments and less limestone than do the associated Miami and Bellefontaine soils. This soil is moderately fertile.

Hillsdale sandy loam, within the areas shown on the map, is fairly uniform but exhibits the textural variations which are a common feature of practically all the soils of the State. The texture is sandier and more pervious where the soil grades toward the Coloma and Bellefontaine soils, and is more clayey where it most closely approaches Miami loam.
Hillsdale sandy loam is widely distributed throughout the northern half of the county and is the most extensive soil in the county. Areas are gently rolling or moderately hilly. The smoother land, which presents fewer inequalities and smaller differences in local relief, lies mostly in Reading, Allen, Litchfield, and Scipio Townships. In parts of Moscow and Somerset Townships the slopes are steeper and longer, and the relief is therefore bolder and more broken. Practically all the land is arable, but differences in slope are sufficient to effect appreciable differences in agricultural value and use of the land. Natural drainage is, in general, sufficient for agricultural purposes.

The original forest growth was of an oak-hickory type. Hard maple, beech, elm, and basswood were present as constituents of the forest, but it appears that these species were less abundant than on the Miami soils. The greater part of the land, probably 90 percent or more, has been cleared of the original forest growth.

General farming, including dairying or stock feeding, is carried on with fair success on the smoother soil. Corn, oats, hay, and wheat are the principal crops. Rye, buckwheat, and alfalfa are also of considerable importance. Special crops, such as cabbage, cucumbers, and melons, are grown, and much of the soil is favorably situated for orchard fruits. Where the land is manured and properly managed, the productivity of the smoother areas is but little or not at all inferior to that of Miami loam.

Present experience indicates that applications of 200 or 300 pounds to the acre of complete fertilizers, such as 2-12-2 or 3-12-4 mixtures, are profitable for grain. Fertilizers are also used to advantage for special crops, such as cabbage. Liming in general may be expected to be beneficial, especially for alfalfa and red clover.

This soil is not excessively coherent, ordinarily does not become cloddy, and is, therefore, easily maintained in good tilth. Locally stones may be of such size or may occur in such abundance as to hinder cultivation. Unless precautions are taken erosion may be serious on the steeper cultivated slopes.

A stony phase of Hillsdale sandy loam, which differs from the typical soil primarily in the higher percentage of stones scattered over the surface and in the parent drift material, has been included with Hillsdale sandy loam in mapping. In places, particularly in Litchfield Township, bedrock of sandstone and shale lies close to the surface. The texture of the plowed soil is for the most part sandy loam, but considerable loam is included in the areas shown on the soil map. The land varies from smooth to rolling, and perhaps on the whole has fewer inequalities and less range in relief than typical Hillsdale sandy loam. It has about the same crop adaptation and same productivity as the sandy loam. The stones constitute a hindrance to easy tillage, and in most places it has been necessary to partly remove them from cultivated fields.

FOX SANDY LOAM

Fox sandy loam consists of a light-brownish surface soil, from 5 to 7 inches thick, underlain by pale-yellowish friable sandy loam, from 6 to 15 inches thick, which in turn is underlain by reddish-brown, moderately heavy, gritty or sandy and gravelly clayey ma-
terial which grades abruptly, at a depth varying from 24 to 36 inches, to coarse pervious sand or sand and gravel.

A distinguishing peculiarity of Fox sandy loam is the reddish clayey layer. The percentage of clay may be small, but sufficient of this material is present to bind the coarser matter into a coherent mass and to render this layer less pervious and more retentive of moisture than the soil material above or below it. The organic matter, or humus, is not plentiful in the virgin soil, and appreciable coloring from this source extends to a depth of only 3 or 4 inches. The soil has only moderate fertility, but according to chemical analyses which have been made in southern Michigan, the content of any essential element is not abnormally low. Calcium appears to be scarce in the surface soil, more plentiful in the clay layer, and abundant in the substratum, where much of it occurs in the form of calcium carbonate or limestone. The soil commonly exhibits an acid reaction, medium or strong in the surface layer, medium or strong in the subsurface layer, from acid to alkaline in the subsoil, and alkaline in the substratum. The average content of moisture is low or only moderate. The reddish clay layer may become moderately compact when dry, but it does not prevent root penetration.

Fox sandy loam occurs only in a few small irregular areas in this county. The land is nearly level or only slightly uneven, and drainage is good because of the perviousness of the coarse substratum. The land was originally forested, the growth consisting mainly of oaks.

This soil is utilized principally for general farm crops. Where the land is liberally manured, good average yields of corn, potatoes, and other crops may be obtained. Ordinarily rye does better than wheat, and timothy and clover yield less than they do on the heavier soils. Alfalfa and sweet clover are grown on a small acreage. Small fruits do well.

Lack of abundant moisture is probably the main limiting factor in crop yields and is the explanation of the somewhat lower agricultural value as compared with the Miami and Hillsdale soils. The greater part of the land at present is poorly supplied with organic matter. Liming is considered advisable, in general, although in places there are excellent stands of alfalfa where the roots of the plants have finally penetrated into the more limy subsurface layer.

**FOX LOAM**

The surface layer of Fox loam consists of grayish-brown friable loam from 5 to 7 inches thick. Below this is grayish-yellow soil, sander or less loamy than the surface layer. This varies in thickness from 4 to 12 inches, and is underlain by a layer, from 10 to 18 inches thick, of dark-reddish or reddish-brown clayey material containing some sand and gravel cemented by sticky reddish clay and colloidal matter. This grades abruptly to unconsolidated sand and gravel which contain considerable limestone.

This soil is moderately retentive of moisture. The clayey layer becomes moderately compact but is not impervious and does not stop the downward penetration of plant roots. The reaction of the first two layers is in general medium or strongly acid; that of the third layer is generally acid, except that coarse particles of limestone may
be found in places; and that of the substratum is alkaline. Fox loam has medium natural fertility.

This is one of the less extensive soils but occurs in considerable areas in the western and northern parts of the county and is of agricultural importance. Areas range from nearly level to uneven, as there are depressions in the surface of the plain and hummocky inequalities which are a feature of the glacial deposits with which the soil is associated. Natural drainage is good even in level areas, because of the coarseness and perviousness of the substratum.

This land was originally forested, but in places it appears that there was a thin stand or open growth. Oaks, including bur oak, white oak, red oak, and black oak, were most abundant, and there were some hickory, hard maple, and beech.

The greater part of the land is under cultivation. The rougher or more broken land is included in wood lots and pastures. Fair average yields of corn, oats, rye, clover, and alfalfa are obtained. Near Hillsdale, special crops such as cabbage, cantaloupes, cucumbers, and small fruits are grown.

Applications of barnyard manure and rotation of crops are important in maintaining productivity. Commercial fertilizers are not extensively used but apparently give increased yields. Liming is not general, but probably this soil would be benefited by lime. It presents no especial tillage difficulties.

**FOX STONY LOAM**

Fox stony loam is very similar to Fox sandy loam and Fox loam in the succession of the different layers in the profile. This soil is characterized by a higher percentage of coarse material of gravel, cobble, and stone size, and the reddish, clayey horizon may lie a little closer to the surface and be, in general, a little thicker.

This soil has medium fertility and produces good average yields of the staple general farm crops. Alfalfa is successfully grown. The abundance of cobbles on the surface constitutes the principal tillage difficulty.

**PLAINFIELD LOAMY SAND**

In virgin areas of Plainfield loamy sand a layer, 2 or 3 inches thick, of light-brownish humus soil, a mixture of organic matter and loamy sand is present on the surface. This is underlain by grayish loamy sand, slightly tinted by organic matter, which varies in thickness from 1 to 4 inches, and which is underlain by dull-yellowish (average moisture) loamy sand from 10 to 15 inches thick. This material grades to paler yellow or cream-colored incoherent sand which, at a depth varying from 36 to 40 inches, grades to the substratum of sand or sand and gravel. The mixture formed by plowing to a depth of 6 or 7 inches is light grayish-brown loamy sand, poorly supplied with organic matter and clay, and therefore incoherent.

The water-holding capacity of this soil is low, and the average amount of moisture held in all layers is smaller than for the other soils in the county. Plainfield loamy sand, however, is loose and easily penetrable to a depth of several feet and allows free root development. The reaction is moderately or strongly acid to a depth of
3 or 4 feet, and the substratum or parent material is less well supplied with limestone and other basic rocks and minerals than is the corresponding layer of other soils. The natural fertility of this soil is low so far as this can be inferred from experience under cultivation and from chemical analyses.

Liberal manuring or turning under of green crops is most essential to retain productiveness. Liming is advisable, especially for alfalfa, and the soil responds readily to the use of complete fertilizers. Compacting the soil by rolling or by the use of cultipackers may be advisable.

The soil, as mapped, is fairly uniform and true to type in the different areas. However, some of the soil, especially near Long Lake in Reading Township and near Sand Lake, is a little darker and more moist and is very similar to the Berrien soils.

Plainfield loamy sand occurs in small areas, principally in the western part of the county. It is one of the less extensive soils. Areas are nearly level or only slightly undulating. The soil is, for the most part, dry or well drained because of the perviousness of the soil and substratum.

The original forest growth consisted dominantly of oaks, with other species of trees common to this region present in smaller numbers.

The greater part of the land is at present or has been in the past under cultivation. The staple farm crops are grown, but yields average less than for other soils unless the land is heavily manured or fertilized. Lack of moisture may be one of the chief limiting factors, since corn and other crops give fair average results during a wet year. Plainfield loamy sand is used with a fair measure of success for bush fruits, such as dewberries, blackberries, and raspberries, and for strawberries, melons, and cucumbers.

**Bellefontaine Sandy Loam**

Bellefontaine sandy loam, to a depth of 6 or 7 inches, is grayish-brown, friable or loosely coherent sandy loam. The underlying soil, to a depth varying from 15 to 24 inches, is yellowish sandy loam with little or no color from organic matter. This is underlain by reddish sandy or gritty material which in places is coarse and gravelly but which contains sufficient clay to produce a coherent or slightly compact structure. Evidence of soil weathering is present in most places to a depth of about 4 feet. The substratum, or parent drift material, is a confused mass of sand, sandy clay, gravel, and bowlders.

The surface soil contains only a moderate supply of organic matter, barely sufficient to impart a light-brownish tint. The organic matter or humus is not so durable as it is in the heavier soils. The surface layer is loose and pervious, but there is sufficient clay and closeness of structure in the subsurface layer to check the free downward movement of gravitation water. The soil is, therefore, only moderately retentive of moisture but holds a sufficient quantity to carry crops through ordinary periods of dry weather. Most of the surface soil shows medium acidity; below a depth of 2 or 3 feet the reaction is less acid and in places may be slightly alkaline; the substratum commonly contains sufficient calcium carbonate or other
bases to effervesce with acid or to give an alkaline reaction. The soil has low or medium fertility according to local standards.

Bellefontaine sandy loam occurs in small areas and is of small total extent. It is closely associated with Hillsdale sandy loam and can not everywhere be sharply differentiated from that soil.

This soil is characterized by moderately steep slopes, but none of the land is so excessively steep as to be nonarable. It was originally covered with an oak-hickory type of forest. It appears that elm, ash, and basswood were less abundant than on the Miami soils.

General farm crops, corn, oats, wheat, clover, rye, potatoes, and fruits give fair results, although the surface features are less favorable and the agricultural value of the land is, on the whole, less than that of the Miami soils.

This soil is easily plowed and maintained in good tilth with ordinary care in management, but the steeper slopes are susceptible to erosion and gullying. Liming is advisable in most areas. The soil responds well to applications of commercial fertilizers.

A gravelly phase of Bellefontaine sandy loam consisting of grayish-brown friable gravelly sandy soil underlain at a slight depth by a mass of sand, gravel, and cobbles slightly cemented by reddish clay, has been included with Bellefontaine sandy loam in mapping. The substratum is a confused deposit of sand, gravel, and bowlders.

This included soil occurs in only a few small areas on knolls or hills and is characterized by steep or broken slopes. On the whole, it is probably a little higher in fertility and is less acid at the surface or more limy at a slight depth than are other sandy soils, but because of its unfavorable surface features, susceptibility to erosion, and stoniness it has only small agricultural value. Much of the land has been excavated for gravel to be used for road material and construction purposes.

**COLOMA LOAMY SAND**

Coloma loamy sand, from the surface downward, consists of the following layers: (1) A layer of mixed sand and organic matter, from 2 to 4 inches thick; (2) a layer of dull-grayish sand, from 1 to 4 inches thick; (3) a dull or brownish-yellow (average moisture) loamy sand layer, varying from 10 to 20 inches in thickness, which grades to (4) a paler yellow or cream-colored incoherent sand layer; (5) unaltered parent material of sandy drift, which occurs at a depth ranging from 3 to 5 feet. The soil, to the depth to which it is plowed, is light brownish, is loamy, and is only slightly coherent. The third layer described contains a small percentage of clay and inorganic colloids but not in sufficient quantity to bind the soil into a coherent mass. The substratum is predominantly sandy but is lithologically heterogeneous, as it is composed, in part, of lenses or pockets of clay and contains a variable percentage of gravel and bowlders.

Coloma loamy sand is pervious and penetrable throughout. Water moves freely through it and free and extensive root development is possible. The average quantity of moisture held is comparatively low, but apparently a high percentage is free or available for plant use. The fertility is comparatively low or only medium; according to chemical analyses, nitrogen, calcium, potassium, and, less markedly, phosphorus, are present in smaller quantities than in the more
clayey soils such as the Miami. Coloma loamy sand in most places exhibits medium or strong acidity to a depth of 4 or more feet, but calcium carbonate is nearly everywhere present in the deep substratum, either as thoroughly disseminated fine particles or as conspicuous veining and cementation.

Coloma loamy sand is widely distributed in small areas but is one of the minor soils, as it comprises only about 0.8 per cent of the land in the county.

Areas of this soil are for the most part uneven and hummocky or rolling but are characterized by smooth and not excessively steep slopes. The drainage is free, both because of the slope and the perviousness of the soil.

This soil was originally all forested. The trees were principally black oak, white oak, and red oak, but in places there was a considerable proportion of hard maple, beech, and other species found on associated soils.

The greater part of this land is under cultivation, generally in conjunction with other soils. Where the land is well manured and fertilized fair yields of corn, small grains, and potatoes are obtained. The soil is not well adapted to wheat and red clover and can not be expected to give as good results as the heavier soils. Fair stands of alfalfa can be established. Apples, pears, plums, and bush fruits give fair results.

In the management of this soil, experience has demonstrated that it is most essential to maintain a good supply of organic matter, either by the use of barnyard manure or by turning under green crops. The soil responds to the use of complete commercial fertilizers in applications of 200 or 300 pounds to the acre, and topdressings of nitrate of soda have proved effective and profitable. Liming is advisable for alfalfa and sweet clover.

**BERRIEN SANDY LOAM**

Berrien sandy loam, from the surface downward, consists of the following layers: (1) A grayish-brown sandy loam layer, 6 or 8 inches thick; (2) a layer of yellowish, loosely coherent sand or sandy loam, which grades, at a depth varying from 20 to 30 inches to; (3) a layer of grayish and yellow or rust-colored mottled sand or sandy loam, in which a high average content of moisture and incomplete aeration and oxidation are evident; (4) a deep substratum sufficiently clayey to hold water.

In content of organic matter in the surface layer and in average moisture content, Berrien sandy loam is intermediate between Plainfield loamy sand and Newton loamy sand. It is level or flat but, for the most part, the surface soil is not too wet for farming purposes. The soil is medium or strongly acid in reaction and is low or medium in natural fertility.

Only a few small scattered areas of Berrien sandy loam are mapped in this county. There are, however, small additional areas included with other soils.

Fair yields of corn, potatoes, and other crops are obtained. Liming and fertilization are advisable.
BRADY SANDY LOAM

Brady sandy loam, from the surface downward, consists of the following layers: (1) A dark-gray sandy loam layer, from 4 to 6 inches thick; (2) a layer of lighter-gray sandy loam, with less coloring from organic matter, ranging in thickness from 10 to 20 inches; (3) a grayish and yellowish mottled sandy and gravelly clay layer, from 10 to 20 inches thick; (4) a substratum of unconsolidated sand and gravel. The soil is moderately gravelly throughout.

Brady sandy loam is distinguished from Newton loamy sand by the clayey third layer and from the Brookston soils by the pervious or loose sand and gravel substratum, although clay may be present at a depth of 5 or 6 feet. Most of the soil, as mapped here, is probably darker than typical, and some of it is underlain by clay at a slight depth.

Under natural conditions, the third and fourth layers are waterlogged, and the surface soil is high in average content of moisture. The content of organic matter is comparatively high; the reaction varies from slightly acid to alkaline at the surface, and is alkaline in the third layer and in the substratum. The soil ranks as medium or high in natural fertility.

Brady sandy loam is of small total extent. The largest acreages occur in Litchfield, Woodbridge, and Wright Townships.

When properly drained, this soil is productive for the staple general farm crops. Liming is probably not essential. Manure can be applied profitably, and the soil may be expected to respond to applications of commercial fertilizers.

NEWTON LOAMY SAND

Newton loamy sand, from the surface downward, consists of the following layers: (1) A layer, from 4 to 12 inches thick, of dark-gray sandy loam, rich in organic matter; (2) a lighter gray incoherent or but slightly loamy sand layer, from 6 to 12 inches thick; (3) a layer of gray and rust-colored or yellowish sandy loam; and (4) a substratum of bluish-gray sand containing only a slight admixture of clay to a depth of 5 or more feet. There is a gradation or shading from one layer to another, and the thicknesses given are arbitrary. Under natural conditions the water table is high, and hence most of organic matter in the surface soil is not highly humified and the intensity of the color tends to decrease markedly with drainage and cultivation.

This soil varies from acid to alkaline in reaction and possesses medium fertility.

Only a few small areas were differentiated on the map, but doubtless other patches may be found associated with the allied Brookston and Brady soils.

Where provided with proper drainage, the common general farm crops can be grown, although the soil is not very well adapted to small grains.

BROOKSTON LOAM

The surface layer of Brookston loam consists of dark-gray or dark grayish-brown loam moderately rich in organic matter and
from 6 to 10 inches deep. This grades to gray or drab, more coherent and more clayey material, from 6 to 10 inches thick, which in turn grades to steel-gray or bluish-gray, more plastic or sticky sandy clay mottled with yellow or brown. The substratum consists of sandy clay or alternate thin layers of sand and clay.

There is considerable variation in the texture of the surface soil in the areas shown on the soil map, but on the whole these areas represent the lighter and sandier phase of Brookston loam, and the soil that is predominantly more clayey, both in surface and subsurface layers, represents Brookston clay loam.

Brookston loam possesses medium or high natural fertility. The content of organic matter is comparatively high and the supply is fairly durable under cultivation. The reaction is slightly acid or alkaline at the surface and alkaline at a slight depth. The subsurface clay is hard and resistant when dry, but under natural conditions is penetrable, so that the depth of root penetration is limited by the depth of the water table rather than by resistant soil layers.

Brookston loam occurs in small areas in depressions and in other flat situations characterized by a high water table but not necessarily permanently wet at the surface.

The forest growth consists mainly of tall, closely spaced elm, ash, shagbark hickory, soft maple, basswood, and swamp white oak.

The greater part of this land is utilized for pasture. Where provided with proper drainage excellent yields of corn, hay, oats, alfalfa, and sugar beets are obtained.

**Brookston Clay Loam**

Brookston clay loam differs from Brookston loam in containing a higher percentage of clay throughout. The soil is very fertile and is durable under cultivation. Tillage may be difficult because of a tendency of the soil to cohere strongly and to clod if it is worked when too wet, but where proper drainage is provided excellent yields of the staple farm crops are obtained.

The greater part of this soil is utilized for pasture. The timber growth is essentially the same as that on Brookston loam.

**Griffin Sandy Loam**

Griffin sandy loam consists of recently deposited alluvium which exists under conditions of poor drainage. The surface soil is, for the most part, brownish sandy loam containing a comparatively high percentage of organic matter. At a depth of a few inches characteristic rust-brown or yellowish mottles appear. These indicate poor subsurface drainage and consequent poor aeration and oxidation. The alluvium, although for the most part sandy throughout, is variable and consists of alternate layers of sand and sandy clay and, in places, of thin beds of muck. Some sandy muck soil is included.

Griffin sandy loam is nearly neutral or slightly alkaline in reaction and possesses moderate or high natural fertility. It is of small total extent and does not have a high agricultural value because of its poor drainage and unfavorable surface features. It is utilized chiefly for pasture. It supports a vigorous growth of elm, ash, soft maple, willow, and basswood.
GRiffin Silt loam

Griffin silt loam consists in general of recently deposited alluvium which is heavier in texture at the surface and is more uniformly underlain by clay than the material mapped as Griffin sandy loam. At a depth varying from 4 to 6 feet, there is generally a sandy or gravelly layer resting on the older glacial deposit. Considerable variation occurs in the texture or lithologic character of the deposit.

This soil is well supplied with organic matter, is generally neutral or alkaline in reaction, and possesses medium or high natural fertility. Its principal defect, from an agricultural point of view, is poor drainage.

Griffin silt loam is not an extensive soil in this county. It occurs principally in the southeastern part of the county, in association with the Miami soils, but the alluvial bottoms nowhere reach any great width.

The original forest cover consisted of a dense stand and large volume growth of elm, ash, soft maple, basswood, shagbark hickory, and considerable walnut, butternut, and sycamore. The soil affords excellent pasturage, and where it is cultivated along East Branch St. Joseph River it has given excellent yields of corn, wheat, clover, alfalfa, and sugar beets.

Organic Soils

Carlisle muck

Carlisle muck is characterized by a dark-brown or black color at the surface and by a coarse, granular, loamy structure. In the typical soil the organic matter becomes finer in texture, more colloidal, pasty, and more compact at a depth of a few inches below the surface. At a greater depth, generally 15 or 20 inches, the material becomes coarser, more fibrous, or peaty and less decomposed. In this soil the parent organic material, to a depth varying from 12 to 20 or more inches, has been modified to such an extent that in most cases the original botanic composition of the deposit can not be determined.

This soil is characteristically nearly neutral or alkaline in reaction. Analyses in various parts of the State indicate that it is comparatively rich in lime and phosphorus but poor in potash. The content of ash or inorganic matter is generally higher than in other muck soils. Throughout the greater part of the county the deposits are more than 3 feet thick and most of them are underlain by marl or clay.

This type of muck was originally forested and still remains largely in timber. Elm, ash, and soft maple were the dominant or characteristic species, and tamarack, aspen, and willow were present in varying numbers.

Only a very small percentage of this land has been utilized for agricultural purposes in this county, although in other parts of the State, where provided with proper drainage and properly cultivated and fertilized, it has been used with success, especially for such crops as celery, onions, cabbage, and mint. When cleared or partly cleared of trees and shrubs, this soil supports a good growth of bluegrass, timothy, alsike clover, and redtop and furnishes good pasturage.
GREENWOOD PEAT

Greenwood peat is yellowish brown or reddish brown in color; is coarse in texture, uncompacted and fibrous, spongy or feltlike; exhibits but very little decomposition of the parent plant matter; and has a very low ash content. Under natural conditions the water table is high; that is, lies at or within a few inches of the surface. This peat is very strongly acid in reaction, and analyses of samples from various parts of the State indicate that most of it is probably low in lime and phosphorus.

This peat is, in general, characterized by a growth of blueberry, huckleberry, Cassandra, Kalmia, and Sphagnum moss.

Only two small areas of Greenwood peat were mapped. This peat is not regarded as having any appreciable agricultural value at present.

RIFLE PEAT

Rifle peat is intermediate between Carlisle muck and Greenwood peat in the depth of water table and in the state of decomposition of the organic matter. The surface soil is granular, woody, and loamy, blackish or brown, but does not show very much decomposition below a depth of a few inches. The underlying material is coarse in texture, is woody, fibrous, feltlike, and not compact. The quantity of ash or mineral matter present is very small. Rifle peat presents a greater range in reaction than do the other two organic soils mapped, but it is not so strongly acid as Greenwood peat and in places is fairly rich in lime. Most of the parent deposits are more than 4 feet thick.

In this county, Rifle peat is characterized by a dominant tree growth of tamarack, and by such shrubs as red osier (Coriaceae stolonifer), winterberry (Ilex verticillata), dwarf birch, elderberry, and huckleberry. In treeless areas there is a dense growth of sedges and grasses, principally wire grass (Carex filiformis) and bluejoint (Calamagrostis canadensis). Rifle peat is widely distributed in irregular areas throughout the entire county. There has been very little attempt to drain or utilize it for agricultural purposes other than, to a small extent, for pasturage and wild hay. When properly drained, thoroughly cultivated to produce good tilth, and properly fertilized, Rifle peat has been successfully utilized in other localities for truck crops. Cost of reclamation in general may be expected to be somewhat higher than for Carlisle muck, and greater time or greater cost is involved in obtaining good tilth.

A separate phase or type of peat (Houghton) occurs in small areas, but this has been combined with the Rifle peat, because of the physical difficulties of drawing accurate boundaries between the two. Houghton peat is coarse in texture, exhibits little decomposition, and is characterized by a very high water table. It is darker in color and is not so highly acid as Greenwood peat. It is marshy or semimarshy and is characterized by a growth of sedges, grasses, and rushes.

SUMMARY

Hillsdale County is in the south-central part of Michigan and is bordered by Ohio and Indiana.
The county, as a whole, is gently rolling or moderately hilly, but there is no great local difference in elevation. The general elevation ranges from 800 to 1,800 feet above sea level.

Most of the soil is well drained, although the streams are small and do not ramify the whole county. Small depressions filled with muck, and peat bogs and poorly drained mineral soils constitute an aggregate area of 116.6 square miles, or 19.4 per cent of the land in the county. This soil is without adequate natural drainage.

The county originally was entirely forested with hardwoods on the uplands and with tamarack, aspen, and willow on the muck and peat swamps. The greater part of the tree growth has been removed, either in farming operations or by lumbering, although a considerable aggregate of wood lots and small patches of original forest remain.

The population, according to the 1920 census, is 28,161. Agriculture is the principal industry. The total value of agricultural products in 1919, according to the 1920 census, was $7,405,458, and the value of farm land and buildings was $31,477,236. Transportation facilities are afforded by the New York Central Railroad and Michigan Central Railroad and by State trunk-line highways. Detroit and Chicago are the principal city markets for agricultural products shipped from the county.

The main features of the climate are a mean annual temperature of about 47° F.; a moderate precipitation of about 35 inches, including melted snow; an average snowfall of about 40 inches; a low wind movement; low evaporation; and moderately high humidity. The winters are rather cold, and the summers are mild. The average frost-free season is about five months.

Farming began in the county about 1830. Agriculture at present consists of the general farming common to this region, namely, the growing of corn, oats, and hay, and the keeping of livestock, together with a less distinct type of agriculture which consists of general farming combined with the production of various special income crops. Farms range in size from 80 to 200 acres.

Eleven series of mineral soils, including 16 types, and 3 types of organic soils have been mapped in Hillsdale County.

The soils, in general, have developed under forest cover and the well-drained soils are characterized by grayish-brown topsoils and yellow or reddish-brown heavier subsoils. This group includes the soils of the Miami, Hillsdale, Bellefontaine, Fox, Plainfield, and Coloma series.

Mineral soils developed under conditions of poor drainage have dark-gray or black topsoils containing a comparatively high percentage of organic matter, underlain by grayish, drab-colored, or mottled subsoils. The soils of the Brookston, Newton, Brady, and Berrien series are included within this group.

The soils consisting of recently deposited alluvium are grouped in the Griffin series.

The organic soils are classified as Carlisle muck, Greenwood peat, and Rifle peat.
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