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Soil Survey

of

Branch County, Michigan

By

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Bureau of Chemistry and Soils

In cooperation with the Michigan Agricultural Experiment Station

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COUNTY SURVEYED

Branch County is in the south-central part of Michigan, bordering the Indiana State line. (Fig. 1.) It is about midway between Detroit and Chicago and about equally distant from Lake Erie on the east and Lake Michigan on the west. Its total area is 503 square miles, or 321,920 acres.

Physiographically, the county is a part of the comparatively smooth broad glaciated upland extending from the Ohio-Indiana line northeastward to Huron County, Mich. This upland ranges in elevation from about 800 to a little more than 1,300 feet above sea level and is from 200 to 400 feet higher than the average elevation of the plain which adjoins it on the east, west, and north.

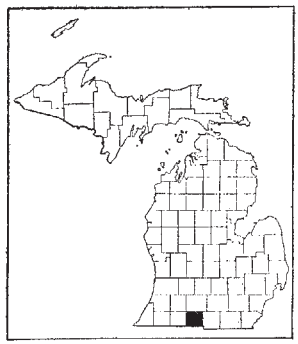

FIGURE 1.—Sketch map showing location of Branch County, Mich.

The relief of the county as a whole is subdued, since there are no conspicuous constructional hills or ridges and no great stream erosion. The lowest point in the county is near Sherwood, approximately 850 feet above sea level, where St. Joseph River crosses the St. Joseph County line. The highest point is probably in the southeastern part and is a little more than 1,100 feet above sea level. Strictly local differences in elevation in few places exceed 100 feet. The land surface consists for the most part of level featureless plains and gently rolling plains, having low ridges or swells with smooth slopes and complementary broad constructional valleys or basins. A few small scattered areas, the aggregate of which is less than 5 per cent of the whole county area, might be classed as moderately hilly. A few areas in the vicinity of Hodunk, a small one northwest of Sherwood along the St. Joseph County line, a third near Matteson Center, others in the extreme southwestern part of the county, and several of minor extent scattered throughout the southeastern and northeastern parts comprise the relatively hilly and rougher land. More than 95 per cent of the county is approximately equally divided between nearly level plains and undulating or smoothly rolling uplands. The level plains are for the most part smooth, although some of those in the southern part of the county have a pitted appearance. The larger plains occur near and south of Bronson, near Coldwater

Lake, and farther north and northwest along Coldwater and St. Joseph Rivers, and narrow belts penetrate all parts of the county. Areas of undulating upland occur throughout the county as island-like bodies surrounded by plains, their occurrence, outline, and extent, like those of the complementary plains, being extremely variable. Figure 2 shows the distribution and approximate extent of the two major topographic divisions—the level or nearly level plains and the undulating or smoothly rolling uplands. The small moderately hilly areas are too small to justify a third separation.

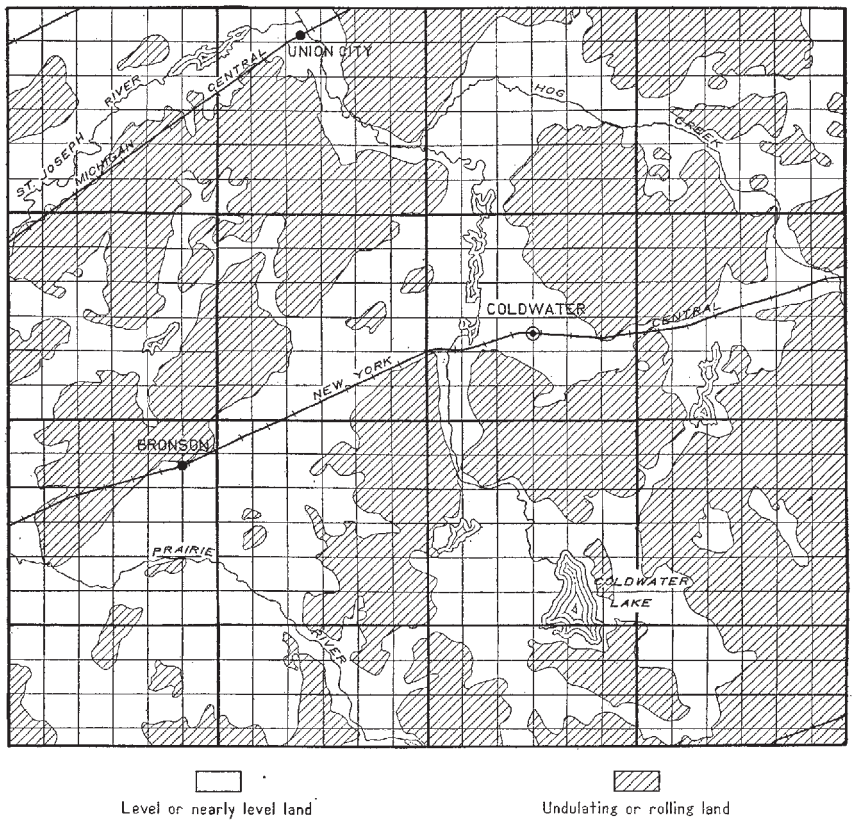

FIGURE 2.—Sketch map showing topographic divisions of Branch County, Mich.

There are comparatively few perennial streams in Branch County in proportion to the land area. St. Joseph River, which crosses the northwestern corner of the county and flows into Lake Michigan, is the largest stream, and, with its tributaries, including Fawn, Prairie, and Coldwater Rivers, affords the outlet for the county drainage. Characteristic of the younger glaciated regions of mild relief, stream channels necessary to develop a dendritic drainage system have not been cut, and the drainage system, therefore, is not well developed. Streams flow in all directions following constructional valleys and depressions, and small tributary streams are few.

In general, lakes constitute the headwaters of the perennial streams which carry clear water. In some places small streams developed in the rolling uplands disappear on reaching the plains where the substrata are gravelly. Approximately 70 lakes, with an aggregate area of more than 7,000 acres, occur in all parts of the county, but they are less numerous in the northeastern part. They differ in size and depth, ranging from small shallow ponds to Coldwater Lake which covers nearly 1,500 acres and is more than 75 feet deep. There seems to be no systematic arrangement of the lakes, although some of them, including some of the larger lakes, are in two chains. One chain, extending from Coldwater Lake to Quincy, includes Coldwater, Long, Mud, Bartholomew, Middle, and Marble Lakes; and the other chain includes, together with smaller lakes, Lake of the Woods, Grass, South, North, Randall, and Morrison Lakes. Coldwater River flows through the last four. Many summer colonies and resorts are on the shores of the lakes, especially on Coldwater and Morrison Lakes.

It is estimated that about 70 per cent of the land is naturally sufficiently drained for agriculture, as a result either of surface run-off or rapid subdrainage through pervious substrata; the remaining 30 per cent is naturally excessively wet or poorly drained, owing to sluggish run-off and a high water table, or, in a few places, to impervious substrata. The poorly drained land, which may consist of either mineral or organic soils, occurs for the most part in small widely distributed areas occupying low-lying strips along constructional valleys, depressions in the undulating upland, and swales and flats on the plains. Most of the larger peat or muck areas are sites of former lakes which have been filled in largely by vegetation.

When the first white settlers came to what is now Branch County 100 years ago, nearly the whole of the area supported a forest cover. A small acreage of marshland bordering the lakes, and a very few huckleberry peat bogs represented the treeless areas. Several so-called prairies, comprising a total area of probably 10 or 12 square miles, scattered over the county, supported on open forest and a grass cover. Trees, consisting principally of bur oak, grew here and there on such areas, but they were sufficiently scattered to allow a grass cover. The original cover of the poorly drained heavy soils consisted principally of elm, ash, soft maple, hickory, basswood, and swamp white oak. On the better-drained loam and sandy loam soils, red oak, black oak, white oak, beech, and hard maple were more characteristic. A somewhat irregular east-west belt, approximately 6 miles in width, crossing the county just south of Coldwater, contained an unusually high proportion of black walnut. Butternut, sycamore, aspen, red cedar, dogwood, and wild cherry were minor components of the forest. Tamarack was the principal tree growth of the wetter peat swamps and elm, ash, or soft maple of the muck land. In the marshy areas the principal growth consisted of wire grass and bluejoint. The greater part of the original forest has long since been removed either for lumber or other purposes, although small wood lots are in all parts of the county, and forested areas remain in swampy places.

Sufficient water of excellent quality is easily obtainable for farm use. The most healthful water comes from wells 75 or more feet

deep, but most of the wells in the county are less than 50 feet deep. Springs are little used. In most of the pastures, water for livestock is obtained from a stream or lake during the greater part of the year, but in many pastures water is obtained from shallow wells.

The first permanent white settlements in the area included in Branch County were made in 1828, but settlers came in rather slowly until immediately following the organization of the county in 1833. Most of the pioneers came from the Eastern States, including New York, Pennsylvania, and Ohio. According to the 1930 census [1] the population of Branch County is 23,950, of which 71.9 per cent is classed as rural. The density of the rural population is 34.6 persons a square mile. Although the population is somewhat more dense near the towns and villages, it is well distributed over the county. The people are dominantly native whites, with a small percentage of foreigners. Coldwater, with a population of 6,735, is the county seat and largest town. Bronson, Union City, and Quincy are other towns in the county. The manufacture of cement is an important industry in Coldwater, Union City, and Quincy, and several other industries are carried on in Coldwater and Bronson. The wealth of the county is, however, almost entirely agricultural.

Transportation facilities are very good. A main line of the New York Central system traverses the county, connecting three of the larger towns. Three other railroads touch the county, two in the northwestern part and one in the southeastern part. Seven railroad shipping points are well distributed over the county. Paved trunk-line highways, including the main Chicago-Detroit road, traverse the county, and a splendid network of local gravel-surfaced roads, penetrating all parts, is maintained in good condition. Schools and churches are easily accessible to all rural sections, and rural mail routes are convenient to all farm homes.

Only a small part of the marketed farm produce is consumed locally. Detroit and Chicago are the principal outside markets, and Jackson, Kalamazoo, and Battle Creek are also important markets.

CLIMATE

The climate of Branch County is characterized by moderately long cold winters, mild pleasant summers, low evaporation and wind movement, moderately high humidity, an average annual snowfall of 43.9 inches, and an annual mean precipitation of 35.92 inches, including melted snow.

The mean annual temperature is 48.6° F. Sudden changes of temperature are the most unpleasant features of winter, but the pleasant late spring, summer, and early fall are compensating features. The average length of the frost-free season is 155 days, from May 4 to October 6, which is ample time for the growing and maturing of the wide variety of farm crops produced in the county. Although frosts have been known to occur as late as May 28 and as early as September 12, material damage to crops from frosts is uncommon.

[1] Soil survey reports are dated as of the year during which the field work was done. Later census figures are given when available.

The distribution of precipitation throughout the year is favorable to agriculture, that of the summer months, when the moisture requirements of growing crops are greatest, being heaviest. Crop failures from excessive or deficient amounts of rainfall very rarely occur even on the naturally wetter or drier soils. Winter snows may be depended on as a protection to fall-sown grain during the greater part of the season, although in most places the cover is not continuous, and damage from freezes sometimes occurs. Summer hailstorms are not common, and damage to growing crops from this source is very rare.

The prevailing winds are westerly, rarely attaining high velocity. They are, therefore, seldom destructive to crops or other farm property.

Observations as recorded at Coldwater, which is centrally located, represent average climatic conditions in all parts of the county, as there are no great differences in altitude and no large bodies of water to create local inequalities. Crops growing in low wet situations are more often injured by frost than those on the adjacent higher land. The degree of success in fruit growing may be influenced slightly by the topographic situation and the direction of the land slope on which the orchard is planted.

Table 1 gives the normal monthly, seasonal, and annual temperature and precipitation, as compiled from records of the Weather Bureau station at Coldwater.

TABLE 1.—*Normal, monthly, seasonal, and annual temperature and precipitation at Coldwater, Mich.*

[Elevation, 984 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1910)	Total amount for the wettest year (1905)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	27.1	66	−17	2.20	1.51	1.27	13.8
January	24.2	70	−19	1.93	2.02	2.27	9.1
February	23.1	64	−21	2.01	2.30	1.50	7.4
Winter	24.8	70	−21	6.14	5.83	5.04	30.3
March	35.7	78	−1	2.56	.22	3.64	7.6
April	47.1	89	8	2.80	3.03	3.54	1.0
May	58.7	96	25	4.31	3.36	7.51	.2
Spring	47.2	96	−1	9.67	6.61	14.69	8.8
June	67.7	99	35	4.03	1.65	3.50	.0
July	72.6	101	42	3.72	3.54	4.61	.0
August	70.5	99	38	3.49	3.55	8.03	.0
Summer	70.3	101	35	11.24	8.74	16.14	.0
September	63.9	96	28	2.88	4.01	4.00	.0
October	52.9	89	17	3.11	1.38	3.70	.6
November	39.6	76	9	2.88	1.83	2.55	4.2
Fall	52.1	96	9	8.87	7.22	10.25	4.8
Year	48.6	101	−21	35.92	28.40	46.12	43.9

AGRICULTURE

Agriculture had its beginning in a simple way with the first permanent white settlements which were in the vicinity of Bronson in 1828–1830. The pioneers concerned themselves primarily with producing subsistence crops. The earliest sources of income were principally farm produce, cattle, furs, and lumber. Development was slow until 1835 and 1836, when the influx of settlers increased very rapidly. According to local history the county population had reached 5,715 by 1840, and practically doubled each 10 years during the next two decades. This meant an extremely rapid increase in the cultivated acreage of the county, as agriculture was the principal pursuit of the settlers. Wheat was the principal cash crop, corn was an important subsistence crop, and potatoes and other food crops were grown largely to supply local demands. The dairy industry had not been developed. In 1852 the first railroad was built through the county, connecting Chicago with Lake Erie. This direct outlet to distant markets gave new impetus to agricultural development, and cash incomes were subsequently derived from a greater variety of sources. The population steadily increased, with a corresponding increase in farm acreage, until 1880, when the census reported 27,941 inhabitants and 3,670 farms embracing 96.9 per cent of the county's area. At this time corn, wheat, oats, potatoes, and hay constituted the principal crops, and buckwheat, rye, and barley were minor crops.

Since 1880 significant changes have been brought about in the farming system. The average size of farms has increased 14 per cent, the use of lime and chemical fertilizers has been introduced, barley and rye have partly replaced wheat, alfalfa has become an important hay crop at the expense of timothy, and more hay and forage are now being produced and consumed on the farm. Dairying has been developed and is now the principal source of farm income.

The present agriculture consists chiefly of the growing of such staple crops as corn, oats, wheat, potatoes, and hay and the keeping of livestock and poultry. A small number of farms combine general farming with some one or more special cash-income crops, such as cabbage, onions, mint, flowers, and cucumbers, or with mixed truck growing, and a few small farms are devoted entirely to one or a combination of these specialties. A number of dairy farms are operated in the vicinities of the larger towns, especially along the Detroit-Chicago highway. The average farm is rather small, and profits usually depend on average results of growing the same crops from year to year without material change of methods. Farming is, however, gradually evolving from the stage in which inherent productiveness of the soil is entirely relied on for results toward that in which means for maintaining productiveness and increasing yields are practiced. To this end, the average farmer is devoting more thought to such measures as artificial drainage, requirements of the soil for lime and commercial fertilizers, the proper selection and varieties of seed, rotation of crops, and incorporation of organic matter in the soils.

Table 2 gives the acreage and yield of the principal crops of the county as reported by the Federal censuses for the years 1919 and 1929.

TABLE 2.—*Acreage and yield of the principal crops in Branch County, Mich., in 1919 and 1929*

Crop	1919		1929	
	Acres	Yield	Acres	Yield
		Tons		*Tons*
Hay	44,529	45,891	42,367	55,381
		Bushels		*Bushels*
Corn	38,925	1,385,674	[1] 24,571	636,929
Wheat	24,421	465,541	20,688	287,600
Oats	22,874	463,938	25,243	590,066
Rye	22,354	325,834	1,464	16,557
Barley	9,716	121,854	4,322	68,902

[1] In addition to the corn harvested for grain, 4,191 acres were cut for silage, 4,246 acres were cut for fodder, and 2,785 acres were hogged off.

In addition to the tabulated crops, alfalfa, potatoes, buckwheat, and some beans are grown with more or less regularity. A few small farms are devoted to the growing of bulbs, principally peonies and gladioluses. Potatoes, cabbage, onions, and cucumbers are grown, not only as special cash crops, but together with a variety of other truck crops, such as carrots, celery, beets, peas, beans, lettuce, radishes, and tomatoes, which are commonly grown for the needs of the home, and small quantities are disposed of on local markets.

Owing largely to the absence of a large body of water to stabilize and prevent sudden changes of temperature, fruit growing is not so successful in Branch County as farther west along the shore of Lake Michigan. Apples, peaches, pears, plums, and cherries are grown with some degree of success in small home orchards. Strawberries, and to less extent raspberries, are grown for home use and to supply local markets. Apples constitute the principal orchard fruit and a few young orchards of commercial size have been planted recently, although the number of trees has consistently decreased from 219,755 in 1889 to 30,619 in 1929.

Dairy cattle greatly exceed beef cattle in number, and sheep and hog raising and fattening are of importance. The tendency in recent years, however, has been for the number of sheep, hogs, and beef cattle to decrease and for the number of dairy cattle to increase.

The physical and chemical character of the soil, together with other factors, such as surface relief, streams, drainage conditions, stoniness, and geographic location, have much influence on crop selection and rotation and largely determine the distribution and extent of virgin woodland, abandoned land, and pasture locations.

General farming, typical of the county, including the growing of staple crops, together with raising a small number of dairy cattle, hogs, poultry, and a few sheep, is most common on the Fox, Miami, and Hillsdale soils. On the well-drained sandier soils, such as Oshtemo, Plainfield, and Coloma soils, wheat and oats largely give

way to rye. On the Conover and Coldwater soils, locally referred to as the "heavy timbered lands," livestock, especially dairy cattle, partly replace cash crops. Peonies, gladioluses, strawberries, raspberries, and most of the truck crops grown commercially are for the most part restricted to the Fox soils near the larger towns along the Detroit-Chicago highway. Mint and onions are largely grown on Carlisle muck. Probably 90 per cent of the cabbage grown for market is produced on the Conover and Coldwater soils. Most of the abandoned farm lands are on the droughty Coloma and Plainfield soils, or on extremely stony areas of the Hillsdale, Conover, Coldwater, and Bellefontaine soils, and the distribution of most upland wood lots is similarly determined. Probably more than 80 per cent of the virgin woodland occupies low wet areas which are for the greater part peaty.

Only in a very general way do the farmers as a whole recognize the crop adaptation of the different soils. Extreme conditions of drainage, texture, and acidity are apparently the outstanding soil characteristics commonly recognized in this respect. Farmers who grow special crops, such as mint, vegetables, or flowers, recognize the soils to which their specialties are best adapted.

As the system of agriculture in Branch County is just emerging from the stage of land exploitation and as many farmers still rely largely on natural soil fertility, the use of lime, commercial fertilizer, and green manure in soil management are new to a large percentage of the farmers. That the virgin fertility, especially of the lighter-textured soils, is becoming rapidly depleted is common knowledge. The growing of sweetclover as a soil builder is being resorted to by many. Alfalfa is gradually replacing timothy, not only for hay production but for the purpose of maintaining soil productivity. The general tendency is to turn more organic matter back to the soils.

No common system of rotation is generally practiced throughout the county. The character of the soils, the location of the farm in reference to local markets, resort lakes, and highways carrying heavy traffic, farm equipment, and many other factors determine the kind of rotation. Many farmers, typical of the general-farmer type, approximate some such system as corn or potatoes, oats or barley, wheat, and seeding the land to hay for the fourth year; some others plant corn or potatoes, followed by oats or barley, and the land is seeded to hay the third year.

The value of manure and the importance of properly caring for it are becoming more generally appreciated. More hay and feedstuffs are being consumed on the farm as a means of maintaining soil productivity as well as a means of producing a more refined, or less bulky, product. Numerous failures of alfalfa and clover on strongly acid soils, such as the Hillsdale soils, have awakened the farmer to the need of the soils for lime, and the use of lime in the form of marl, hydrated lime, or ground rock is increasing. Commercial fertilizers are not in general use. Slightly less than 35 per cent of the farmers purchased commercial fertilizer in 1929. Different mixtures and grades are used. About 200 pounds of superphosphate (acid phosphate) is sometimes applied to land to be sown to small grain, and some farmers apply a complete fertilizer mixture when hay is to follow the grain. Potash alone, or a mixture high in potash,

is often applied to land used for truck crops, particularly on muck soils. Corn is seldom fertilized, although this crop, as well as most others, responds profitably to applications of fertilizer on most of the soils. Recommendations for formulas and rates of application of fertilizers suitable for the land in Branch County are given in a bulletin published by the Michigan Agricultural Experiment Station.[2]

According to the 1930 census, Branch County has 2,750 farms, including 91 per cent of the total county area. The farms average 105.2 acres in size, and about 80 per cent of them are operated by owners. Cultivated land in 1929 occupied 58.2 per cent of the farm land, and 32.4 per cent was in pasture. The rest of the land is mainly in woodland.

The usual system of renting land is on a share basis, only about 9 per cent of the rentals, according to the 1930 census, being for cash. The share system varies greatly in detail, according to improvements, proximity to market, productiveness of the soil, and the kind and number of livestock kept. For general farming, however, the land is furnished by the owner and the labor by the tenant, and other expenses and the proceeds are equally divided.

Most of the farmhouses are good, and such modern conveniences as electric lights and running water in the homes are becoming more common. Most farms are well supplied with modern equipment, and tractors are used on a large proportion of the farms, especially throughout the more level parts of the county. Most of the work animals are horses and are usually of good quality, consisting principally of grade Percherons and Belgians.

SOIL SERIES AND TYPES[3]

The soils of Branch County have been grouped in soil series and types on the basis of characteristics that could be determined by examination or by simple tests in the field. The series is the broader group and may include a number of soil types. It is a group of soils having certain physical characteristics in common, such as the arrangement and thickness of the layers from the surface downward, texture (except in the surface soil), color, consistence, and structure. Chemical characteristics produced by various important components of the soil, such as organic matter, lime, and iron, are also group characteristics. The soil type, a subdivision of the series, is separated solely on the basis of the texture of the surface soil. The series is given a place name, generally the name of the place or county where the soils of the series were first described, and this name with the texture name comprises the type name. Slight variations from typical are called phases; for example, any part of a soil area in

[2] MILLAR, C. E., GRANTHAM, G. M., and HARMER, P. M. FERTILIZER RECOMMENDATIONS FOR 1931. Mich. Agr. Expt. Sta. Circ. Bul. 53 (rev.), 22 p., illus. 1930.

[3] The soil boundaries which cross the Branch County lines do not everywhere join with those of previously published soil maps. The failure to join with the work in Calhoun and St. Joseph Counties is owing to great improvements in accuracy in field work and to refinement of soil classification since the publication of the soil survey reports of those counties. The discrepancies along the Branch-Hillsdale County line are minor, both in extent and in definition. They consist mostly of slight differences in texture and drainage conditions, as where Miami loam joins Miami silt loam, or where Bronson loam, an imperfectly drained soil, first recognized in Branch County, joins areas mapped as Fox loam or Fox sandy loam in Hillsdale County.

which the surface is so rolling as to impair the agricultural value of the land may be designated as a rolling phase of that type.

All mineral soils are composed of particles of different sizes. The soils have different characteristics, depending in part on their content of the different-sized particles. Sand soils are in general comparatively infertile, and their loose open consistence causes them to drift soon after they are broken. The sandy loam soils contain more silt and clay than the sandy soils and are, therefore, more fertile and have a greater water-holding capacity. The loams are commonly spoken of as " all-round soils " and are, as a rule, adapted to a greater variety of crops than any other class of soils. The silt loams and clay loams are heavier than the sandy loams and require more careful management in order to maintain good tilth. They are usually well adapted to most crops. The silty clays and clays contain 20 or more per cent of clay and are very hard to work when wet, as the particles run together and with subsequent drying form into hard clods. Under certain moisture conditions clayey soils form a good seed bed. They absorb water very slowly and give it up slowly. They are adapted to many grasses, cereals, and legumes.

In this report is a description of the soils of Branch County, in which the most obvious and important characteristics are brought out. Discussions of their extent, location, and agricultural value are given. Eighteen mineral soil series including 24 soil types and 1 phase of a type have been recognized. Five types of organic soils, consisting in large part or entirely of plant remains, are mapped. Table 3 gives the acreage and proportionate extent of the different soils mapped in the county.

TABLE 3.—*Acreage and proportionate extent of soils mapped in Branch County, Mich.*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Fox loam	22,464	7.0	Bronson loam	19,136	5.9
Fox cobbly loam	10,752	4.7	Brady loam	13,760	4.3
Pitted phase	4,416		Gilford loam	20,224	6.3
Fox sandy loam	21,952	6.8	Berrien loamy sand	4,096	1.2
Oshtemo loamy sand	7,232	2.2	Newton loamy sand	832	.3
Plainfield loamy sand	832	.3	Brookston loam	14,720	4.6
Warsaw loam	7,808	2.4	Griffin loam	3,200	1.0
Hillsdale sandy loam	42,560	13.2	Maumee loam	832	.3
Hillsdale loam	10,624	3.3	Kerston muck	1,856	.6
Bellefontaine sandy loam	11,072	3.4	Carlisle muck	17,600	5.4
Coloma loamy sand	3,584	1.1	Rifle peat	12,800	4.0
Miami loam	5,888	1.8	Houghton muck	7,040	2.2
Miami silt loam	1,856	.6	Greenwood peat	128	.1
Coldwater loam	34,240	10.6	Quarries	64	.1
Coldwater silt loam	6,208	1.9			
Coldwater silty clay loam	320	.1	Total	321,920	
Conover loam	13,824	4.3			

FOX LOAM

The 3-inch surface layer of Fox loam in wooded areas is dark-brown loose light friable loam. Below this is a layer of light-yellow loose sandy loam, grading at a depth ranging from 18 to 24 inches into reddish-yellow gravelly sandy clay which is sticky and only moderately pervious to water when wet, and hard, compact, and brit-

tle when dry. This layer, locally referred to as a hardpan layer, contains decidedly more clay and fine material than the layers above, and at a depth ranging from 30 to 45 inches grades abruptly into unconsolidated sand and gravel. In cultivated fields the surface soil to plow depth (5 or 6 inches) is grayish-brown light loam or darker-colored loam, the variation in color depending on the amount and character of the organic matter present. All layers of this soil, including the red clayey layer, range from slightly acid to strongly acid, but the underlying sand and gravel substratum is strongly alkaline, owing to the high percentage of limestone gravel and other basic material.

Fox loam occurs on level plains in close association with Fox sandy loam and Warsaw loam, and small areas and transitional strips of these two soils are included with Fox loam in mapping. Boundary lines separating Fox loam and Bellefontaine sandy loam could not be accurately placed in all places, especially in the southern part of the county where there is but little difference in topographic expression of the two soils. Such deviations from the typical soil apply to only a very small percentage of the soil as mapped.

This is one of the most important soils of the county considered both as to extent and agricultural value. Approximately 35 square miles are mapped, and the soil occurs in all parts of the county. The larger areas, and the greater part of the aggregate area, however, are in the vicinities of Coldwater, Union City, Batavia, Coldwater Lake, along Coldwater River between Coldwater and Union City, and in the northwestern corner of the county. The surface relief being nearly flat, surface run-off is slow, although drainage is good, owing to the openness of the characteristic sand and gravel substratum.

This soil was originally forested, but a sparse, open growth apparently covered parts of it. Bur oak, white oak, red oak, and black oak predominated, although hickory, hard maple, beech, and black walnut were plentiful in some localities.

Probably 90 per cent of the land has been cleared and placed under cultivation, and the remaining 10 per cent is mostly in pastures and wood lots near the farm homes. General farming, including the growing of such crops as corn, oats, barley, rye, alfalfa, and other hay crops, is engaged in over the greater part of this soil. Truck crops, fruit, and flowers are grown on small acreages in the vicinities of the larger towns along the main highways.

Chemical analyses indicate this soil to be medium in natural fertility. Observations and experiments show it to be moderately high in productivity and satisfactorily responsive to common measures of soil management. Yields of all staple crops, as well as of most special crops, are good. The physical condition of the soil and its tilth are inherently good, and the level surface relief and absence of stones are very favorable to the use of tractors and other modern farm machinery. The soil is moderately durable in productivity and retentive of moisture, and yet the perviousness of the substratum insures rapid drainage and early warming up in spring.

Applications of manure are occasionally made, usually to the corn crop. The use of lime is not common, except when deemed neces-

sary through failures of alfalfa or clover. The use of commercial fertilizers is not a general practice, but it is increasing.

Applications of lime and barnyard manure, a rotation of crops that includes an occasional soil-building crop, such as sweetclover or alfalfa, and organic matter turned back to the soil, together with a judicious use of chemical fertilizers, are important measures of soil management in maintaining productivity.

FOX COBBLY LOAM

Fox cobbly loam is practically identical with Fox loam, except in the large quantity of cobblestones which are scattered over the surface and throughout the mass of the soil and substratum of the cobbly loam. The stones range in size from coarse gravel to stones 8 inches in diameter, and in quantity from barely enough to interfere with cultivation to large quantities where the surface is thickly strewn with them.

Probably half the total area of this soil occurs in the southwestern quarter of the county, although areas are scattered throughout the southern and northeastern parts. Some of the larger bodies are near Gilead Lake, southeast of Coldwater Lake, and northeast of Quincy. The aggregate area of this soil in the county is 16.8 square miles.

Although this soil is similar to Fox loam in natural fertility, productiveness, durability, and capacity for retaining moisture, it is of slightly lower agricultural value, and a somewhat larger proportion of it is devoted to woodland or pasture as a result of its high stone content. Probably 75 per cent of the total area is devoted to the same crops as are grown on Fox loam, and yields are fully as high. This is, despite the presence of cobbles, a good soil.

Fox cobbly loam, pitted phase.—Fox cobbly loam, pitted phase, differs from the typical soil principally in that it occupies a more or less broken or pitted plain which is characteristically stony. The arrangement of the soil layers, or the soil profile, is similar to that of Fox cobbly loam, but the surface relief is, in general apearance, somewhat intermediate between that typical of the Fox soils and that typical of the Bellefontaine soils. The plain surface is apparent in most places, although numerous pits and breaks toward lower levels of streams, lakes, or narrow sinuous depressions produce the uneven appearance, or pitted effect, of the land.

The soil is not extensive, occupying an aggregate area of 6.9 square miles. Small areas are scattered well over the southern part of the county, the larger areas being south of California, south of Coldwater Lake, and in the vicinity of Gilead Lake.

Surface drainage is somewhat more rapid than is typical of the Fox soils, owing to the more uneven surface. For a similar reason, soil of this phase is thought to be a trifle more droughty, although the difference in this respect is practically negligible.

Because of its pitted surface, in addition to the presence of stones, a slightly larger percentage of the phase is uncultivated, probably 35 or 40 per cent being devoted to pasture and forest.

In all other essential respects, including utilization, crop adaptations, yields, and problems of management and treatment, the pitted phase is similar to typical Fox cobbly loam.

FOX SANDY LOAM

Other than being slightly lighter in texture, the successive soil layers of Fox sandy loam are very similar in essential characteristics to those of Fox loam. The surface soil of Fox sandy loam is sandier than the loam, slightly lower in organic matter, and lighter in color; and the red clayey layer is, on the average, at a greater depth and is not so thick. As typically developed in the virgin condition, the surface soil of Fox sandy loam consists of a dark-gray loose sandy loam surface layer about 3 inches thick, which grades into a subsurface layer of pale-yellow, loose, friable, sandy loam or light sandy loam continuing to a depth ranging from 20 to 30 inches. The heavier layer of the subsoil, or reddish-yellow sandy gravelly clay layer, is sticky when wet but rather hard, brittle, and compact when thoroughly dry. It contains a much higher percentage of clay than do the layers above, and at a depth ranging from 30 to 40 inches abruptly gives way to an underlying bed of stratified gray sand and gravel. Under cultivation, the surface soil to plow depth becomes lighter in color, owing to loss of organic matter, and apparently slightly lighter in texture, owing to the plowing up of the second, or subsurface, layer.

All the soil layers of Fox sandy loam above the sand and gravel substratum typically range from acid to strongly acid in reaction, but the substratum is invariably calcareous, owing to the high content of limestone and other basic materials. The upper three layers probably average slightly more acid than the corresponding layers of Fox loam.

Fox sandy loam occurs on level or nearly level plains. Minor variations in texture were included with this soil in mapping. The lighter-textured coarser or deeper Fox sandy loam appears to be more extensive in the northwestern part of the county, in the vicinities of Sherwood and Union City, along the St. Joseph County line, and along the courses of the larger streams or in close proximity to lakes. Small areas occur in all parts of the county.

Surface drainage of this soil is very similar to that of Fox loam, and internal drainage is even slightly more rapid, owing to the lighter-textured and thinner clayey layer characteristic of the sandy loam.

Fox sandy loam is nearly as extensive as Fox loam. It is estimated that 75 per cent of this soil is under cultivation, the remainder being devoted principally to pasture and small widely scattered wood lots. Such staple farm crops as corn, hay, and rye, with some wheat, barley, and potatoes, are grown. Some small fields of truck crops, flowers, strawberries, raspberries, and orchard fruits are also grown. Yields of staple crops vary widely, according to seasonal conditions and management, but average slightly lower than on Fox loam. The surface relief is favorable to the use of all farm machinery.

Although this soil is fairly fertile, its low moisture-holding capacity is probably the limiting factor in crop production during a normal growing season. Under good soil management, the soil responds favorably to applications of lime, manure, and chemical fertilizers, and the need of these and a crop rotation including soil-building crops, together with the return of liberal amounts of organic matter to the land, is probably even more apparent than on Fox loam.

OSHTEMO LOAMY SAND

Oshtemo loamy sand in wooded areas has a brown loose loamy sand surface soil, stained dark with organic matter to a depth ranging from 3 to 6 inches. Beneath this is a layer of loose yellow or grayish-yellow light loamy sand extending to a depth ranging from 25 to 30 inches. At this depth a reddish-yellow clay and sand mixture is developed, but this layer is either much thinner or contains less clay than in the corresponding soil of the Fox series. The substratum is similar to that of the Fox soils but contains less gravel. Under cultivation the surface soil to plow depth is yellowish gray or brownish gray owing to loss of organic matter.

The soil material down to the substratum ranges from medium to strongly acid in reaction, although the substratum is characteristically alkaline in reaction, owing to the presence of limestone and other basic materials. The organic matter in the surface soil is not very durable under cultivation. Chemical analyses indicate that the content of nitrogen, phosphorus, and potassium is low, though not abnormally so.

A total area of 11.3 square miles of this soil is mapped in Branch County. It occurs only on the plains in small widely scattered areas. The more extensive areas are along Prairie River near Cranson Church, south of Bronson, north of Dutch Settlement School, in the vicinity of Matteson Lake, and along St. Joseph River, especially near Sherwood.

Oshtemo loamy sand occurs in close association with Fox sandy loam, and in many places differentiation of these soils was difficult. Oshtemo loamy sand is much lighter in texture both in the surface soil and subsoil than Fox sandy loam, but gradational areas between the two soils are not uncommon. In a few small areas some cobbles are scattered over the surface and throughout the soil mass. Along and near some of the large streams small areas occupy terracelike positions where stream action has been a disturbing factor during development. Such deviations from typical are not sufficiently extensive to justify separation on the map.

This soil occupies level or nearly level areas, similar in relief to those of the Fox soils, and, although surface run-off is slow, the comparatively light texture of the soil and the pervious substratum insure free movement of water and rapid subdrainage, so that the land is well drained.

It is estimated that 65 per cent of this soil is now under cultivation, and the remaining 35 per cent is included in original wood lots, woodland pastures, and abandoned fields. The land is devoted principally to growing such general farm crops as corn, oats, rye, hay, and potatoes. Some alfalfa is grown but is rarely successful without an application of lime. Less wheat and barley but more rye are grown than on the heavier-textured Fox soils. Such special crops as buckwheat, flowers, melons, and a great number of truck crops are grown to some extent.

Average crop yields are moderately low. The productiveness of this soil is slightly lower than that of Fox sandy loam, but slightly higher than that of Plainfield loamy sand. Moisture during the critical periods of crop growth is the limiting factor in crop yields, as there is insufficient fine material in the soil to retain the necessary moisture for most growing crops over long periods of light rainfall. Yields of truck crops grown under irrigation are very good.

Observation and experiments suggest the use of lime in a rotation of crops including alfalfa and clover, returning to the soil generous supplies of organic matter, liberal manuring, and a practical use of commercial fertilizers, as important factors in the management of this soil.

PLAINFIELD LOAMY SAND

Plainfield loamy sand includes the yellow loose sand lands which occur on nearly level plains and are locally spoken of as "level sand lands."

The surface layer of this soil as it occurs in wooded areas, to a depth ranging from 3 to 6 inches, consists of grayish-brown loose loamy sand more or less stained by organic matter. Beneath this is a layer of grayish-yellow or pale-yellow slightly loamy sand which grades at a depth ranging from 14 to 20 inches into yellow incoherent sand extending downward to the substratum, a loose mass of sand or sand and gravel lying at a depth ranging from 36 to 48 inches. To a depth of 6 or 7 inches, the plowed soil is characteristically brownish-gray sand.

All layers of this soil above the substratum show an acid reaction, in most places strongly acid. The substratum is somewhat variable in this respect, but in many places the reaction of the material is neutral below a depth of 4 or 5 feet.

Some variations occur in the depth of the sand or in the texture of the substratum, and a few places were observed in which the surface soil approaches sand or fine sand, but the soil as mapped seems to be very uniform.

The total area of Plainfield loamy sand is only 1.3 square miles. Only a very few fair-sized areas are mapped, such as the one near Matteson Lake and one on the St. Joseph County line west of Sherwood.

The extremely open character of the soil and substratum, and the low proportion of fine materials in the soil mass account for the overfree subdrainage and droughtiness of the soil. The water-holding capacity is probably least of all the soils in the county. The physical character of the soil is, however, very favorable to a free development of the root systems of plants, as well as to tillage operations.

A large proportion of the land has been cleared and was cultivated at one time, but many fields have been abandoned and probably less than 50 per cent of the total acreage is now under cultivation. The common farm crops are grown, but yields differ widely, according to seasonal conditions, on account of the droughty character of the soil.

Plainfield loamy sand responds well to lime, manure, and fertilizers, and liberal applications must be made, along with a proper crop rotation and added supplies of organic matter, if reasonable yields of ordinary farm or truck crops are to be obtained. Dewberries, blackberries, raspberries, and strawberries are grown with a fair measure of success, and some melons and cucumbers are produced.

WARSAW LOAM

The surface soil of Warsaw loam is very dark brown mellow or fine-granular loam to a depth ranging from 6 to 12 inches. Beneath this is a layer of friable grayish-brown loam, slightly granular in

structure, which extends to a depth ranging from approximately 18 to 24 inches where it grades downward into a reddish-yellow or yellowish-brown coherent gravelly sandy clay layer. The substratum, which consists of a bed of unconsolidated loose gray, yellow, and brown sand and gravel, occurs at a depth ranging from 30 to 40 inches. The plow soil gradually becomes lighter in color under cultivation, although the abundant organic matter, characteristic of the surface soil, is comparatively durable, and a cultivated field ordinarily appears very dark.

The level or nearly level relief of the land, and the dark-colored surface soil, associated with good drainage, are the distinguishable features of this soil which is readily recognized by the farmers and is locally known as "black prairie soil." All layers of the soil above the substratum are acid, and the reaction in most places is strong. The high percentage of basic materials, especially of limestone gravel, causes the substratum to be alkaline in reaction.

This is not an extensive soil. Its occurrence is largely restricted to those areas formerly known as prairies. Most of it occurs in large areas rather than in small scattered ones. Nearly all of this soil is in the vicinities of Coldwater, Union City, Gilead Lake, in the extreme northwestern corner of the county, near and west of Girard, and near and south of Bronson.

In mapping this soil it was difficult to differentiate between it and the closely associated Fox loam, where the change of color from the one to the other was very gradual. There are some textural variations as mapped. The clayey layer is not quite so heavy in the areas in the vicinity of Coldwater as in those near Girard. A large area mapped south of Gilead Lake is somewhat cobbly, and in one place a dark-colored soil originally densely forested is included.

Practically all of this soil has been put in cultivation. The so-called prairies were not entirely treeless, but supported a scattered growth, consisting principally of bur oak, with smaller numbers of other trees, including elm, but the tree growth was not sufficiently dense to prevent the growth of a heavy grass cover. Such areas, being easily cleared, were the first to be put into cultivation by the pioneers. Practically none of this land has been abandoned, and only a small percentage is devoted to permanent pasture. General farm crops, such as corn, oats, wheat, barley, hay, and some potatoes and alfalfa, occupy probably more than 90 per cent of the land.

According to chemical analyses, there is no wide difference in natural fertility between this soil and Fox loam, other than the high percentage of organic matter and nitrogen in the surface layer of Warsaw loam. The natural productivity of this soil is somewhat higher than that of the closely associated Fox soils, and yields of the common farm crops average slightly higher. The productiveness of Warsaw loam seems to be more durable, which may be owing to the greater thickness of the humous layer and higher degree of humification of the organic matter.

Experience seems to warrant the use of lime in a rotation of crops including alfalfa, sweetclover, and other legumes. Applications of manure give good results, and commercial fertilizers high in potash and superphosphate appear to give increased yields.

HILLSDALE SANDY LOAM

In the virgin condition the 3 or 4 inch surface soil of Hillsdale sandy loam is grayish-brown heavy sandy loam, colored dark with organic matter. Below this is pale-yellow loose sandy loam or fine sandy loam extending to a depth ranging from 15 to 25 inches, at which depth it grades downward into the subsoil which is a moderately compact predominantly yellow or brownish-yellow friable sandy clay, with dull splotches of brown, yellow, and gray. This layer extends to a depth ranging from 40 to 48 inches where it grades downward into the substratum which is somewhat lighter in color and in most places reacts neutral or alkaline in contrast to the acid layers above. Under cultivation, the surface soil to plow depth is typically brownish-gray sandy loam, characterized by less coloration from organic matter.

Good tilth in Hillsdale sandy loam is not difficult to maintain. The percentage of sand is sufficient to prevent surface compactness, or clodding, and the proportion of fine earth is ample to render the soil retentive of moisture. The surface relief is typically undulating or smoothly rolling, and surface run-off is good. Destructive erosion may occur on the steepest slopes. The subsoil is sufficiently pervious to allow normal water movement, or good internal drainage. The soil is moderately fertile and is one of the more productive soils of the county. Stoniness is the outstanding objection to this soil. The size and proportion of stones differ greatly from place to place, but a degree of stoniness under natural conditions sufficient to interfere with cultural operations is typical rather than the exception.

Hillsdale sandy loam is the most extensive soil in the county, covering a total area of 66.5 square miles, and it is widely distributed. Large areas are more numerous in the northwestern quarter of the county, especially in the more rolling parts around Sherwood and Matteson Lake, and farther west and north along the St. Joseph County line. Many large areas occur in the vicinities of Bronson, Bethel, and in the northeastern part of the county along the Calhoun and Hillsdale County lines.

The greater part of this soil as mapped in the county is similar to the soil as described, although textural variations occur in transitional areas toward closely associated soils. Very small areas, an acre or two in size, which, had they been sufficiently extensive, would have been separated as Coloma loamy sand, are included. Other areas, with slightly more red gravelly material in the third layer, or subsoil, tending toward Bellefontaine soils, are also included. A few areas in the southeastern part of the county are apparently slightly less acid in reaction, a calcareous substratum material occurring at a depth of 3 or 4 feet from the surface. A few small areas with finer-textured surface soils occur in the southwestern part of the county. Such variations were not of sufficient extent to justify separation and cover only a very small proportion of the total area of this soil.

The original forest growth consisted predominantly of oak and hickory, although hard maple, beech, elm, and basswood were numerous in many localities. The greater part of the land, probably more than 90 per cent, has been cleared of the original forest.

It is estimated that 75 per cent of this soil is under cultivation. It is a general-farming soil and has a wide crop adaptation. Corn, oats, hay, and wheat are the principal crops, and rye, buckwheat, and alfalfa are also grown. A number of special crops do well, although the use of the land for this purpose is not so common as of areas occupied by the Fox soils. Hillsdale sandy loam is apparently one of the best soils for orchard fruits in the county, although there are but few orchards on it.

Crop yields differ widely, according to fertilizer treatment, soil management, and seasonal conditions. They are well above the average of the county and compare favorably with those on Fox loam and are very slightly less than those on Hillsdale loam.

An application of barnyard manure each third or fourth year and a rotation of the staple crops are generally practiced. The use of lime or commercial fertilizers with the general farm crops is not a common practice. Alfalfa fields are usually limed, and repeated failures of clover often force the use of lime on this soil, but probably only 20 or 25 per cent of the land receives lime. Commercial fertilizers are usually applied to special crops, but, like lime, are applied to a rather small percentage of the general farm crops, although results from the proper use of both lime and fertilizers have proved profitable. From 200 to 300 pounds of a complete fertilizer are sometimes used for grain, and a few farmers use superphosphate alone. Fertilizers for most truck crops contain higher percentages of nitrogen and potash than those applied to grain. This soil is rather sensitive to methods of management, its productivity being greatly affected by the care and treatment received.

HILLSDALE LOAM

Hillsdale loam differs from Hillsdale sandy loam primarily in texture, although there is a slight difference in the structure of the third, or subsoil, layer, which in most places lies slightly closer to the surface in the loam than in the sandy loam. In essential soil characteristics, Hillsdale loam might be classed as transitional between Hillsdale sandy loam and Miami loam.

Hillsdale loam, as it typically occurs in the natural forested state, is characterized by a 3 or 4 inch surface layer of grayish-brown mellow loam which grades downward into very pale yellow pulverulent heavy fine sandy loam extending to a depth ranging from 10 to 15 inches. Below this is a third layer, or the subsoil, which consists of heavy sandy clay, moderately coherent and firm, of crumbly structure, and having a predominantly yellow color on fresh cut surfaces or in a crushed condition, although the surfaces of the structure particles, or crumbs, have brown coatings. This layer extends to a depth of about 40 inches where it grades downward into the underlying substratum of yellowish-gray medium or light textured sandy clay material, similar to that underlying Hillsdale sandy loam.

The total area of this soil in the county is 16.6 square miles. Hillsdale loam is similar to Hillsdale sandy loam in regard to distribution over the county, surface relief, drainage conditions under which it has developed, proportion of land cleared, agricultural use, original forest cover, minor variations included in mapping, tilth, and degree of stoniness.

The natural fertility of the two soils is similar, with probably a slight difference in favor of the loam which has been subjected to slightly less leaching, is slightly more retentive of moisture, and is more durable in productiveness. Yields in general are a trifle higher on the loam, and the lime requirement is probably a little less, although all layers of both soils above the substratum show an acid reaction.

General methods of soil management or treatment practiced are about the same on both soils, the loam apparently withstanding neglect a trifle better. The need of lime, manure, chemical fertilizers, and proper crop rotation is apparent through profitable results now being realized on farms where such measures are practiced.

BELLEFONTAINE SANDY LOAM

The surface layer of Bellefontaine sandy loam in wooded areas consists of dark-brown loose sandy loam or fine sandy loam 3 or 4 inches thick. Beneath this is a layer of light-yellow loose sandy loam which passes, at a depth ranging from 15 to 30 inches, into yellowish-red gravelly sandy clay extending downward to the substratum. The substratum occurs at a depth ranging from 36 to 50 inches and consists of an open or pervious mixture of sand, gravel, sandy clay, and bowlders of different sizes. The surface layer in plowed fields to a depth of 6 or 7 inches is light-brown sandy loam or fine sandy loam. The first two layers are everywhere acid. Most tests made in the third or red clayey layer show acidity, but the substratum is characteristically high in lime. The proportion of organic matter is comparatively low, and this material is less durable than is that of the Miami soils. The surface layers and the substratum are open and porous, but the subsoil, or third layer, is sufficiently compact and high in percentage of clay to make the soil moderately retentive of moisture. The soil is characteristically stony, and bowlders of different sizes occur over the surface and throughout the entire soil mass.

This soil is moderately extensive and areas are scattered well over the northeastern, central, and southern parts of the county, the largest areas occurring near South Butler, south of Lockwood, west of Quincy, and in the southern part of the county along the Indiana State line. The surface relief ranges from undulating to rolling, and because of the pervious substratum drainage ranges from good to overfree.

Variations from the typical soil as described are not uncommon. In the south-central part of the county are a few areas which are characterized by abrupt color and textural changes in the subsoil over very short horizontal distances. In other areas, especially south of Lockwood, small patches of Hillsdale soils and Bellefontaine sandy loam are so intermingled and so intricately associated that a separation on the map was impossible. A few included areas in the southeastern part of the county are slightly heavier in texture than typical. Such included areas are either too intricately mixed with the Bellefontaine soil or too small to separate.

The original forest cover consisted principally of hickory and oaks of the different species common to the region. This cover has been removed from about 95 per cent of the land, and it is estimated that

from 65 to 70 per cent of the soil is now being cultivated. General field crops, such as corn, oats, barley, rye, hay, and some wheat, potatoes, alfalfa, sweetclover, and buckwheat, are grown. During the course of the survey, a few apple and peach orchards were observed, which were for the most part poorly kept.

Stoniness is the most objectionable drawback in tilling this land. Only a few slopes are sufficiently steep to materially interfere with cultivation, and destructive erosion is restricted to such slopes. On the whole, the tilth is good and the land can be plowed over a rather wide range of moisture conditions. Natural productiveness ranges from moderately low to medium, and yields of the staple crops average a trifle lower than on the associated Hillsdale soils.

Applications of barnyard manure are made and the common crop rotations are practiced. Superphosphate is applied to grain by some farmers. A few apply complete fertilizer mixtures to corn and potatoes. The use of both manure and commercial fertilizers is apparently beneficial. Lime is not generally applied, its use being commonly restricted to such crops as sweetclover and alfalfa. Its use is apparently advisable for the most part, but on the steeper slopes the substratum, which is high in lime, is sufficiently near the surface to satisfy the lime requirements of most crops. On such slopes it seems desirable to take measures to check erosion, to add to the meager supply of organic matter, and to make comparatively liberal applications of manure and complete chemical fertilizers.

COLOMA LOAMY SAND

Coloma loamy sand comprises the rolling sand lands of the county and is locally referred to as "sandy hill land."

As typically developed in wooded areas, Coloma loamy sand has a 3 or 4 inch surface layer of loose grayish-brown loamy sand, the dark stain being caused by organic matter. Beneath this is a layer of yellowish-gray loose incoherent sand or fine sand, which extends to a depth of 3 or 4 feet where it grades into lighter-colored, or grayish-yellow, sand containing small patches and lenses of slightly heavier textured material. The substratum varies greatly both as to depth and composition, but in most places it occurs at a depth ranging from 3 to 5 feet and consists of a mixture of sand, sandy clay, and bowlders, with the sand predominating. Under cultivation the surface layer to plow depth consists of grayish-brown or very light brown loamy sand or loamy fine sand.

In most places this soil shows an acid reaction to a depth ranging from 4 to 6 feet, but below this depth neutral reactions occur in places. The organic matter is largely confined to the upper 2 or 3 inches of the surface soil and appears to be less durable than in the Hillsdale soils. The soil is open and porous throughout, so that water movement is comparatively rapid and root development is unhindered. The soil is not very retentive of moisture although it seems that a high percentage of the moisture present is available to plant growth. The natural fertility of the land is moderately low. Chemical analyses indicate that nitrogen, calcium, potassium, and to less extent phosphorus, are lower than in the heavier Hillsdale and Miami soils.

Coloma loamy sand occurs in small areas scattered widely in all parts of the county and has an aggregate area of 5.6 square miles. The larger areas are in the southwestern quarter of the county.

Other areas are just east of California, near Matteson Lake, and just east of Gilead.

A part of this soil is finer textured than typical, especially in the areas in the extreme southwestern corner of the county. An area immediately east of Round Lake is characterized by a heavier substratum than is typical, which occurs at a depth ranging from 4 to 6 feet. In places wind shifting is in evidence. However, such variations are unimportant and too small to justify separation.

The surface relief of this soil ranges from undulating to rolling, and drainage ranges from excellent to excessive.

The original tree growth is thought to have been dominantly oaks and hickory, with hard maple and beech less numerous. Probably 25 per cent of this land is now devoted to forest or pasture; the remainder is farmed to general field crops in conjunction with the associated soils. Such crops as corn, rye, and hay are most common. Buckwheat, potatoes, and a few fields of alfalfa were seen during the course of the survey.

MIAMI LOAM

The surface layer of Miami loam in wooded areas is dark-brown mellow loam from 4 to 6 inches thick. It is underlain by a layer of ashlike light-yellow friable loam which extends to a depth ranging from 8 to 12 inches. Beneath this is a layer of brown or yellowish-brown moderately coherent brittle heavy fine sandy clay of a fine blocky, or granular, structure, extending downward to the substratum which occurs at a depth ranging from 30 to 40 inches. The substratum consists of massive gritty clay somewhat lighter in color, less coherent, and usually more moist than the layer above. Under cultivation a part of the organic matter disappears, and the surface soil assumes a lighter shade of brown.

In most places this soil is slightly or moderately acid to a depth ranging from 30 to 36 inches, including all layers above the substratum. Below this depth lime and other bases are present in sufficient quantities to give marked alkaline reactions. The subsoil is somewhat compact in places but not to such an extent as to prevent normal deep root development. In many places such plants as alfalfa and sweetclover develop roots reaching into the substratum. This is one of the more fertile well-drained soils of the county, and it retains moisture well.

Areas of this soil occur only in the southeastern quarter of the county, the more extensive areas lying just south of Algansee, southeast of Bartholomew Lake, and south of Huyck Lake along the Indiana State line.

Part of this soil as mapped just south of Algansee is slightly sandier than typical, especially in the subsoil, but because of the presence of lime at comparatively slight depths it is included with Miami loam. A few very small areas north of Algansee are unusual in that they have gravel at slight depths beneath the massive clay. Aside from these small areas, where the soil varies from typical, the principal difficulty experienced in mapping this soil was that of accurately differentiating between it and Hillsdale loam in places where the two soils grade into each other.

Miami loam is rather extensively developed in the southeastern part of the county, but it is not an extensive soil in the county as

a whole. It occurs as undulating or rolling areas where the slope of the land is ample to insure rather rapid surface run-off, but in only a few places is the slope sufficient to make erosion a serious problem. Internal drainage is moderately slow, owing to the comparatively tight subsoil and clayey substratum. Artificial drainage is needed in but few places.

Practically all the land has been cleared of its original forest, which was doubtless heavy, consisting largely of hard maple, beech, ash, hickory, basswood, elm, and oaks common to this region.

Probably 90 per cent of this soil is now devoted to general farm crops, principally corn, wheat, oats, barley, timothy, and clover. Some alfalfa, potatoes, and a few field beans were observed during the course of the survey. Where management and treatment are adequate, the yields on this land are probably the highest in the county.

It is common practice to make an application of manure every two to four years, and crops are rotated to some extent. Lime is used rarely even on land seeded to alfalfa or clover, but when it is applied yields of these crops are usually increased. Complete fertilizers are seldom used, although acre applications ranging from 100 to 200 pounds are sometimes made to grain crops. Yields of corn and potatoes show material increases after applications of complete commercial fertilizers.

MIAMI SILT LOAM

Miami silt loam, in the virgin condition, is characterized by a 3 or 4 inch surface layer of dark brownish-yellow silt loam with a granular structure, passing downward into pale yellowish-brown friable or pulverulent loam which extends to a depth ranging from 10 to 14 inches. Beneath this is a layer of brown firm heavy silty clay of pronounced granular structure, the soil material readily falling into small subangular blocks ranging in diameter from one-eighth to one-fourth inch. This layer extends to a depth ranging from 30 to 38 inches where it grades into the substratum of massive sandy clay material which is slightly lighter in color, more easily crushed, and more nearly structureless than the subsoil layer above. In cultivated fields the surface layer, to a depth of 5 or 7 inches, consists of light-brown silt loam or heavy loam with a slight ash-gray shade.

In the virgin condition, the immediate surface soil shows a neutral or slightly acid reaction; the second layer, strongly acid; and the third layer, strongly or very strongly acid to a depth ranging from 24 to 36 inches, below which the supply of lime is abundant. The natural supply of organic matter is moderately small, occurring almost entirely within 4 inches of the surface, but it is apparently durable. The fertility is considered moderately high, and the natural tilth of the land ranges from medium to good. Both the surface soil and substratum are comparatively low in porosity and highly retentive of moisture. The subsoil is noticeably firm and hard when dry but is readily penetrated by roots.

This soil occurs only in the extreme southeastern part of the county, practically all of it in California Township. The larger areas are east of California along the Hillsdale County line. This is one of the inextensive soils of the county. It occurs in close association with Miami loam and, owing to transitional areas, lines separating the two soils could not be sharply drawn in all places.

The surface relief is probably a little milder than that of Miami loam, but the slope is ample to insure good surface run-off in practically all places.

Miami silt loam is used for the same crops as Miami loam, and yields are similar, with, possibly, a slight advantage in favor of the silt loam.

Fertilization and other problems of soil management of the two soils are similar, although the silt loam can be cultivated within a slightly narrower range of moisture conditions and more effort is required to maintain or improve its physical condition and tilth.

COLDWATER LOAM

The Coldwater soils occupy undulating or rolling uplands and are characterized by moderately good surface drainage but imperfect internal drainage and heavy mottled subsoils. These soils are locally designated as "heavy timbered lands."

The surface soil of Coldwater loam consists of a dark grayish-brown or dark-gray slightly granular or mellow loam surface layer underlain by a subsurface layer of dingy grayish-yellow friable heavy sandy loam which when dry has an imperfect fine platy structure and is perforated by numerous small holes. This layer extends to a depth ranging from 16 to 20 inches where it grades into a third and heavier layer of mottled brown and yellow heavy sandy clay with whitish-gray streaks following roots or root channels. The structure is granular and the mass is moderately compact, tough, and slowly pervious when wet but hard and brittle when dry. This layer extends to a depth ranging from 35 to 45 inches where it gives way to the substratum which is of slightly lighter texture and predominantly yellow with large whitish-gray streaks having a tendency to follow along roots, root channels, and other openings in the mass.

In most places the surface soil is slightly acid in reaction, but the second and third layers are everywhere acid to a depth ranging from 36 to 50 inches. The deep substratum is characteristically neutral or slightly alkaline in reaction. The content of organic matter is comparatively large in the surface layer to a depth ranging from 8 to 12 inches and imparts the dark color characteristic of this soil. The third layer, or subsoil, is typically heavy in texture, highly retentive of moisture, and imperfectly drained and aerated as is evidenced by the characteristic mottled effect. Stones are plentiful over the surface and throughout the soil mass, and in most places they are sufficiently numerous to interfere with cultivation. The tilth of the soil is only fair or moderate, and the land requires special attention. The natural fertility of this soil is above the average for the soils of the county, but, as natural internal drainage is inadequate, the productiveness of the land depends largely on artificial drainage and on the distribution and amount of rainfall.

This is one of the extensive soils of the county, occupying 53.5 square miles. It is developed in all parts but principally in the central and northeastern parts. Large areas are numerous in the vicinity of Lockwood, north and northeast of Coldwater, and north and northeast of Algansee. Southeast of Union City a belt of large areas extends southwestward nearly to the New York Central Railroad.

This soil is closely associated with the Hillsdale soils, and in many places soils of the two series grade imperceptibly into each other. In such places the placing of boundary lines was somewhat arbitrary. A comparatively small proportion of the land has a mild relief where slow surface run-off as well as poor internal drainage accounts for the high content of organic matter and moisture and the mottled appearance of the subsoil. A few small areas, which are lighter in texture than typical, are included in mapping.

This soil originally supported a heavy cover of hardwood forest, in which elm, beech, and maple were dominant. A high percentage of beech has been observed in places. Probably from 10 to 15 per cent of the land is forested at the present time. It is estimated that about 60 per cent of the total area is under cultivation, and 25 or 30 per cent is devoted to pasture. The land is used largely for general farming which includes such crops as corn, hay, and probably a smaller proportion of fall-sown grain. Greater numbers of livestock, especially cattle, are kept on this soil than on the Fox or the Hillsdale soils. Cabbage is the principal special crop, and probably more than 75 per cent of all the cabbage produced in the county is grown on the Coldwater and Conover soils. Alfalfa is sometimes grown, but drainage conditions are not good and winter heaving is sometimes destructive. A comparatively small acreage is in truck crops, but there are few fruit orchards.

Yields of corn vary widely according to distribution and amount of rainfall. Wet weather in spring often delays the date of planting too long, and too much rain during the growing season decreases yields. Hay yields are almost invariably good, averaging better than those on the Hillsdale soils. The same is true of oats when seasonal conditions in the spring allow seeding at the proper date. Yields of cabbage are very satisfactory. This is one of the best grass-producing soils of the uplands in the county, and grazing is good.

Crops are rotated within a narrow range, and applications of barnyard manure are made. Little commercial fertilizer is used with the common crops, and lime is rarely applied. A complete commercial fertilizer high in potassium is in general use for cabbage. A few farmers apply from 150 to 200 pounds of superphosphate or a complete fertilizer to grain and light applications of complete fertilizer to corn.

Artificial drainage or tiling has been resorted to by a few farmers only, with varying degrees of success. The removal of surface stones and adequate drainage constitute the greatest needs of this soil.

COLDWATER SILT LOAM

Coldwater silt loam, as it occurs in woodland pastures, has a surface layer of dark or nearly black silt loam from 4 to 6 inches thick, which is moderately loose and of a fine-granular structure. Beneath this is a layer of dull-gray or light yellowish-gray friable loam of an imperfect platy structure, faintly splotched with gray and yellow, which extends to a depth ranging from 12 to 15 inches where it grades into the third layer consisting of impervious compact silty clay loam, highly mottled with whitish gray, yellow, and brown. At a depth ranging from 35 to 45 inches there is a highly mottled compact silty clay substratum which is extremely impervious and characterized by a very smooth soapy feel. The substratum is under-

lain at a depth ranging from 10 to 20 feet by bedrock composed principally of shale with some sandrock. In cultivated fields the surface soil to a depth ranging from 8 to 12 inches is dark-brown silt loam.

Tests made for acidity show that this soil is not so uniform in reaction as most other soils in the county. In one place all layers showed an acid reaction from the surface to bedrock which lay at a depth of about 10 feet. In a few places the surface layer showed less acidity than the second, third, or substratum layers. In most places, however, the surface layer is very slightly acid, the second and third layers are moderately acid, and the substratum usually shows a neutral or slightly alkaline reaction. The organic content of the surface soil, like that of Coldwater loam, is high and durable. The subsoil, or third layer, of silty clay loam is heavier textured and much more compact and impervious than the corresponding layer of the loam, and a similar difference exists between the respective substrata of the two soils. Stones charcteristically occur in sufficient size and numbers to interfere with farm work.

The larger areas of this soil are in the central and northwestern parts of the county, near Lockwood, just north of Coldwater, and a few miles south of Union City.

As mapped in Branch County, this soil is in most respects rather typical of the profile above described. In regard to texture and many other characteristics Coldwater silt loam is transitional between the heavier-textured and lighter-textured members of the Coldwater series, and small areas of those soils are included in places. There is also a wide variation in the depth to bedrock, as well as in the character of the substratum, but such variations are either of minor consequence or apply only to very small areas.

Coldwater silt loam is inextensive in Branch County. It is closely associated with Coldwater loam and occurs only in undulating or rolling areas. Surface drainage ranges from fair to good, but internal drainage is more restricted by the impervious subsoil and substratum than is that of the loam.

Coldwater silt loam and Coldwater loam are very similar as to proportion of total area under cultivation, crops grown, yields, and soil management. Probably a slightly higher percentage of the silt loam is devoted to woodland and pasture, and it is probable that crops growing on the loam are not injured quite so much by excessive rainfall. The range of moisture conditions over which the soil can be plowed in order to maintain proper tilth is slightly less in the silt loam than in the loam.

COLDWATER SILTY CLAY LOAM

Coldwater silty clay loam has a surface layer of dark-brown mellow silty clay loam of granular structure and high organic-matter content. Beneath this is a layer of yellow friable sandy clay loam which, at a depth of 15 or 16 inches, passes abruptly into an underlying layer much heavier in texture. This layer consists of tight, compact silty clay, predominantly steel gray in color but with pronounced splotches of light gray and pale yellow. The material is of a blocky or coarse crumb structure, and it is rather brittle and crumbly when removed from place. This layer extends to bedrock which occurs at a depth ranging probably from 6 to 15 feet.

The surface soil ranges from nearly neutral to slightly acid, and the deeper layers show an acid reaction to a depth of about 40 inches, below which the material in most but not all places shows an alkaline reaction. The surface soil is rather high in organic content where erosion has not removed it, and, like that of the other Coldwater soils, it is very finely divided or humified and durable. Earthworms seem to be plentiful in the surface soil.

This soil is closely associated with Coldwater silt loam, and the two soils could not be sharply differentiated in many places where they merge. The impervious character of the subsoil and the moderately steep slopes over the greater part of this soil have resulted in much erosion which has removed the surface soil in many places and exposed the silty clay subsoil layer.

This is one of the least extensive soils mapped in the county. It occurs in close association with Coldwater silt loam, in most places occupying the steeper slopes. The largest area is southwest of Coldwater, a small area is between Coldwater and Quincy, another is at Lockwood, one is just west of Batavia Center, and others are about 2 miles northeast of Algansee.

This soil occurs in small areas and most of it is farmed in connection with Coldwater silt loam, in about the same way.

CONOVER LOAM

Conover loam is a moderately heavy textured soil which is intermediate in drainage between the Miami or Hillsdale soils on the higher slopes and the Brookston soils in the lower situations.

The surface soil to a depth of 6 or 8 inches is typically dark loam, rather high in organic matter, underlain by grayish-yellow or pale-yellow friable sandy loam which extends to a depth ranging from 12 to 18 inches. Beneath this is a layer of heavy sandy clay splotched or streaked with gray, yellow, and brown. At a depth ranging from 24 to 30 inches this material grades into a more compact mottled substratum, with gray colors predominating.

The amount of organic matter in the surface layer varies somewhat but seems to average slightly higher than that in the Coldwater soils. The surface soil to plow depth shows a nearly neutral or slightly acid reaction, and the second and third layers are moderately acid to a depth ranging from 30 to 36 inches, below which depth the reaction is alkaline. The Conover soils are much less acid than are the Coldwater soils.

Conover loam is retentive of moisture and moderately high in natural fertility. The tilth in most areas is fair, although stoniness is not uncommon. The characteristic mild surface relief, sluggish surface run-off, and, in places, slope seepage, necessitate tile drainage in many places. Heavy rainfall during the growing season is injurious to crops.

This soil is only moderately extensive. Although small areas occur in all parts of the county, probably 80 per cent of the soil lies in the northern half. Many areas are northwest of Matteson Lake and in the vicinity of Butler, and larger areas are east of Union City and southeast of Quincy.

This soil occupies positions near the bottoms of the slopes which gradually merge into low flat land, so that boundary lines separating

this from adjoining better-drained soils or from the adjacent wetter soils could not be sharply drawn in all places. Some areas of minor textural variations, especially of the subsoil, were included, owing to their small extent.

Conover loam originally supported a heavy cover of hardwood forest, and probably from 10 to 20 per cent of the original forest still remains. It is estimated that about 50 per cent of the land is cultivated, and more than 40 per cent is devoted to pasture or to pasture and forest. The cultivated area is largely used, together with better-drained soils, for general farming, corn, hay, with a smaller acreage of fall-sown grain being the principal crops grown. Farms including an appreciable acreage of this soil carry a greater number of livestock, especially cattle. Some cabbage is grown, and yields are usually satisfactory. Some alfalfa is grown, and the degree of success is materially affected by artificial drainage, as this crop is often destroyed by winter heaving. In other parts of the State sugar beets are grown on many areas of this soil.

This is one of the best grazing soils of the county. In general, yields of corn are above the average for the county, although heavy rainfall in spring may delay planting, or during the growing season, may prevent necessary cultivation. With normal seasonal conditions, oats do well. Yields of hay are almost invariably good.

Crops are rotated in a rather narrow range, owing to poor natural drainage. Applications of barnyard manure are sometimes made, but very little commercial fertilizer is used with the common crops. A 2–8–16 mixture is being used by some farmers with cabbage, but a 2–12–2 mixture is more commonly used with the general crops.

A few farmers have tiled their land and results are apparently satisfactory. Drainage is the greatest need of this soil.

BRONSON LOAM

Bronson loam, as it occurs in the uncultivated state, consists of moderately dark grayish-brown mellow loam containing a large quantity of organic matter and extending to a depth of 4 or 6 inches. Beneath this is a layer of pale-yellow loose sandy loam which extends to a depth ranging from 14 to 20 inches where it passes into a layer of reddish-yellow or yellow compact gravelly sandy clay. This layer, in turn, grades downward into a fourth layer of similar texture but noticeably mottled with gray. The substratum of grayish-yellow or yellowish-gray sand and gravel occurs at a depth ranging from 30 to 40 inches and is typically moist. In plowed fields the surface layer to a depth of 7 inches is grayish-brown loam or sandy loam.

All layers of the soil down to the sand and gravel substratum show a moderately or strongly acid reaction, and in this respect, also in textural profile, are very similar to Fox loam. Although the areas of Bronson loam occupy plains similar in general appearance to those occupied by the Fox soils, the Bronson loam areas lie much lower in reference to surrounding or adjoining peat bogs, stream beds, and lakes. This results in the mottled coloration as typically developed. Bronson loam differs from Fox loam primarily in higher average moisture content and in having a slightly darker colored surface soil. It differs from Brady loam principally in having better

drainage. The third and fourth layers, the clayey layers, of Bronson loam contain a comparatively high percentage of clay and when wet are decidedly sticky, but when thoroughly dry are compact, hard, and brittle.

The soil is extensive, especially throughout the southwestern quarter of the county. It occupies a total area of 29.9 square miles. The largest areas occur near Bronson and southward. A number of moderately large areas are east of Girard, and others are widely scattered over the county, except the extreme northwestern part.

Some textural variations are included with this soil as mapped, as the size of the areas does not justify separations on this basis. Over a few areas the clayey subsoil occurs at a greater depth than typical. In a few areas cobbles occur over the surface and throughout the soil mass. Minor variations in the color of the surface soil occur in a few areas.

Probably 70 per cent of this soil is now cultivated. Very little land has been abandoned, but probably 25 per cent of the aggregate area is devoted to pasture, wood lots, and woodland pastures. The land is devoted largely to staple farm crops, such as corn, oats, barley, wheat, rye, hay, and some potatoes. Some special crops are grown, but this soil is not so well suited to most special crops as are the better-drained soils, such as the Fox and Oshtemo soils.

The natural fertility of this soil is about the same as that of Fox loam. Bronson loam is probably slightly more productive of such crops as corn, oats, barley, and hay, as the moisture supply throughout the drier periods is more lasting, and the land supports a slightly heavier cover of grass than do the Fox soils. Alfalfa is slightly better adapted to Fox loam.

Lime for clover or alfalfa and manure or chemical fertilizer for most crops seem to give profitable increases in yields.

BRADY LOAM

Brady loam occurs on low-lying plains which are more poorly drained than are those of Bronson loam but better drained than those of Gilford loam.

Brady loam is characterized by a surface layer, from 6 to 10 inches thick, of dark-gray mellow loam of slightly crumbly structure, which grades downward into a second layer of light-gray or drab-gray friable loose sandy loam, with faint yellow splotches, extending to a depth of 15 or 20 inches. Beneath this is rather tight slightly compact mottled gray, yellow, and brown gravelly sandy clay which extends to a depth ranging from 28 to 36 inches and is underlain by a substratum of sand and gravel.

The first three layers range from neutral to slightly acid in reaction, but the substratum is everywhere high in lime. The organic-matter content of the surface soil is rather high. Chemical analyses indicate that this soil ranges from medium to moderately high in natural fertility.

Some areas having minor textural variations are included in mapping. A few areas southeast of Sherwood approach silt loam, and in other places small areas or parts of areas, which are doubtless light enough in texture to be classed as sandy loam are included. Drainage conditions and color of the surface soil differ in places over such short distances that separations were impossible.

Although the total area of Brady loam in the county is not large, small bodies are widely scattered in all parts. Some of the larger bodies are between Batavia and Sherwood, southwest of Matteson Lake along Swan Creek, and north of East Gilead.

Brady loam originally supported a rather heavy forest, consisting mainly of elm, ash, soft maple, hickory, and basswood, and a large proportion of the land still remains in forest and pasture. Probably 55 or 60 per cent of the land is under the plow. When properly drained the staple farm crops produce good yields. The use of lime is probably not essential.

GILFORD LOAM

The surface layer of Gilford loam to a depth of 8 or 10 inches is very dark grayish-brown moderately compact loam which is brittle when dry but sticky when wet. Beneath this is a less distinct layer of mottled drab-gray, yellowish-brown, and dark-brown sandy clay containing different proportions of gravel. This layer grades at a depth ranging from 30 to 40 inches into the substratum which consists of saturated mottled whitish-gray, yellow, and drab sand and gravel. In cultivated fields the surface layer to a depth of 6 or 8 inches is dark-brown loam or heavy sandy loam.

This soil occupies low-lying poorly drained plains, and it has developed under a very moist, wet, or saturated condition. All layers of the soil show a neutral or alkaline reaction, becoming more distinctly alkaline with increasing depth to the calcareous substratum. The surface soil is very high in organic matter, in many places a thin coating of a few inches of mucky material having accumulated. The moisture content of all layers is very high depending usually on the extent of artificial drainage. In places the soil is saturated.

Gilford loam is scattered well over all parts of the county. The total area is 31.6 square miles, probably slightly more than two-thirds of which occurs in the northern half of the county. The soil is developed in depressions of the plains and in stream or drainage valleys which occur tributary to the plains or leading from one plain to another.

This soil as mapped includes variations in color, texture, and extent of saturation. The sand and gravel substratum is not so consistently developed nor so uniform in composition as that of the Fox soils, and pockets, patches, or lenses of finer materials are numerous, especially in the drainage valleys. The extent of saturation or degree of drainage varies over a somewhat wider range owing to artificial drainage and general lowering of the water table during the last 50 years. Such variations are of rather minor importance and apply to only a small proportion of the soil.

This soil is not very important agriculturally. Probably 80 per cent of the land is devoted to pasture and forest, and the remainder is farmed to staple crops, in conjunction with associated better-drained soils. Where artificially drained, fair yields of corn, grain, and hay may be expected when seasonal conditions are favorable. Pastures are usually good, and the soil seems best adapted to this use.

Little manure and practically no commercial fertilizers are used. Lime is probably not needed. Poor drainage is the limiting factor

in the productiveness of this soil. Much of it can be artificially drained at a reasonable cost.

BERRIEN LOAMY SAND

Berrien loamy sand occupies low-lying sand plains. The areas are lower and not so well drained as Plainfield sand but higher and better drained than Newton loamy sand. As developed in virgin areas, Berrien loamy sand has a surface layer from 3 to 6 inches thick, of dark-gray loose sand or loamy sand, the dark color being caused by organic matter. Beneath this is a layer of incoherent or feebly coherent yellow sand or loamy sand, which shows faint splotches of deep yellow or dull reddish brown, especially in the lower part. This layer extends to a depth ranging from 30 to 48 inches where it grades into a highly mottled gray, yellow, and brown wet sandy loam or light sandy clay which shows some evidence of cementation and is noticeably hard and brittle when thoroughly dry. Under cultivation the surface soil is slightly lighter in color.

This soil is typically acid down to the level of the water table or point of saturation which occurs at a depth ranging from 3 to 5 feet. An impervious substratum is developed in most places at a depth ranging from 4 to 6 feet. The soil is low in natural fertility, although it is slightly more productive than Plainfield sand, owing to the higher average moisture content.

Berrien loamy sand occurs in widely scattered areas in all parts of the county, mostly in small areas. A few fair-sized areas are west of Bronson, south and southwest of Matteson Lake, west of Quincy, and near Marble Lake. Probably more than half the total area of this soil occurs in the southwest quarter of the county.

Variations included are not widely different from the typical soil. A few small areas northwest of Bronson have surface layers sufficiently heavy in texture to have been differentiated as sandy loam had their extent justified it, and other areas sandier than typical are included for a similar reason.

Probably 50 per cent of the land is used for pasture or supports a moderately light forest growth, and the remainder is cultivated, together with more productive soils, to such staple crops as corn, rye, or hay. Some potatoes and buckwheat are grown. Yields range from low to fair. Lime, complete fertilizers, and liberal applications of manure are advisable where cultivation is attempted.

NEWTON LOAMY SAND

Newton loamy sand has a 3 to 10 inch surface layer of dark-gray loamy sand, high in organic matter, which grades into a second layer of loosely coherent loamy sand characterized by a mixture of gray, dull-yellow, and dull-brown colors. The yellow and brown colors are associated with roots and root channels. This layer extends to a depth of 25 or 30 inches where it grades into saturated sand or very sandy material, which is predominantly whitish gray with small blotches of yellow. At a depth of 4 or 5 feet a more impervious clayey layer may occur.

Some variations in soil reaction were observed, but most examinations indicate this soil to be acid down to the level of the water table. The organic-matter content is fairly high, but as this material is mixed with quartz sand and not very finely divided, it is not durable

when the soil is drained and cultivated. Below a depth ranging from 30 to 36 inches the soil material in most places shows evidence of heavy leaching. The natural fertility probably ranges from medium to moderately low.

This is one of the most inextensive soils mapped in the county. It occurs in small areas widely scattered in nearly all parts of the county. Areas too small for separation on the map are included with associated soils, such as the Brookston and Maumee soils.

The soil is devoted almost entirely to pasture and woodland.

BROOKSTON LOAM

The surface layer of Brookston loam, to a depth ranging from 8 to 12 inches, is dark grayish-brown loam, heavy sandy loam, or light silt loam, somewhat compact in place but mellow when crushed. This layer grades into a lower layer of heavy sandy clay or gritty silty clay which is predominantly gray but mottled with light gray, dark gray, and yellow. This layer is rather firm in place, but when moist is moderately crumbly when crushed. It extends to a depth ranging from 25 to 30 inches where it grades into the substratum which is composed either of tenacious sandy clay or of alternate layers of sand and sandy clay.

The surface soil in most places is neutral or slightly alkaline, and the lower layers are consistently alkaline in reaction. The organic-matter content of the surface layer is high and for the greater part well combined with the mineral constituents, although in places a thin surface layer of a few inches of muck has accumulated. This soil is characterized by poor drainage, a high water table, high natural fertility, and a rather dense heavy subsoil and substratum.

Brookston loam is developed in low depressions, mostly along the small drainage ways of the undulating or rolling uplands. It is differentiated from Gilford loam primarily on subsoil and substratum differences, those layers of the Brookston soil being decidedly more dense and less pervious to water.

Brookston loam is rather variable in texture, as well as in thickness of the various layers and the character of the substratum. Boundary lines separating this soil from Gilford loam are arbitrarily drawn in many places on the soil map. Included with Brookston loam are a few small areas of Brookston clay loam which differs from the loam in the heavier texture of the surface soil and subsoil. The surface soil in some of the narrow swales consists largely of wash from the adjacent higher land.

Brookston loam is mapped in all parts of the county. Nearly half the total area of 23 square miles occurs in the northeastern quarter.

More than half of this soil, probably 65 per cent of it, is used for pasture or woodland. Having a high moisture content and high natural fertility it supports a heavy sod of grass, and most of the pastures are good. The natural forest cover is heavy, and such trees as elm, ash, shagbark hickory, soft maple, basswood, and swamp white oak are dominant.

Adequate drainage is the first requisite in soil management, and practically all of this soil devoted to crops is ditched or tiled. When sufficiently drained yields of such crops as corn, hay, and oats are usually good or excellent. Some cabbage and alfalfa are grown with fair results.

GRIFFIN LOAM

Griffin loam occupies poorly drained bottom lands along the larger streams. This soil has been deposited by the streams and is periodically flooded, accompanied by disturbance of the material by deposition and erosion. No definite arrangement of soil layers has developed, and the material consists of irregularly stratified sand, silt, and heavier-textured materials.

The surface soil to a depth of 8 or 10 inches is brown or dark-brown, mellow, sandy loam or silty loam containing some mottlings of yellow and rust brown in the lower part. Beneath this is sandy clay material, the color of which is mixed gray, yellow, and brown, the yellow color in many places being most conspicuous. The deep substratum, or basal layer, is usually porous, in many places consisting of sand or sand and gravel, with thin strata of silt and clay.

The surface layer ranges from nearly neutral to slightly alkaline, and the deeper layers of soil material are consistently alkaline in reaction. The natural fertility is apparently high, but the soil is used almost entirely for pasture and forestry, owing to the high-water table, susceptibility to flooding, and the presence of stream channels through the areas.

More than 95 per cent of this land occurs in the western and northern parts of the county, along St. Joseph and Coldwater Rivers, and along Hog Creek. The larger areas are along St. Joseph River, north and west of Sherwood, and along Coldwater River in the vicinity and southeast of Union City.

A few small areas, which are better drained than typical, occur along St. Joseph River north of Sherwood and are included with Griffin loam in mapping. Such areas would have been separated as Genesee loam had they been of sufficient size. Griffin loam is very closely associated with Kerston muck, and accurate differentiation could not be made in all places. In other places, differentiation between Griffin loam and Gilford loam was difficult.

Practically none of the Griffin loam as mapped in this county is under cultivation. Probably 80 per cent of it is in pasture, and a large proportion of this supports a forest cover, consisting of a vigorous growth of such trees as elm, ash, soft maple, basswood, and willow, but the trees are thinned out of many pastures to allow grasses to make better growth.

MAUMEE LOAM

Maumee loam has a surface layer 10 or 15 inches thick composed of a black or nearly black mellow loamy mixture of muck and mineral soil. It passes into a layer of comparatively loose whitish-gray fine sand or sandy loam having faint splotches of pale yellow. At a depth ranging from 36 to 48 inches this layer grades into a wet or saturated substratum which is more drab gray, conspicuously splotched with yellow and rust brown.

The soil in most places ranges from neutral to moderately alkaline. Probably from 25 to 50 per cent of the surface soil, to a depth of 1 foot, is finely divided organic matter which is thoroughly mixed with mineral soil, the organic matter not being highly humified and only moderately durable. The second and third layers range in texture from fine sand to sandy loam and in many places to light sandy clay in the lower substratum. The soil is comparatively high in nitrogen but not balanced in potassium.

This soil is of small extent. The greater part of it is well scattered over the northern half of the county in small areas, the larger ones occurring north of Matteson Center and southwest of Matteson Lake. It is developed on low-lying plains along small streams, county ditches, and other drainage ways, in close association with mucky areas.

Such special crops as cabbage, onions, peppermint, spearmint, and a few beets constitute the principal crops. Some corn is grown. Commercial fertilizers carrying a high percentage of potash are commonly used with these crops. Where drainage, treatment, and fertilization receive proper attention yields usually range from fair to good. Probably 30 per cent of the total area is used as pasture or woodland.

KERSTON MUCK

Kerston muck, like Griffin loam, occurs only in the larger stream bottoms, but unlike Griffin loam, organic matter constitutes about 50 per cent of the soil mass to a depth of more than 3 feet.

Kerston muck consists, in vertical section, of alternate layers of organic matter and mineral alluvium. The organic matter is usually in a rather finely divided state, yet it differs in degree of decomposition. The mineral soil material ranges from sand or gravel to silt or clay, and the mass varies widely as to the proportional parts of the mineral and organic constituents. Probably a small part of the organic matter was transported by the streams, but the greater part is thought to be an accumulation in place, which was buried by subsequent depositions of alluvium. The soil mass is ordinarily comparatively loose and when thoroughly mixed is brown or dark brown in color. The material is poorly drained at the surface and grades into saturated material at a depth of 2 or 3 feet, or in places less. Land of this kind ranges from medium to high in natural fertility, but adverse drainage conditions restrict its use to pasture or woodland.

Kerston muck occurs in narrow strips along the larger streams. Probably three-fourths of it is in the northeastern and southwestern quarters of the county, along Swan and Hog Creeks, and along Prairie and Coldwater Rivers and their larger tributaries.

The forest cover, where undisturbed, is heavy and very similar to that on Griffin loam. Pastures are good where the forest has been thinned or removed.

CARLISLE MUCK

The surface layer of Carlisle muck is dark-brown or black granular well-decomposed muck, ranging in depth from 12 to 20 inches. The lower part of this layer in many places is slightly more compact, finer textured, and more pasty than the topmost 4 or 5 inches. Beneath the black surface layer the organic matter, in general, is coarser, more fibrous and peaty, and less decomposed, but it is variable in texture, composition, and thickness. The surface material is usually altered by decomposition to such an extent that the parent organic material can not be identified, and that at greater depths is apparently derived from wood, sedges, and grass.

This muck is slightly acid or alkaline in the highly decomposed surface layer. Analyses made in various parts of the State indicate that it is comparatively high in lime and phosphorus but low in

potash. The content of ash or inorganic matter is higher in this than in any other organic soil mapped in the county. A large area of the accumulation is less than 40 inches deep, although probably more than 50 per cent of the muck is deeper. The underlying mineral substratum in most places is gravelly sandy clay, and a number of areas are underlain by marl or clay.

The total area of Carlisle muck in Branch County is 27.5 square miles. The areas range in size from 2 to more than 500 acres. Although it occurs in widely scattered areas, about three-fourths of the total area is in the southern half of the county. Some of the larger areas are along Little Swan Creek northwest of Bronson, north of Honey Lake, west of Coldwater Lake, and west of Butler along the Calhoun County line. Like all the accumulations of organic matter in the county, it is developed along valleys of streams, in drainage ways, and in other depressions.

Carlisle muck was originally forested, and probably 50 per cent of it still supports a forest cover, in which elm, ash, and soft maple are dominant, with willow and aspen common in places. Tamarack is rare on this land. A large proportion of the land has been cleared, or partly cleared, and put into pasture. Good growths of bluegrass, timothy, and alsike may be expected when the depth of the water table is properly adjusted. Pastures range from fair to good.

Probably 15 per cent of the total acreage of Carlisle muck is cultivated. Mint, cabbage, and onions are the principal crops grown. Yields vary widely with drainage conditions, treatment, and tillage methods practiced. Where plowing is moderately shallow and rollers are used to prevent the surface soil from becoming too loose and dry, the level of the water table properly adjusted, and liberal applications of commercial fertilizers high in potash are made, yields of the special crops named are good. Mint is especially adapted to this land, and probably 85 per cent of this crop is now being grown on Carlisle muck. Most commercial plantings of onions are made on this soil. As on all organic soils, crops are more susceptible to damage from frost than on adjacent mineral soils.

RIFLE PEAT

Rifle peat is intermediate between Carlisle muck and Greenwood peat with regard to depth to water table, degree of decomposition of the parent plant material, agricultural value, color, perhaps lime content, and probably some other characteristics.

The surface layer, to a depth ranging from 6 to 12 inches, consists predominantly of very dark brown well-decomposed plant material, with woody fragments scattered throughout the layer. Beneath this is less well decomposed or coarser brown peaty material derived from wood, grass, and sedges. With increasing depth the color becomes lighter brown, the material becomes coarser and more fibrous, and the woody material gives way to a higher proportion of sedges, grass, and purely aquatic plants.

This soil varies in reaction over a wider range than does Carlisle muck or Greenwood peat, but in most places it ranges from nearly neutral to medium acid. It is not so acid as Greenwood peat, and it is probably slightly lower in lime than Carlisle muck. Rifle peat contains much more ash or inorganic matter than does Greenwood peat but probably less than Carlisle muck.

Rifle peat and Carlisle muck are so closely associated and grade so gradually into each other that sharp boundary lines could not be drawn in many places. Some small areas tending in many characteristics toward Houghton muck are included.

Areas of Rifle peat are widely scattered, although about half the total area occurs in the southeastern quarter of the county. Very little is mapped in the northeastern quarter. The larger areas occur near the lakes, in the vicinities of Coldwater Lake, Lake of the Woods, Matteson Lake, and northeast of Bronson.

Tamarack is a common tree on this soil, and such shrubs as red-osier dogwood (*Cornus stolonifera*), common winterberry (*Ilex verticillata*), dwarf birch, elderberry, and huckleberry are plentiful.

Very little of this soil is cultivated. One field near Algansee is planted to mint and onions. Practically all the soil is devoted to forest and pasture. It is thought to be slightly more difficult to maintain proper moisture conditions and develop a suitable tilth in this soil than in Carlisle muck.

HOUGHTON MUCK

Houghton muck consists typically of a surface layer of dark-brown or black moderately decomposed fibrous material from 12 to 24 inches deep, grading downward into lighter-colored more fibrous coarser less decomposed material.

This soil is associated with a marsh vegetation. Wire grass and bluejoint are characteristic. The marshy condition and absence of tree growth are conspicuous features. The water table is high. The material is derived almost entirely from marsh grasses, sedges, and rushes, and contains only a very few wood fragments. The ash or inorganic content is low, and the process of decomposition is in the early stages. The material is neither strongly acid nor alkaline but is commonly near the neutral point.

Areas of this soil occur adjacent to lakes or on sites of former lakes. Large areas are around Silver and Huyck Lakes and along Swan Creek east of Bronson.

Practically all of Houghton muck is still covered with the natural vegetation. The greater part of it is fenced and pastured, and wild hay is harvested from a small acreage. None of the land is under cultivation.

GREENWOOD PEAT

Greenwood peat differs widely from the other organic soils of the county in color, texture, and in reaction. It supports a characteristic vegetation of blueberry, huckleberry, leatherleaf, sedges, and Sphagnum moss.

Greenwood peat consists of coarse-textured loose coarsely fibrous, or feltlike, yellowish-brown or brown peat. It is composed almost entirely of organic matter, in which very little decomposition has taken place. The water table fluctuates greatly, according to rainfall, but is never low. This soil shows a very strong acid reaction, and analyses of samples from different parts of the State indicate that it is low in content of lime and phosphorus.

Only a few bodies of this peat are mapped in Branch County. The largest area is just west of Lake Lavine, an area is 1 mile southwest of Gilead Lake, and a third is east of Lake George.

This soil is not regarded as having any agricultural value at present.

SOILS AND THEIR INTERPRETATION

The soils of Branch County show a great diversity or range in texture, consistence, structure, moisture relations, chemical composition, and natural fertility, all of which bear close relationship to plant growth, soil management, and agriculture. They are also characterized by abrupt changes over very short horizontal distances, which is a condition common in this region.

In texture the soils range from loose incoherent nearly pure sand to silty clay loam, although approximately half the total area of the county is mapped as loam and from 25 to 30 per cent as sandy loam. About 5 per cent of the land falls into the textural class of loamy sand and approximately 2 per cent is silt loam and silty clay loam. Probably less than 4 per cent of the soils are difficult to cultivate because of toughness or stickiness when wet or because of steep slopes. Stoniness is the chief tillage difficulty, and it is estimated that from 30 to 35 per cent of the soils are sufficiently stony to interfere more or less with tillage operations, although none is nonarable.

The surface relief is practically as constructed by the last, or Wisconsin, stage of glaciation. The natural drainage system is immature, and a large aggregate area of poorly drained land occurs. The thoroughness of drainage throughout the county as a whole is not correlated with surface relief so much as with the character of the substratum and the elevations relative to the contiguous swampy depressions, stream beds, and lake levels. For instance, the Coldwater and Conover soils, as developed here, are imperfectly drained owing to impervious substrata, notwithstanding the undulating or rolling relief; whereas the soils of the Fox, Warsaw, Oshtemo, and Plainfield series are well drained because of the pervious sand and gravel substratum, although they occupy flat plains. Such soils, however, as those of the Bronson, Brady, and Gilford series, characterized by nearly flat relief, and directly underlain by similar pervious sand and gravel substrata, have developed under conditions of imperfect drainage, due to a comparatively low elevation in reference to associated stream beds, saturated depressions, and lakes. It is estimated that about 50 per cent of the soils are naturally well drained, about 25 per cent imperfectly drained, and about 25 per cent, including the organic soils, very poorly drained.

With one conspicuous exception, the content of organic matter of the soils is closely associated with drainage conditions, the better-drained soils containing the smaller amounts. Warsaw loam was developed under prairie or semiprairie conditions, and this soil, although well drained, is relatively high in content of organic matter. Other than this, the well-drained soils of the county range from moderately low to low in organic matter, as is typical of soils developed under forest conditions in this region.

Probably more than 95 per cent of the well-drained soils show an acid reaction to a depth ranging from 30 to 40 inches; perhaps 85 per cent of those of intermediate drainage conditions show an acid reaction in the surface layers; and practically all the very poorly drained mineral soils show a nearly neutral or alkaline reaction in all layers.

Approximately 95 per cent of the agricultural mineral soils of the county range from fair to moderately high in fertility and productiveness, measured by the standards for this region. Probably from 5 to 10 per cent of the soils are low in productiveness because of droughtiness of the very sandy soils, because of extreme acid conditions, or because of a poor supply of mineral plant food, as in some of the organic soils.

The depth to indurated bedrock differs in different parts of the county. Under about 12 per cent of the county, bedrock, principally shale but with some sandstone, occurs at a depth ranging from 8 to 40 feet, but the depth to the unconsolidated rock material is much greater in all other parts of the county. Soils developed where the bedrock occurs at a depth of less than 50 feet are markedly affected or at least are very different from the other soils of the county. They are characterized by poor internal drainage despite the undulating or rolling relief, and the heavier soil types, which occur invariably where the bedrock is nearest the surface, have extremely heavy, compact, impervious B and C horizons of gritless silty clay which is in all probability derived from materials high in shale.

The reddish-yellow B horizons of the Fox and Bellefontaine soils, as developed in this county, are not so red as is typical of these soils throughout the region of southern Michigan and northern Indiana, but the clay content causes them to be unusually sticky. It is probable that the high percentage of shale and sandstone in the parent material accounts, at least in part, for these variations from the typical characteristics of these soils. Fragments of shale remaining in the B and C horizons of these soils, as well as in the Hillsdale, Conover, Bronson, and Brady soils, are very numerous. The extensive development of Hillsdale sandy loam in the county may be explained, in part, by the large proportion of shale, sandstone, and other nonbasic parent materials, as their presence is not nearly so much in evidence in the southeastern part of the county where the texture is heavier and the structure better developed. The southeastern part of the county, where the parent materials contain larger proportions of limestone and smaller proportions of shale and sandstone, is the highest part and here, probably, the last glacial deposit is much thicker over the shale and sandstone bedrock. In this part of the county carbonates have been leached from the soils to less depth, usually to a depth of 30 or 36 inches, as compared with a depth of 40 or more inches in other parts. The development of the Miami soils is entirely restricted to this part.

The soils of the county are of two kinds—inorganic or mineral soils and organic soils or mucks and peats. The mineral soils cover about 87 per cent of the total land area of the county, the organic soils about 12 per cent.

The inorganic, or mineral soils may be subdivided, on the basis of drainage into well-drained soils and poorly drained soils.

The well-drained mineral soils belong to the family of gray-brown podzolic soils. Leaching, particularly the removal of calcium and magnesium carbonates, and the associated translocation of materials, are dominant in the soil-forming processes. The leaching of carbonates has taken place to a depth ranging from 30 to 50 inches.

The generalized profile of the well-drained mineral soils in the virgin state is as follows: (1) A layer of litter and forest mold,

(2) a grayish-brown humous layer, (3) a highly leached gray or yellowish-gray layer, (4) a layer of maximum intensity of coloring from ferric oxides, and (5) the parent material, or geologic substratum.

These soils are further divided into three groups according to the texture and consistence of layers 4 and 5 in the profile described. They are as follows: (1) A group in which layers 4 and 5 are heavy textured and slowly pervious; (2) a group in which layer 4 is heavy textured and slowly pervious, but layer 5 is pervious and unconsolidated; and (3) a group in which both layers 4 and 5 are light textured and freely pervious.

The first group occupies about 22 per cent of the area of the county. It includes the soils of the Miami and Hillsdale series. The second group occupies about 25 per cent of the total area of the county and includes the soils of the Fox, Bellefontaine, and Warsaw series. The third group includes the soils of the Oshtemo, Plainfield, and Coloma series.

The poorly drained mineral soils are likewise subdivided into three groups according to the degree of perviousness of the B and C horizons. The first group, the poorly drained soils with comparatively impervious B and C horizons, includes the soils of the Coldwater, Conover, and Brookston series. This group occupies about 17 per cent of the total area of the county, the greater part of which is only moderately poorly drained. The second group which includes soils which have comparatively impervious B horizons, but unconsolidated pervious C horizons, is separated, largely according to degree of drainage and organic content of the surface soils, into the loams of the Bronson, Brady, and Gilford series. This group occupies about 15 per cent of the area of the county. The third group, represented by soils with very loose and pervious B and C horizons, includes the soils of the Berrien, Newton, and Maumee series. The separation of these soils is based largely on the degree of drainage, color, and content of organic matter characterizing the A horizons. All these soils have saturated sandy substrata at comparatively slight depths. Soils of this group occupy only about 2 per cent of the county's area.

The alluvium of the county, which is purely local in origin, occurs only in comparatively narrow strips along the streams and comprises less than 2 per cent of the total area. On account of recent deposition of material, disturbance of the soil material by periodic overflows, and poor drainage and aeration, no definite soil profile has been developed. The mineral alluvium has all been mapped as Griffin loam.

Organic soils occupy slightly more than 12 per cent of the area of the county. They have been accumulated for the most part in lakes, and the greater part of them apparently now occupies previous sites of lakes. The deposits range in depth from very thin to a maximum of more than 30 feet, but the more common depth ranges from 3 to 10 feet. In most places the mineral substratum is some combination of sand, clay, and gravel, although marl deposits are comparatively numerous throughout the county. The organic soils differ greatly in percentage of volatile or combustible matter, but most of them probably contain more than 50 per cent of plant matter.

The organic soils are separated into five types on the basis of such characteristics as stage of decomposition, color, depth to the water

table, and soil reaction. A definite soil profile is not so plainly evident as in the mineral soils, and on the whole, boundary lines between the types could not be so accurately drawn as between areas of mineral soils.

SUMMARY

Branch County is in the extreme south-central part of Michigan on the Indiana State line. Its total area is 503 square miles, or 321,920 acres.

The surface relief of the county as a whole is mild. Level or nearly level plains, in part dry and in part wet or swampy, occupy nearly three-fifths of the total area, and low rounded hills, basins, and shallow valleys feature the remainder. No great local differences in elevation occur, the range being from about 850 feet to slightly more than 1,100 feet above sea level.

There are comparatively few perennial streams in proportion to the land area. The natural drainage system is not well developed in all places, although about 75 per cent of the county is sufficiently drained for agriculture. Lakes cover an estimated total area of about 11 square miles. Good water can be obtained from shallow wells.

A heavy hardwood forest originally covered all the mineral soils except a few square miles of prairie which supported only a thin stand, principally of bur oak. Tamarack, dwarf birch, and willow were common on the wet peaty areas. The greater part of the original forest has been removed, although a large aggregate acreage of wood lots and woodland pasture remains.

According to the 1930 census, the population of the county is 23,950, of which 71.9 per cent is classed as rural. Coldwater is the largest town. Agriculture is the principal industry. Transportation facilities are good. Detroit and Chicago afford splendid markets.

The climate of Branch County is characterized by moderately long cold winters, mild pleasant summers, low evaporation and wind movement, a moderately high humidity, a mean annual temperature of 48.6° F., an average annual snowfall of 43.9 inches, and an annual mean precipitation of 35.92 inches, including melted snow. The average length of the frost-free season is 155 days.

The agricultural development of the county has been rapid. The present agriculture consists mainly in the production of corn, oats, hay, wheat, barley, rye, alfalfa, and potatoes, and in dairying. A less general type of agriculture consists of general farming combined with the growing of one or more special cash-income crops, as cabbage, onions, cucumbers, and mint.

Animal manure and some rotation of crops, which includes the growing of a legume, are the chief means of maintaining soil productivity on a large proportion of the general farms. The use of commercial fertilizer is not common but is increasing, and fertilizer is commonly used with special crops. A greater increase in the use of lime is taking place, owing to the acid condition of many of the soils and special requirements of such crops as alfalfa and clovers.

The soils of the county differ widely in texture, drainage, moisture retentiveness, acidity, natural fertility, and other characteristics affecting plant growth. Approximately one-half the soils are classed

as loam, from 25 to 30 per cent as sandy loam, about 5 per cent as sand and loamy sand, and 2 per cent as silt loam, silty clay loam, and clay loam.

Natural drainage, both surface and internal, is thorough, or perfect for about 50 per cent of the soils, fair to moderately poor for approximately 30 per cent, and poor to very poor, for about 20 per cent.

Only a negligible percentage of the land is difficult to cultivate on account of steep slopes or heavy texture of the surface soil, but from 30 to 35 per cent is sufficiently stony to interfere more or less with tillage operations. Gullying is very rare.

About 95 per cent of the well-drained soils were developed under heavy forest growth and have grayish-brown surface soils and yellowish-brown or reddish-yellow subsoils, usually heavy in texture. About 5 per cent of the well-drained soils were developed under a prairielike grass cover and are characterized by dark surface soils. All poorly drained mineral soils were developed under forest and are characterized by dark-gray or black surface soils, high in organic matter, and drab-gray mottled subsoils. Less than 2 per cent of the soils in the county are alluvial and about 12 per cent are organic soils, peats and mucks.

The mineral, or inorganic soils of the county, are divided into three groups on the basis of degree of perviousness of the subsoils and substrata, which influence drainage, root development, and plant growth, as follows: (1) Soils with comparatively heavy clayey subsoils, underlain by rather heavy clayey substrata; (2) soils with comparatively heavy clayey subsoils, underlain by open pervious substrata; and (3) soils in which both subsoils and substrata consist of coarse pervious materials.

The well-drained soils of the first group include the Hillsdale and Miami soils. These are devoted largely to general farming and are moderately productive.

The poorly-drained soils include the Coldwater, Conover, and Brookston soils. The Brookston soils are largely devoted to forestry and pasture.

The well-drained soils of the second group are the Fox, Bellefontaine, and Warsaw soils. The Fox soils are extensively developed, are moderately productive, and have a wide crop adaptation. The poorly drained soils of the second group are separated largely according to degree of drainage into the respective loam types of the Bronson, Brady, and Gilford series.

The well-drained soils of the third group include soils of the Oshtemo, Plainfield, and Coloma series. These soils are of comparatively little agricultural value. The poorly-drained soils of the third group include Berrien loamy sand, Newton loamy sand, and Maumee loam. All these soils have saturated sandy substrata at comparatively slight depths. They are very inextensively developed and are largely used as pasture or woodland.

Griffin loam represents strips of alluvium along the larger streams. The organic soils of the county were differentiated into five types largely on differences of color, degree of decomposition or disintegration, and character of the parent plant material.

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[PUBLIC RESOLUTION—No. 9]

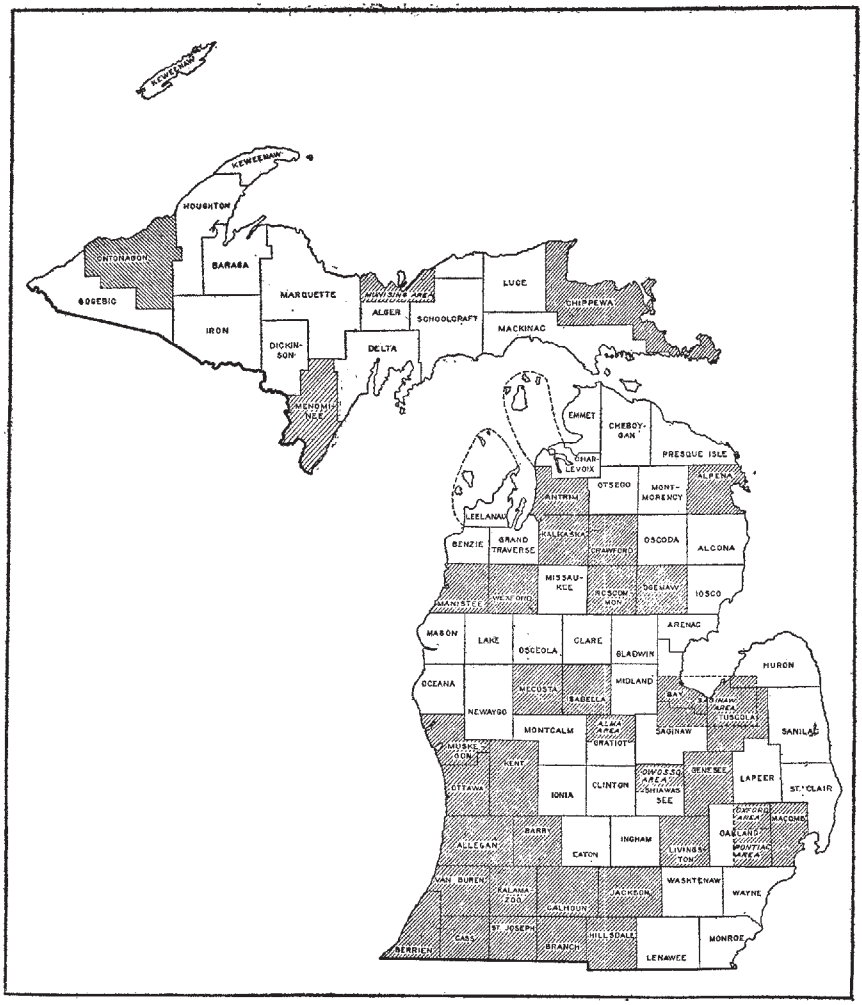
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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

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

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in Michigan, shown by shading

U. S. GOVERNMENT PRINTING OFFICE: 1932

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