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Areas surveyed in Michigan, shown by shading

U. S. DEPARTMENT OF AGRICULTURE

BUREAU OF CHEMISTRY AND SOILS

IN COOPERATION WITH THE MICHIGAN AGRICULTURAL EXPERIMENT STATION

SOIL SURVEY OF ANTRIM COUNTY MICHIGAN

BY

J. O. VEATCH, MICHIGAN AGRICULTURAL EXPERIMENT STATION
IN CHARGE, L. R. SCHOENMANN, LAND-ECONOMIC SURVEY
MICHIGAN DEPARTMENT OF CONSERVATION, AND
G. L. FULLER, U. S. DEPARTMENT
OF AGRICULTURE

[Advance Sheets—Field Operations of the Bureau of Soils, 1923]

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON
1928

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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 Representaitves 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.]

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FIGURE

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MAP

Soil map, Antrim County, Mich.

SOIL SURVEY OF ANTRIM COUNTY, MICHIGAN

By J. O. VEATCH, Michigan Agricultural Experiment Station, in Charge; L. R. SCHOENMANN, Land-Economic Survey, Michigan Department of Conservation, and G. L. FULLER, United States Department of Agriculture

COUNTY SURVEYED

Antrim County is in the northwestern part of the southern peninsula of Michigan and fronts on Grand Traverse Bay, an arm of Lake Michigan. The area of the county is 486 square miles, or 311,040 acres, which includes about 50 square miles of lake surface. The Late Wisconsin glaciation has given to this county a varied surface configuration of hilly and broad rolling country with long smooth slopes, gently rolling country with low, elliptic ridges and hills, level dry plains and poorly drained plains, peat or muck swamps, and numerous lakes. The few streams are small and short and flow into inland lakes or directly into Lake Michigan. There has been very little erosion since the close of the glacial period, and the changes in surface relief are those which have resulted from the deposition of beach sand, the formation of low dunes along the bay, and the filling of lakes through accumulation of organic matter.

FIG. 32.—Sketch map showing location of Antrim County, Mich.

From west to east the major topographic divisions are: (1) A low, narrow, benchlike sandy plain bordering the bay and having narrow arms which extend into the higher country to the east; (2) a rolling plateau which extends from 6 to 8 miles back from Grand Traverse Bay, is from 150 to 300 feet above the lake level, and is characterized by smooth slopes, low elliptic hills, and a succession of ridges, swales, and elongated lakes; (3) a central hilly belt of sandy land characterized by deep valleys and broad smooth slopes, and lying from 300 to 600 feet above the bay; (4) a narrow, nearly level, dry plain in the eastern part of the county in which are located the towns of Mancelona, Alba, and Elmira; (5) a narrow ridge east of this plain, which has an abrupt escarpment on the west and rises from 50 to 200 feet above the Mancelona plain, gradually merging on the east into (6) a high, nearly level to slightly undulating, dry plain in the southeastern part of the county. The extreme range in elevation is probably about 700 feet. The level of the bay is approximately 580 feet above sea level and the highest land in the eastern part of the county is about 1,300 feet.

There are several large lakes in the western part of the county which are of sufficient size to exert an indirect influence upon agriculture. They also possess scenic beauty and offer desirable locations for summer camps, cottages, and resort hotels, so that they are a commercial asset to the county. The largest of these, Torch Lake, is approximately 18 miles long, varies from 1 to 2 miles wide, and has a total area of 28.5 square miles. Other large lakes are Elk, Grass, and Intermediate.

It is estimated that about 13 per cent of the county is swampy or almost always wet. The poorly drained land, for the most part, is widely distributed in small bodies about the borders of lakes, or occurs as elongated swamps in the stream valleys, which consist mostly of peaty or mucky accumulations. In the eastern part of the county, where there are comparatively few streams and lakes, the soil substrata are pervious and allow free downward movement of water, so that the land, although it may be level, is dry and well drained.

The whole area, except for a few small spots of marsh or bogland, was originally densely forested, but at present only a few small tracts of virgin forest remain. The original forest consisted largely of hardwoods, but hemlock, pine, spruce, fir, and cedar were also abundant in places. Several tree associations were represented: (1) Hardwood forest, in which the principal trees were hard maple, beech, basswood, elm, ash, and yellow birch; (2) mixed forest, which consisted mainly of hard maple, beech, yellow birch, hemlock, and some white pine; (3) forest in which white pine, Norway pine, and hemlock were abundant, in association with the common hardwoods; (4) swamp forest, in which white cedar, spruce, balsam fir, and tamarack were characteristic and most abundant. Where the forest has been cut over in lumbering operations the older cut-over land is now covered by small second-growth aspen, pin cherry, red maple, white birch, and oaks, together with a dense tangle of briers, sweet fern, grasses, sumac, and other shrubs or bushes. Much of the former forest land has been repeatedly burned over since it was cut over and is now a desolate barren covered with charred stumps and tree trunks. The swamps have also been cut over but have been less completely depleted of their original tree growth. A few wood lots of second growth and plots of virgin timber from 2 to 15 acres in extent remain on the heavier or clay lands in the western part of the county, which have been most extensively occupied by farms. It is estimated that from 25 to 30 per cent of the original forest land of the county has been cleared and improved for farming, although all of this is not in use at present.

Good drinking water can be obtained from wells at depths of less than 100 feet, except perhaps in a few places on the higher sandy ridges and plains in the central and eastern parts of the county. Flowing wells have been obtained in a few places on the lower land. The streams are clear and cold, but for the most part they are bordered by swamps, so that they are not easily accessible, except where they are crossed by roads.

The population consists mainly of native-born whites, and the total number of persons in the county, according to the 1920 census, is 11,543, of which it is estimated about 5,000 live in towns. During the summer months the population is appreciably augmented by temporary residents in the towns and in cottages and camps on the lakes. Most of the people live in the western part of the county and along the Pennsylvania Railroad in the eastern part; the central and southeastern parts are very sparsely populated. The factors influencing this concentration of population in the western part in a strip of country 8 or 10 miles back from Lake Michigan are the greater fertility of the soil, favorable climate, and the recreational advantages which the large lakes afford.

Agriculture is the chief industry, and the total value of all agricultural products in 1919 was $3,416,102. The lumber industry, formerly of chief importance in the area, has greatly declined during recent years because of timber depletion. Small areas of merchantable timber, however, still exist and a few logging camps and lumber mills are in operation. The only other industry of any importance is the manufacture of pig iron and wood-distillation products at Mancelona.

Railway transportation facilities are afforded by the Pere Marquette Railway, which passes through the western part of the county, and by the Pennsylvania Railroad, which passes through the eastern part. Two of the main highways of the State pass through the county. These carry heavy tourist traffic during the summer and facilitate transportation of agricultural products by motor truck.

As there are no large cities or large industrial plants in this part of the State, the local markets can dispose of only a small quantity of agricultural products. The distance and cost of transportation to outside markets are at present handicaps and retard possible further agricultural development.

CLIMATE

The main features of the climate of Antrim County are an average annual precipitation of 28.32 inches (including melted snow), an average snowfall of 88 inches, an average annual temperature of 43.3° F., rigorous winters, short mild summers, a large number of cloudy days, fairly high humidity, and low evaporation.

The precipitation is fairly well distributed throughout the year, but it is somewhat higher for the six months from May to October than for the remainder of the year. The rainfall occurs mostly as slow or prolonged rains, or as frequent showers, but rarely as destructive downpours. As the evaporation is comparatively low and extended periods of drought are rare, the amount of rainfall is ample ordinarily for the growth of the staple crops of this region, except on some of the more pervious and nonretentive sandy soils.

The snowfall is heaviest from November to March, but light falls and flurries have occurred in April, May, September, and October. During the winter, snow protects fall-sown grain.

The temperature records show an extreme range of 147° from the minimum recorded in winter to the maximum in summer, although this probably has very little direct influence either upon health or upon agriculture. Low temperatures are experienced in the winter and the entire season is cold, but the mildness of the summer offers a compensation. The frost-free season probably ranges from about 120 to 150 days in different parts of the county, which, considering other climatic features, seems to be sufficient for successful agriculture. Corn does not always reach maturity, because the short growing season and the cool nights are unfavorable for the crop; but by the selection of hardy and early maturing varieties, grain is produced, and the crop always yields forage or silage. In the swales, or low wet places, all crops are apt to be damaged by frost. Occasional losses of potatoes, one of the chief cash crops, may be expected because of very cold weather in October and November, but ordinarily there is sufficient time for the harvesting of this and all other crops before excessively cold weather and heavy snows set in.

The maximum cloudiness is in winter and spring. It is believed that this condition is really favorable for agriculture,[1] as moist air and cloudiness exert a protective influence on fruit trees and also prevent thawing of wheat and rye fields during the day.

The only climatic data for the county is that compiled from records of the United States Weather Bureau at Mancelona, in the southeastern part of the county. It is reasonably certain that in the western part adjacent to Grand Traverse Bay, the mean annual temperature is 1° or 2° higher and the frost-free season possibly as much as 20 or 30 days longer, judging from the conditions prevailing at Charlevoix and Traverse City. It is probable, therefore, that a strip of country from 10 to 12 miles wide in the western part of the county has superior advantages for agriculture because of more favorable climate and better soils.

Climatic records at Charlevoix and Traverse City

Station	Mean temperature	Lowest temperature	Frost-free season	Annual precipitation
	° F.	° F.	Days	Inches
Charlevoix	44.2	−33	159	27.86
Traverse City	45.1	−33	152	26.73

The following table gives the more important climatic data as recorded at the Weather Bureau station at Mancelona:

[1] SEELEY, D. A. MICHIGAN AGRICULTURE. 3. CLIMATE. Mich. Dept. Agr. [Bul. 15]: 34. 1922.

Normal monthly, seasonal, and annual temperature and precipitation at Mancelona

[Elevation, 1,121 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1903)	Total amount for the wettest year (1897)	Snow, average depth
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December	22.8	55	−22	2.78	5.20	5.11	23.5
January	18.8	52	−30	2.34	3.90	4.66	23.0
February	13.2	52	−43	1.68	2.40	2.33	16.8
Winter	18.3	55	−43	6.80	11.50	12.10	63.3
March	27.1	81	−19	1.40	.80	3.06	8.5
April	41.7	89	7	1.53	.50	5.74	2.1
May	53.1	94	12	2.30	.50	4.30	.9
Spring	40.6	94	−19	5.23	1.80	13.10	11.5
June	63.2	101	25	2.25	.35	1.95	0
July	67.5	104	29	2.50	.40	1.88	0
August	71.6	96	28	2.33	.65	2.74	0
Summer	67.4	104	25	7.08	1.40	6.57	0
September	58.3	94	24	3.25	.65	2.91	.5
October	47.8	86	9	2.87	.82	4.02	1.6
November	35.0	77	−2	3.09	1.20	3.64	11.1
Fall	47.0	94	−2	9.21	2.67	10.57	13.2
Year	43.3	104	−43	28.32	17.37	42.34	88.0

Killing frost: Average last in spring, May 28; average first in fall, Sept. 22; latest in spring, July 13; earliest in fall, Aug. 26.

AGRICULTURE

Settlement began in the western part of Antrim County about 1850. Few of the early settlers depended entirely upon agriculture for a living, as lumbering, the manufacture of "charcoal" iron, the cutting of hemlock bark for tanning purposes, and trapping were the principal means of livelihood. Land was purchased or homesteaded mainly for the timber. By 1880 the population had increased to a little more than 5,000, and considerable farming was done on the better lands in the western part of the county. In this early farming, hay (timothy and red clover), wheat, potatoes, and corn were the chief crops. The amount of land under cultivation on each farm was necessarily small on account of the labor involved in removing trees and stumps. The Grand Rapids & Indiana Railway (now the Pennsylvania Railroad) was extended into the eastern part of the county in 1878–79, and by 1890 some of the land along this railway was being utilized for farming purposes.

From 1880 to 1910 there was a fairly continuous increase in the number of farms and in the amount of land improved, but according to census statistics the number of farms decreased during the decade from 1910 to 1920, although the amount of improved land remained about the same. At the present time (1923) it would appear that the area of abandoned land is approximately the same as that in

new farms and newly cleared land. Depletion of the timber resources, as well as other causes, has adversely affected agricultural development. As no other industry of equal importance has come in to replace lumbering, the population has decreased, and local markets and consequently the incentive for farming have been affected.

The initial cost of the land is low but because of the expense of clearing, and also to some extent because of unfavorable surface, the production of low acre-value crops on an extensive scale is impracticable; and at the same time natural conditions are unfavorable for the development of extensive grazing and livestock raising, as this region is not a natural grassland. Pastures are artificial, in that they have to be made by clearing the land of trees and brush. On the other hand, intensive farming has not been highly developed, as the factors are lacking which foster this kind of farming, namely, high price of land and large population or proximity to large market centers. The total acre value of all products raised on improved land is about $32, according to available statistics, which is about $16 an acre less than in Berrien County, where farming is more intensively developed.

The tendency of farm practice during the last few years has been toward an increase in the acreage of forage crops like alfalfa and sweet clover, and the development of dairying as the most profitable adjunct of general farming. In addition, there has been increased specialization in growing potatoes, beans, seed crops, cucumbers, and vegetables for local canning factories. It would seem that further expansion in agriculture is dependent on increased specialization such as seed crops, and on improved quality of products, adoption of practicable methods for greatly increasing yields, and concentration on those crops which are naturally best adapted to the soils and climate and which can be grown in competition with other parts of the United States.

Agriculture has not yet proved sufficiently profitable to warrant complete utilization of all the arable land. Only about 50 per cent of the land is in farms and only about 27 per cent is actually cultivated land. Most of the developed farming land lies along the bay in the western part of the county, in a strip from 6 to 12 miles wide. A considerable acreage is also farmed in the vicinity of Mancelona, Alba, and Elmira, but elsewhere throughout the central part of the county and in the southeastern township there is sparse settlement.

According to the 1920 census, corn was grown on 6,516 acres in 1919 and yielded 197,818 bushels; oats, 4,783 acres yielding 43,837 bushels; wheat, 1,881 acres yielding 21,674 bushels; barley, 206 acres yielding 2,114 bushels; rye, 5,944 acres yielding 54,994 bushels; buckwheat, 1,390 acres yielding 13,189 bushels; and dry edible beans, 2,088 acres yielding 21,159 bushels. According to the same authority hay and forage crops were grown on 25,931 acres and yielded 38,890 tons. Of these crops tame or cultivated grasses occupied 18,509 acres yielding 15,222 tons of hay, 64.3 per cent of which is timothy and clover mixed, the remainder consisting of clover alone, timothy alone, and alfalfa. The rest of the hay and forage crops consists of wild grasses, small grains cut for hay, coarse forage and silage crops. Potatoes were grown on 4,760 acres in 1919 and yielded 474,981 bushels; 20 acres of small fruits, principally strawberries and raspberries, yielded 13,089 quarts; and 135,552 fruit trees of bearing age, principally apples and cherries, yielded 103,138 bushels.

The 1923 crop report of the Michigan State Department of Agriculture[2] reports the 10-year average of the acre yields of hay as 1.2 tons; corn, 31 bushels; wheat, 13.8 bushels; buckwheat, 14.3 bushels; rye, 14.2 bushels; oats, 25 bushels; and of potatoes, 99 bushels. The seven-year average acre yield of beans was 9.8 bushels. The estimated yield of alfalfa for 1922 was 5,003 pounds an acre.

Other field crops of less importance, grown with some success, are sweet clover, field peas, soy beans, radishes for seed, red clover for seed, cucumbers, sweet corn, and vegetables for local canning factories.

Hay and forage crops lead all others in acreage and usually in value as well. Hay is principally timothy and red clover mixed, although considerable timothy alone is grown. Fairly good yields of clover are obtained on the heavier soils in the western part of the county without liming the land. The acreage of alfalfa has increased greatly during the last few years and is superseding red clover to some extent. Alfalfa has been most successful on the heavier soils, but when the best recognized methods for growing this crop are followed, fair results are obtained on the better sandy soils. Ordinarily only one cutting a year is obtained, and yields range from 1½ to 2 tons an acre on soils naturally best adapted to alfalfa. It is perhaps inadvisable to attempt to grow it on the lighter, drier, and more acid soils like Rubicon sand. The acreage of sweet clover has also increased during the last few years, and it can perhaps be grown successfully on much of the sandy land. Other crops grown for forage are corn, rye, oats, barley, and vetch. The forage crops are mostly consumed on the farms where grown, so that little forage is sold or shipped from the county; in fact, a small tonnage of hay is actually shipped into the county.

Corn is grown for grain, dry forage, and silage, and both dent and flint varieties are planted. This crop is susceptible to damage from early frosts, particularly in the lower places and also in the eastern part of the county where the frost-free season is shortest. Yields ranging from 30 to 35 bushels an acre are obtained on the heavier and more productive soils in the western part of the county.

The acreage of rye is somewhat larger than that of other small grains, because it can be grown more successfully on the lighter sandy soils. It is grown for grain, for forage, and as a green-manure crop.

Oats are fairly successful throughout the county on practically all soils, except the lightest and driest sands. Yields ranging from 35 to 40 bushels or more are obtained on the more productive and more clayey soils, such as those of the Onaway series. Mixtures of oats and barley and oats and vetch are also grown.

Winter wheat can be grown but the yields average low, and since extensive farming is impracticable, it can hardly be considered a profitable crop, and the acreage appears to be decreasing.

Buckwheat is an important crop as it does fairly well on a variety of soils. It is grown as a cash crop and for home use as feed for poultry and livestock.

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[2] MICHIGAN DEPARTMENT OF AGRICULTURE. CROP REPORT FOR MICHIGAN. ANNUAL SUMMARY, 1923, AND AGRICULTURAL STATISTICS, 1871–1923. 37 p. Lansing, Mich. 1924.

Potatoes are the most important cash crop grown in the county, and it is the principal crop on much of the sandier land. The climate is well suited to potatoes and they are of high quality. A number of growers specialize in the production of seed potatoes on a large scale. Most of the crop is planted in June and harvested in October.

Navy or white beans are also important as a cash crop and may be grown with a fair degree of success on the sandy as well as on the clay soils. The acreage on individual farms is prevailingly small.

A variety of fruits are grown in the western part of the county, where climatic conditions are most favorable. Apples are the principal orchard fruit, but cherries, pears, peaches, grapes, and plums are also produced in considerable quantity. Strawberries and other small fruits are also grown but not on an extensive commercial scale for outside markets. Fruit farming is engaged in both as a special industry on a commercial scale and as an adjunct to general farming.

According to the 1920 census, the total value of all domestic animals amounted to $919,170. The principal source of income is from dairy products, which were valued at $364,841 in 1919. The beef cattle, sheep, and hogs are kept in small numbers on individual farms, and there is no extensive feeding or raising of livestock. Poultry and eggs are an important supplementary source of income on most of the farms, and chickens and eggs produced in 1919 were valued at $159,286.

Very little commercial fertilizer and lime is used. The total quantity of commercial fertilizer sold in this county during the fall of 1921 and spring of 1922 amounted to only 303 tons.[3] This was probably used principally for potatoes. Much of the land is comparatively so new that the original productiveness has not been exhausted. The small use of fertilizers may also be explained by the lack of means to purchase them and the lack of knowledge as to their use. Liming of land is not common, and the soils that are under cultivation are apparently not greatly in need of lime, judging from the little difficulty experienced in obtaining good stands of red clover, alfalfa, and sweet clover. Manure is generally used where available; green-manure crops, such as rye, are also grown for the purpose of maintaining the productiveness of the soil.

The use of commercial fertilizers would probably result in increased yields, especially of potatoes, for which crop a complete fertilizer, such as a 3–12–4 mixture, seems to have given good results, especially on the sandier soils. Experimental tests to date have indicated that small grains, sweet clover, and alfalfa on well-drained soils will also respond to commercial fertilizers.

The production of seed crops is comparatively important locally, and there is a tendency toward increase in this kind of specialized farming. The principal crops now grown for seed are potatoes, red clover, sweet clover, alfalfa, and radishes.

Rotation, or the practice of alternating crops on the same land, is practiced to some extent, although generally no one definite system is followed. On most of the farms it is perhaps the most common practice to plant a small grain, then red clover and then potatoes

[3] MICHIGAN DEPARTMENT OF AGRICULTURE. SPRING REPORT. Mich. Dept. Agr. Fert. Bul. 1922, 42 pp., illus. 1923. (Mich. Dept. Agr. [Bul. 16.])
——— FALL REPORT. Mich. Dept. Agr. Bul. 1922, 19 pp. 1923. (Mich. Dept. Agr. [Bul. 17.])

or corn. Alfalfa and sweet clover also are usually followed by potatoes and corn.

A large variety of crops can be grown in Antrim County which will give fair yields of good quality products, yet the fact remains that less than 30 per cent (1923) of the land has been improved for farming. A very large acreage of comparatively cheap raw land has been available for agriculture for many years, but it has not been successfully farmed. The causes of this condition and the economic factors entering in are hardly within the scope of a soil-survey report. It is apparent, however, from the soil classification here made that a large acreage of land, such as the Onaway soils, is moderately productive, naturally durable, and otherwise favorable for agriculture, but that a larger proportion, such as Rubicon sand and Emmet sand, is inferior because of low fertility or low moisture and because of no known successful crop adaptation. On the assumption that the present inferior lands are not likely to be utilized for the production of food crops in the near future, the logical solution is that such lands should be used for forestry.

SOILS

The distinguishing characteristics which develop in the soils of a region are determined by climate, surface features as affecting drainage, the nature of the parent material, and the native vegetation. Drainage has been an important factor in the differentiation of the soils of Antrim County, as shown by the classification scheme on page 941. Furthermore, the explanation of many of the peculiarities of soils of a given region lies in the study of the geology of that region.

Antrim County lies in the glaciated region of the United States, and the common glacial formations and surface features, such as moraines, till plains or ground moraines, outwash plains, lacustrine deposits, old drainage valleys, glacial lakes are present. The correlation between glacial formations, as defined by the geologist, and soils is mainly one of texture or size of soil particles, and to a less degree, of structure. There may be several soil types or series associated with one glacial feature. In this county, there is the usual general relation of heavier soils to the till plains or ground moraines, the mixed sandy and stony soils to the terminal moraines, and the drier sandy soils to the outwash plains; but the usual modification and variations in the soils exist resulting from local differences in moisture or drainage and from lack of uniformity in the glacial formations themselves.

The parent drift clay in this county exhibits a fainter red coloration than in some other parts of Michigan, and its composition is strongly influenced by the underlying shales and limestone. This may account for the highly calcic nature of Onaway soils and the absence of as marked a red color in the subsoil as is found in the Kewaunee soils. The basic or slightly acidic nature of the sandy soils, such as the Emmet and Mancelona soils, may also be accounted for by the nature of the local glacial deposits. Further, some of the drainage conditions are a direct result of the glaciation and of the flat plains left by the recession or shrinkage of glacial lakes, and these drainage conditions have in turn determined the nature of the

soil. Thus, most of the mucks and such soils as Bergland and Saugatuck soils are more or less directly associated with the drainage conditions consequent to glaciation. The distribution of Bridgman soil is closely associated with dunes which may be regarded purely as a geologic feature comparatively recent in origin.

As the surface geologic formations are comparatively recent, belonging to the Late Wisconsin glaciation, there has not been such deep weathering nor so extensive removal of material by erosion and solution as on older land surfaces. The depth of weathering is generally from 3 to 5 feet, but weathering which has completely changed the physical appearance or composition of the parent material has been effective to a depth of only a foot or two. The alteration is most evident in the removal of a large part of the calcium carbonate, in the development of a leached grayish layer beneath the forest mold, and in a more intense coloring than is found in the parent drift material.

Certain peculiarities of the soil are also traceable to the native vegetation. The shallowness of the true humus soil and the light color of the cultivated soils are consequent mainly to the original forested condition of the country. The accumulation of a thick layer of leaf mold, a leached gray or ash-colored layer beneath the leaf mold, and a brown subsurface layer, the coloring of which is probably due to organic compounds translocated from the surface mold, are also traceable to forest growth. Certain physical and chemical peculiarities of organic soils are determined by the kind of vegetation growing upon them or from which they have developed, as, for example, sedges or herbaceous growth, shrubs, or forest. In the uprooting of trees and the removing of stumps some of the highly alkaline or limy subsurface material is brought up and mixed with the surface soil.

The generalization that certain kinds of native plants or types of vegetation may be rather definitely associated with certain kinds of land, in terms of agricultural adaptation, has been fairly well substantiated by observation. The nature of the vegetation also has a bearing upon the problems and cost of clearing land and its use for grazing. The relation between types of soil and native vegetation has a further application in silviculture and forestry, particularly as an aid in the reconstruction of the original forest which has been largely obliterated by lumbering and by fire. It consequently has a bearing upon the nature and adaptation of the growth which may be expected on different sites. The relation between soils and vegetation is, therefore, briefly indicated in the tabular scheme given on page 955. The relations stated doubtless apply in general for the larger bodies of any particular soil, but may not always apply for very small bodies, and purely local exceptions may be found which are due to various fortuitous causes.

The soils of Antrim County, which have developed under conditions of fair or good drainage, have the characteristics common to the soils of northern Michigan. Having undergone more or less podsolization, they have a grayish or ash-colored leached layer just beneath the surface layer of forest mold. The common-to-all characteristics of virgin soils, from the surface downward, are as follows: (1) A surface layer of forest mold; (2) a very thin humus layer;

(3) a leached grayish layer; (4) a brownish or yellowish layer in which the coloring is entirely or in part the result of the presence of organic compounds; and (5) a layer of material which has the most intense color from iron oxides and which contains the maximum amount of clay or fine particles, and which is most clearly defined in the heavier soils. The substratum consists of geologic material representing that from which the soils have developed. There are variations in texture, color, consistence, structure, thickness of layers, and chemical composition, which are the bases for the differentiation of the soils as types and for grouping them in series.

The well-drained soils may be placed in three groups: (1) Those soils which are underlain by clay; (2) pervious, sandy or gravelly and stony soils, underlain by heterogeneous glacial-drift material, and which usually occur on steeply sloping and hilly areas; and (3) dry sandy soils which are underlain to a depth of several feet by pervious sand or sand and gravel and which generally occur on nearly level plains.

The soils in wet or poorly drained places are mainly organic soils (muck or peat), as the climate of this region favors the accumulation of plant remains or vegetable débris where permanently moist conditions exist. The organic soils differ, and they may be classified on the basis of age, depth to water table, color, stage of decomposition of the organic matter, structure, thickness of the layers, and reaction. A definite development of layers is nowhere so evident as in the mineral soils; and in some of the deposits the plant matter has undergone so little change that the soil is practically equivalent to an organic geologic deposit.

The small areas of wet mineral soils exist mostly as borders of swamps, or bogs, which consist of muck or peat. The characteristics common to the mineral soils which have developed under conditions of poor drainage, from the surface downward, may be described as follows: (1) A dark-gray or nearly black mucky surface layer; (2) a lighter-gray or drab layer; (3) and a layer which contains a larger quantity of colloids than No. 2 and which has variable rust-colored or yellowish mottlings or splotchings in a gray, water-logged mass. The aggregate acreage of wet soils, including mucks, is equivalent to about 13 per cent of the total area of the county.

The mineral soils are dominantly sandy, including medium sands, fine sands, sandy loams, and fine sandy loams. The aggregate acreage of loam soils is very small, and that of clay loam and clay soils almost negligible. The acreage of organic soils aggregate 7.6 per cent of the total area of the county. The soils are not deep, and they do not have the physical characteristics which are common to many of the soils of the central part of the United States, particularly in the subhumid prairie region. This is because the layer of humid soil is very thin, almost nonexistent in the drier sands, and because the bulk of organic matter in the virgin soils exists as a distinctly superficial layer of forest litter and leaf mold. This surface covering of mold, which is partly destroyed by frequent forest fires and by the burning of brush in the process of clearing the land, is further reduced by tillage. As a result the dark-brown or black surface soils are almost nonexistent, except as muck, so that most of the cultivated soils are light gray or brown.

For purposes of classification and mapping, soils are designated as types and are grouped in series on the basis of texture, structure, chemical nature, thickness of layers, and color. The soil series and types (the latter are shown on the soil map) are designated by geographic names. The characteristics which distinguish the soils of each series are described briefly here, and the detailed descriptions of the types of soils, their relation to agriculture, and possible utilization, are given in subsequent pages.

The Onaway soils are characterized by a surface covering of humus; and pale reddish-brown subsoil, or B horizon, of gritty, friable, but comparatively compact clay which contains small stones. The substratum consists of clayey drift material which contains a rather high percentage of limestone. The soils are calcareous at a slight depth, and in many places the plowed part of the soils is alkaline in reaction.

The Emmet soils vary from pervious sand to very light sandy loam to a depth ranging from 2 to 3 or more feet, and are rather well supplied with lime carbonate at a shallow depth. The substratum is of heterogeneous, calcareous sandy drift material. The soils are characterized by a distinctly marked (in places slightly cemented) layer which varies in color from yellow to coffee brown.

The Rubicon soils are dry, well-drained sands, whose substrata consist uniformly of sand and gravel to a depth of several feet. There is a strongly marked yellow or brown layer a few inches below the surface. The soil is consistently acid throughout and the humus layer is very thin or only faintly developed.

The members of the Mancelona series include well-drained sandy soils which have uniform gravelly and sandy substrata. They are characterized by a strongly marked yellowish or coffee-brown subsurface layer and a subsoil, or B horizon, which contains sufficient fine matter to produce a sandy loam or loam. The soils are gravelly and contain a rather high percentage of limestone or other basic gravel, so that their reaction is usually alkaline at a slight depth.

The Eastport soils, composed of dry, loosely coherent sands, have only moderately well developed profiles. The soils may be acid, but they exhibit evidence of limestone influence.

The Bridgman series include soils which have incoherent, yellowish, fine sand and medium sand surface layers, faintly or fairly well-defined brown subsurface layers, and subsoils which do not contain sufficient clay or fine material to form distinct layers. The sands have accumulated in dunes and are not highly acidic. The soil in places gives an alkaline reaction.

The Saugatuck soils have developed under conditions of poor drainage. They are characterized by (1) dark-gray sandy surface layers, (2) grayish or whitish, leached, sandy subsurface layers, (3) strongly developed dark-brown sandy subsoils, more or less cemented. Below the subsoil is water-logged sand to a depth of 3 or more feet. These soils are strongly acid.

The Ogemaw soils have thin coverings of sand, faintly or strongly marked, brown and mottled subsurface layers, and clay substrata. The soils are poorly drained but are not so water-logged near the surface as the Bergland and Saugatuck soils.

The Bergland soils are characterized by dark surface soils, which are rich in organic matter or mucky material, underlain by grayish

FIG. 1.—HARDWOOD FOREST ON ONAWAY LOAM

FIG. 2.—FIELD OF POTATOES ON MANCELONA GRAVELLY SANDY LOAM

or drab material. A layer of mottled clay or sandy clay occurs not far below the surface. These soils have developed where the water table is very near the surface. They are alkaline or only slightly acid.

The Newton soils are similar to the Bergland soils, but the Newton soils are underlain by water-logged sand rather than clay.

Soils of the Antrim series have developed under conditions of moderately poor subsurface drainage. They are characterized by a yellowish or brownish layer near the surface, which contains sufficient clay to bind the sand and gravel mass slightly. The substratum consists of pervious sand and gravel or cobbles. Mottlings, indicative of poor subsurface drainage, occur at depths varying from 20 to 36 inches. These mottlings constitute one of the chief visible differences between the Antrim and Mancelona soils. These soils are alkaline or nearly neutral.

The Genesee series include the fairly well-drained soils of swales and drainage valleys, where the soil is either alluvial or has received wash from adjacent slopes. The surface layers are characteristically sandy and pervious, and poor in organic matter, and the subsurface layers are sandy. They are not uniform in texture or structure throughout their depth, and characteristic layers, such as exist in the well-drained soils, are only weakly or almost imperceptibly developed.

The organic soils are represented by four types: Lupton muck, which includes the older, darker, more loamy and finely disintegrated alkaline or only slightly acid muck; Greenwood peat, which includes raw, coarse-textured, yellow or brown, very acid peat; Rifle peat, which occupies an intermediate position, in physical and chemical nature, between Lupton muck and Greenwood peat; and Edwards muck, which is dark, loamy muck underlain by marl at a depth of less than 3 feet.

The following outline shows the classification of the soils of Antrim County, according to age, drainage, structure, composition, texture, and chemical reaction:

MINERAL SOILS

I. Comparatively old soils, having well-developed profiles and well-marked gray or brown layers:
  A. Soils developed under conditions of fair to good drainage—
    1. Soils with comparatively impervious clay subsurface layers or clay substrata rich in lime—
      a. Sandy soil, having well-marked gray and brown layers. Onaway sandy loam.
      b. Loamy soil, having clay not far below the surface. Onaway loam.
    2. Pervious sandy and gravelly soils—
      a. Soils having sandy drift substrata with bowlders. Emmet soils.
        (1) Soils mainly sandy throughout——Emmet sand.
        (2) Soil with substrata of clayey sandy drift. Emmet sandy loam.
      b. Soils having substrata of pure sand or pure sand and gravel. Rubicon, Mancelona, Bridgman, and Eastport soils.
        (1) Soils with subsurface layers which vary in texture from sandy loam to sandy clay, gravelly substrata——Mancelona gravelly sandy loam.

I. Comparatively old soils, etc.—Continued.
A. Soils developed under conditions of fair to good drainage—Continued.
2. Pervious sandy and gravelly soils—Continued.
b. Soils having substrata of pure sand, etc.—Continued.
(2) Sand soils which have substrata of sand or mixed sand and gravel.
Rubicon, Bridgman, and Eastport soils.
(*a*) More acid soils——Rubicon sand.
(*b*) Less acid and neutral or alkaline soils:
(1) Composed of sand throughout, as dunes—Bridgman sand in part.
(2) Composed of sand and gravel.
Eastport sand, in part.
B. Soils developed under conditions of fair to poor drainage—
1. Shallow sandy soils which have clay substrata, as Ogemaw sandy loam.
2. Soils which have sand or gravel substrata—
a. Soils with sandy loam or sandy clay subsurface layers; less acid——Antrim gravelly sandy loam.
b. Sandy, highly acid soils which have definite brown layers.
Saugatuck sand.

II. Comparatively young soils with immature or faintly developed profiles, representing in part alluvium and materials washed from slopes:
A. Gray or light-brown soils, having fair or good drainage—
1. Sandier soils in swales and valleys.
Genesee sandy loam, colluvial phase.
2. Heavier soils in swales and valleys.
Genesee loam, colluvial phase.
3. Sand——Bridgman sand (dunes) and Eastport sand (recent beach deposits and lake-shore plains).
B. Dark-gray or black soils, having poor drainage and excessive moisture—
1. Sandier soils——Newton sandy loam.
2. Heavier soils having clay substrata——Bergland loam.

ORGANIC SOILS

I. Older soils in advanced stages of decomposition:
A. Soils rich in organic matter, and which are alkaline or slightly acid—
1. Dark-brown or black, loamy, alkaline soils; water table at a depth varying from 2 to 3 feet—
a. Shallow muck over marl——Edwards muck.
b. Alkaline or neutral deep muck——Lupton muck.
2. Brown or dark-brown, alkaline or slightly acid soils; water table at a depth varying from 1 to 2 feet——Rifle peat.

II. Younger soils in less advanced stages of decomposition; more peaty:
A. Soils rich in organic matter—
1. Brown, coarse, strongly acid soils, with water table at or near the surface——Greenwood peat.

The acreage and proportionate extent of the soils mapped in Antrim County are shown in the following table:

Acreage and proportionate extent of the soils mapped in Antrim County, Mich.

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Onaway sandy loam	43,968	14.1	Eastport sand	3,008	1.0
Onaway loam	6,208	2.9	Genesee loam, colluvial phase	1,280	.4
Steep phase	2,880		Genesee sandy loam, colluvial phase	8,640	2.8
Emmet sand	72,000	23.2	Bridgman sand	3,712	1.2
Emmet sandy loam	34,560	11.1	Newton sandy loam	4,288	1.4
Mancelona gravelly sandy loam	21,888	7.0	Lupton muck	13,184	4.2
Rubicon sand	62,848	20.2	Rifle peat	9,024	2.9
Antrim gravelly sandy loam	8,704	2.8	Greenwood peat	832	.3
Ogemaw sandy loam	1,920	.6	Edwards muck	704	.2
Bergland loam	6,208	2.0			
Saugatuck sand	5,184	1.7	Total	311,040	

ONAWAY SANDY LOAM

Onaway sandy loam consists of light-grayish brown, mellow, shallow loam underlain by a gritty, pale reddish-brown, calcareous clay subsoil. In detail, a typical profile of the virgin soil under forest conditions shows (1) a surface cover of mold and dark humus layer from 1 to 3 inches thick, (2) a leached, gray layer composed mainly of various grades of sand and silt, from 3 to 6 inches thick, (3) a layer, from 4 to 10 inches thick, of yellowish or brownish fine sandy loam, and (4) a pale reddish-brown heavier layer, varying in thickness from 12 to 20 inches. This rests on a substratum of calcareous medium-textured, gritty or sandy material which contains small stones and a few bowlders. The cultivated soil consists of a mixture of the first three layers and consists of sandy loam or light loam which contains sufficient organic matter and coloring from the third layer to produce a light-brown color. In places there is some variation in the amount of silt and clay in the surface soil, and considerable variation in the depth to the reddish, clayey subsurface layer. The surface of most of the land is free from any great quantity of stones.

When judged according to chemical analysis, crop yields of areas under cultivation, and according to the growth of native vegetation, this soil is fairly fertile. It is moderately retentive of water and apparently holds sufficient available moisture for good plant growth. The surface soil is usually rather acid,[4] the gray layer is medium to strongly acid, the yellowish third layer is strongly acid, and the heavier layer is slightly acid or alkaline. Carbonates, particularly calcium carbonate or limestone, are present in large quantities in the parent glacial-drift material, but they have been leached out in the soil-forming processes to a depth varying from 20 to 30 inches.

Onaway sandy loam is one of the more extensive and important soils. It occurs in the western part of the county where it comprises most of the heavier, well-drained soils. Its total acreage amounts to 43,968 acres. Its surface is gently undulating or moderately rolling with smooth slopes. Some of the land is marked by drumlins, peculiar oval, elongated hills, or short ridges. A very small acreage is excessively steep or broken, and in places the land is susceptible to erosion and probably can not be profitably utilized for cultivated crops, though it is not too steep for orchards.

This soil originally supported a dense hardwood forest, consisting principally of hard maple and beech, and some elm, basswood, white ash, yellow birch, and hemlock. Except for a few small scattered wood lots, the forest growth has been cut by lumbermen. The land is now almost entirely held in small tracts as farms, and a large proportion has been cleared of stumps and is cultivated.

Onaway sandy loam is valuable land for general farming. Timothy and red clover, potatoes, beans, rye, wheat, oats, barley, corn for silage or forage, alfalfa, sweet clover, and buckwheat are grown with fair success. Some of the farmers derive considerable income

[4] Tests for reaction on all types of soils in this report were made in the field, using Spurway's Soiltex, which is a brom-thymol blue dye and limewater, adjusted to the neutral point by means of the hydrogen electrode. The method is described in the following: SPURWAY, C. H. TESTING SOILS FOR ACIDITY. THE SOILTEX SOIL REACTION TESTING OUTFIT—A NEW AND CONVENIENT METHOD FOR TESTING SOIL REACTION. Mich. Agr. Expt. Sta. Quart. Bul. 6: 93–97, illus. 1924.

from seed crops of potatoes, alfalfa, sweet clover, red clover, and radishes. In addition, sweet corn, peas, beans, and beets are grown on a few farms to supply the canneries at Central Lake and Ellsworth. Among the orchard fruits, apples yield well and are of good quality.

On most of the farms dairying or livestock feeding constitutes a small industry.

Onaway sandy loam is not so easily plowed as the lighter sandy soils, but offers no special tillage difficulties. Fertilizers are not used to any great extent, and good stands of alfalfa and clover have been obtained without the use of agricultural lime.

ONAWAY LOAM

Onaway loam consists of light brownish-gray loam underlain by lighter-gray fine gritty loam, which rests on a layer of yellowish-gray clay loam. Below this, at depths ranging from 10 to 20 inches, is reddish-brown, gritty or pebbly clay loam material. Together with Onaway sandy loam, this soil comprises practically all the heavy, well-drained clay land of the county. The surface soil is somewhat more silty and loamy than that of Onaway sandy loam, and the clay subsurface layer is not so deep. Otherwise, these soils are similar. This soil occurs in small bodies in the western part of the county, in association with Onaway sandy loam, and, including its steep phase, aggregates 9,088 acres. The land is nearly level or rolling, although it includes some moderately steep, smooth slopes. It is for the most part naturally well drained. There are a few stones and large bowlders on the surface.

The original forest growth was a dense stand of hardwoods, chiefly hard maple, beech, basswood, yellow birch, elm, and ash (pl. 40, fig. 1). The merchantable timber has been cut, and practically all of the land is now in farms, most of which is under cultivation.

Onaway loam comprises some of the better farm lands of the county. Good yields of timothy and red clover are produced, and the soil is well adapted to alfalfa and sweet clover. Small grains (oats, rye, wheat, barley), beans, and potatoes are grown, and where the land surface is favorable apple orchards do well.

Onaway loam, steep phase.—Steep phase Onaway loam includes the heavier soils on steep slopes and also land where the underlying clay has been exposed by sheet erosion and gullying. In places some greenish or grayish plastic clay, residual from the weathering of underlying shales, is exposed. The land has little value for cultivated crops, but will produce a good growth of hardwoods.

EMMET SAND

Where forested, Emmet sand consists of (1) a surface layer, from 2 to 4 inches thick, of leaf mold and humus; (2) a gray or nearly white layer, ranging in thickness from 4 to 10 inches, of loose, leached sand; (3) a layer, from 6 to 15 inches thick, of dark-brown or dull-yellow loamy sand; and (4) a thin layer of pale yellow sand which grades downward into sandy glacial-drift material. On the cut-over land, the layer of litter and leaf mold originally present has been consumed by fires; but the surface soil, to a depth varying from 1 to

3 inches, contains sufficient humus and charred organic matter to give the loose sand a grayish or light-brown color. The cultivated soil is light-brown loamy sand, consisting usually of a mixture of the first three layers of the virgin soil. The sand is for the most part uniformly medium or fine in texture.

This soil has only low fertility, as compared with the heavier soils of the State, but apparently contains a little more calcium and magnesium than similar sands and possibly holds slightly more moisture, owing to the well-developed brown layer. The soil is in most places acid, though it may be nearly neutral or slightly alkaline at a slight depth, and the parent drift material is calcareous.

Emmet sand, as mapped, is fairly uniform but probably includes small areas of sandy loam or loam soil. The areas of sandy soil with clay near the surface are the more productive.

Emmet sand is the most extensive soil in the county, aggregating 112.5 square miles. The principal areas are in the central part of the county and are rolling or moderately hilly. Most of the land is characterized by long, broad, smooth slopes, but in places it is choppy and broken. Good drainage is afforded by the texture and consistence of the soil, the sandy substratum, and the sloping surface. The water table in most places occurs at a considerable depth.

The land originally supported a fine forest growth of hemlock and the common hardwoods, hard maple, beech, elm, and yellow birch. It is probable that a greater proportion of hemlock grew on this soil than on the Onaway soils, and a smaller proportion of ash, elm, and basswood. Except in a few small tracts, the trees have been cut for lumber. Much of the land at present is desolate and burned over; and open, old, cut-over lands, covered with charred stumps, briers, grasses, and herbs, or a small scrubby growth of cherry (principally *Prunus pennsylvanicum*), aspen, white birch, and oak, are common. Only a very small percentage is well stocked with second growth.

A few small farms have been developed on the smoother land. Rye, oats, timothy and red clover, potatoes, buckwheat, and sweet clover have been grown. Probably most of this land is too far from Lake Michigan to be within the range of the moderating temperatures, and consequently can not be successfully utilized for orchards. Remoteness from markets, sparse settlement, and competition with better soils have prevented any extensive development of this land for farming. The more open and less brushy land affords fair pasturage for cattle and sheep during a short season.

The following table gives the results of mechanical analyses of samples of three layers of Emmet sand. The first layer of mixed sand and leaf mold is not included.

Mechanical analysis of Emmet sand

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
302002	Subsurface, 2 to 8 inches	2.4	32.2	26.4	30.2	1.8	5.0	1.9
302003	Subsoil, 8 to 20 inches	2.4	28.0	26.4	32.2	1.6	2.6	6.9
302004	Subsoil, 20 to 30 inches	1.4	17.0	30.4	46.8	.4	1.4	2.6
302005	Subsoil, 30 inches +	.2	7.0	34.8	56.9	.1	.3	1.0

EMMET SANDY LOAM

Emmet sandy loam is a light sandy soil, underlain at a depth varying from 3 to 5 feet, by a pervious, gravelly, or stony sand-clay material. The soil in cut-over land has (1) a dark surface layer, 2 or 3 inches thick, of leaf mold or a loose layer of mixed sand and organic matter; (2) a layer, ranging in thickness from 6 to 10 inches, of grayish-lavender loose sand; (3) a layer, from 10 to 18 inches thick, of yellow or brown loamy sand; (4) yellowish sand or sandy loam. The substratum is of sand and clay. The presence of a greater quantity of clay in the substratum distinguishes this soil from Emmet sand. Emmet sandy loam is acid to a depth varying from 2 to 3 feet. Some of this soil, as mapped, is closely related to the Onaway sandy loam.

Emmet sandy loam occurs mainly in small areas in the central and western parts of the county. These areas range from moderately undulating to very rolling, and it is probable that the steeper slopes, if placed under cultivation, would be subject to erosion or gullying. Scattered bowlders and cobblestones are present, in places, but as a whole the soil is not too stony for farming. The land is well drained but possibly holds moisture better than Emmet sand.

Emmet sandy loam originally supported a dense forest of hemlock, hard maple, beech, elm, yellow birch, and basswood. Practically all of it is now covered with a growth of aspen, pin cherry, red maple, oak, and white birch, with here and there clumps and individual trees of the species which grew in the original forest. Most of the land is very stumpy, but a small acreage has been cleared and farmed. It is more productive than Emmet sand but is probably somewhat inferior to the Onaway soils. Potatoes, timothy, red clover, oats, rye, and corn (mainly for forage or silage) are the principal crops. Alfalfa, sweet clover, cucumbers, and radishes (for seed) are also produced. Potatoes constitute the most dependable cash crop. Apple orchards produce well where they are favorably situated.

The rolling surface and the cost of clearing away stumps and stones discourage agricultural development. Because of its loose, sandy nature and low content of organic matter, the soil is not likely to be very durable unless care is taken to maintain the supply of organic matter by plowing under green crops or by applying barnyard manure. Where the land is new, there seems to be no need of liming to obtain stands of red clover, sweet clover, and alfalfa. This soil would probably respond to complete commercial fertilizers.

MANCELONA GRAVELLY SANDY LOAM

Mancelona gravelly sandy loam, described from the surface downward, consists of (1) a layer of forest mold or dark-gray turf and humus material, 2 or 3 inches thick; (2) a layer of gray, loose sand or sandy loam, from 3 to 8 inches deep; (3) a brown gravelly layer ranging in thickness from 6 to 20 inches, which is cemented in places and contains an appreciable quantity of clay; and (4) gradational material which is coarser, less coherent, and more gravelly. The substratum consists of pervious sand with gravel and cobblestones.

The cultivated soil is brownish sandy loam or loam which is easily plowed and maintained in good tilth. The surface soil is commonly somewhat gravelly and in places cobbles are abundant.

This soil contains only a small quantity of organic matter or humus. This supply apparently endures a little better when the land is under cultivation than it does in associated light sandy soils. The third layer contains a small quantity of fine material, but is sufficiently compact and colloidal to impede the downward movement of water and to retain moisture, so that the soil, notwithstanding its coarse, pervious substratum, is not so droughty as similar sandy soils. Though commonly acid, in places the soil may give an alkaline reaction, and there is evidence that percentage of calcium, magnesium, and other bases, unusual for a sandy soil, are present. Fragments of shale and limestone are commonly present in the third and fourth layers, and in places are abundant in the substratum.

Mancelona gravelly sandy loam occurs mainly on the high sandy plains in the eastern and southeastern parts of the county. The land is nearly level, except for occasional potholes or shallow depressions. The natural drainage is good owing to the permeability of the underlying deposits and to the great depth to the water table.

Mancelona gravelly sandy loam was originally forested, mainly with hardwoods. Hard maple, beech, elm, and yellow birch were apparently the most common trees, but hemlock and some white pine were intermingled with the hardwoods. Practically all of the merchantable timber has been removed. The unused stumpy, cut-over land is covered by a brushy growth of aspen, pin cherry, and a poor second growth of hardwoods.

Mancelona gravelly sandy loam is perhaps the most productive soil on the dry sandy plains, and a rather large percentage of it is under cultivation. Fair yields of potatoes, red clover, alfalfa, sweet clover, oats, corn, and beans have been obtained. (Pl. 40, fig. 2.) The most dependable cash crop is potatoes. Yields are not high, mainly because of the lack of sufficient moisture during the growing season.

Fertilizers might be used with profit, especially for potatoes. There is apparently no need of liming for leguminous crops at present. The nearly level surface is favorable for extensive farming and the soil is easily kept in good tilth.

RUBICON SAND

Under forest conditions Rubicon sand consists of (1) a 1 or 2 inch layer of leaf litter or mold at the surface; (2) gray or nearly white incoherent sand, ranging in depth from 3 to 15 inches; (3) a layer, varying from 6 to 20 inches in thickness, of sand stained yellow or brown from colloidal organic matter or organic compounds, and which may be slightly coherent or firmly cemented into a hardpan; and (4) pale-yellow or cream-colored sand grading downward into a substratum of somewhat coarser material, which prevails to a depth of several feet. On old cut-over land, especially where it is covered with grass, the topsoil may be darker to a greater depth. There is less fine material in the soil, and less limestone and shale gravel in the substratum than in Mancelona gravelly sandy loam. The plowed soil is gray or light-brown, loose or incoherent sand, poorly

supplied with organic matter or humus, which is soon depleted under cultivation.

This soil is low in the nutrient elements and is markedly acid in all of its layers, although some limestone is present in the substratum material. The brown layer apparently retains a little more moisture than the sand above and below it, but the average content of moisture in this soil is very low.

Rubicon sand occurs on nearly level dry plains. The principal bodies are on the high, dry plains in the southeastern townships of the county on the Mancelona plain, where this material comprises the lighter sandy soil in association with Mancelona gravelly sandy loam.

The original forest cover, which has been almost entirely removed, consisted mainly of white pine or a poor forest growth of mixed white pine, hemlock, and the common hardwoods, and in places a little jack pine. On the old cut-over land, the pine and hemlock stumps remain standing above a cover of grasses (mainly bluegrass), sweet fern, bracken, and low-bush blueberries. In other places where hardwoods predominated, a poor scrubby second growth of aspen, cherry, and red maple has grown up.

Practically none of the land is utilized for farming, and the few attempts in this direction have failed. In the middle of the summer the soils are very deficient in moisture. Pasturage is poor. Probably the best use to make of this soil would be for forestry. The more gravelly areas are possibly more productive and are more like the Mancelona soils.

ANTRIM GRAVELLY SANDY LOAM

Antrim gravelly sandy loam, to a depth of 8 inches, is dark grayish-brown gravelly sandy loam. This is underlain by a layer, from 12 to 18 inches thick, of brown or reddish-brown coherent sandy loam or coarse clay loam with some gravel, and below this is a substratum of more pervious sand and gravel. The soil is darker and contains a little more organic matter and more moisture than Mancelona gravelly sandy loam. In places, at a depth of 2 or 3 feet, there is evidence of poor subsurface drainage. The surface is usually gravelly or cobbly. Most of the soil is alkaline and appears to be moderately fertile.

This soil occurs in narrow filled-in valleys and on gentle slopes or benches bordering lakes. At the mouth of ravines it is composed in part of sediments brought down by streams from the adjacent higher land. For the most part, it is a fairly mature soil, having definite soil layers. Antrim gravelly sandy loam aggregates a rather large total acreage. Small bodies of this soil occur in the western part of the county on the bench land bordering Intermediate Lake, Torch Lake, and Grand Traverse Bay.

The original vegetation consisted mainly of hardwoods, such as hard maple, beech, elm, ash, and yellow birch and scattered white pine. Very little merchantable timber remains.

Where the land is farmed good crops of corn, alfalfa, and potatoes have been obtained. Apples and cherries have also produced fairly well.

OGEMAW SANDY LOAM

Ogemaw sandy loam is characterized by a layer, from 2 to 4 feet thick, of fine sand and medium sand resting directly on heavy and comparatively impervious brown or reddish-brown clay. The profile of the virgin soil from the surface downward shows (1) a rather dark-gray humus layer from 1 to 3 inches thick; (2) a layer, varying in thickness from 4 to 12 inches, of lighter-gray leached sandy material; (3) a layer, from 6 to 12 inches thick, of rust-colored or coffee-brown sand, which is loamy and slightly cemented in places; and (4) leached gray or mottled wet sand or sandy loam material which forms a layer which varies in thickness from 2 to 20 inches. The soil is underlain by a substratum of pale reddish-brown calcareous clay. The plowed soil, consisting of a mixture of the material in the first three layers, is grayish or light brown in color and contains sufficient organic matter and fine particles of mineral matter to have a loamy texture. Newly cleared and plowed land may present a variegated dark-gray, white, and yellow appearance. The land is practically free from stones.

In the areas mapped as Ogemaw sandy loam considerable variation will be found in the thickness of the sand over the clay, and in the thickness, color, and degree of coherence due to cementation by iron compounds and brownish colloidal organic matter.

Small areas of Ogemaw sandy loam occur in the neighborhood of Bass Lake and Torch Lake, and in Kearney and Banks Townships.

The areas are generally undulating and drainage conditions are somewhat variable. The clay substratum retards the movement of water so that depressed areas are poorly drained, but higher areas are moderately well drained.

The forest growth consisted of mixed conifers and hardwoods, now practically all cut. Much of the land has been entirely cleared and is used as pasture and cultivated farm land. Where properly drained it is considered fairly good land for general farming.

BERGLAND LOAM

Bergland loam includes the heavier-textured mineral soils in wet or poorly drained areas. Most of the soil contains a large quantity of organic matter and is loamy at the surface; but in places there is sufficient fine or clayey material to impart a plastic quality. The dark color from organic matter is evident to depths ranging from 6 to 10 inches, and the subsurface material is plastic clay or sand and clay. The water table is generally less than 3 feet below the surface, and the bluish-gray and yellow mottlings, characteristic of poorly drained mineral soils, are found not far below the surface. The soil is alkaline and appears to be fertile.

This soil is unimportant in extent. It occurs as small detached bodies, principally in association with Onaway soils, on flat-bottomed swales between hills or ridges, and also in flat areas bordering lakes and swamps. Coniferous forest growth is predominant, but the forest may consist of a mixture of arbor vitæ, spruce, fir, tamarack, elm, black ash, white pine, basswood, maple, and hemlock. Trees

attain fair size and make dense stands. Most of the land has been partly cut over, but is fairly well stocked with trees.

The land has very little agricultural value at present, mainly because of poor drainage. The soil is farmed where it occurs as patches in fields including other soils. Corn and other crops are much more susceptible to injury from frost than on drier land. Where cleared of trees and brush, the land affords fair pasturage.

SAUGATUCK SAND

Saugatuck sand consists of (1) a surface layer of dark-gray or nearly black loamy material of mixed organic matter and sand a few inches deep; (2) a layer of nearly white, leached incoherent sand; (3) a deeper layer of yellowish or brownish sand which is strongly colored by organic matter and in places is cemented into a hardpan; and (4) a layer of yellowish-brown and grayish-brown, mottled, wet sand. The dark color of the surface soil is probably the result of the poor drainage conditions under which the soil has developed, since it occurs on wet flats where the average depth to the water table is only 3 or 4 feet. The soil is strongly acid throughout and is probably not very fertile. Patches of shallow muck and Newton sand are included in mapped areas of Saugatuck sand.

The total acreage is small, and the soil occurs as a number of separate bodies in the central and western parts of the county.

The land for the most part was originally covered with a forest growth of white pine, spruce, and balsam fir. The tree growth at present consists of aspen, alder, and willow, and bracken fern is conspicuous in the more open places. In a few places, particularly on very narrow strips, adjoining areas of hardwood forest, such trees as hard maple, elm, and beech predominate. The original white pine grew to very large size.

Saugatuck sand is little used for farming. Some timothy hay is grown on it, and it provides fair pasturage where it is cleared of brush.

EASTPORT SAND

Eastport sand, under forest conditions, consists of (1) a surface layer of leaf mold and loose sandy material rich in organic matter, from 1 or 3 inches thick; (2) a layer of gray, loose, or incoherent sand, varying in thickness from 3 to 18 inches; (3) a faintly to fairly well-developed layer, from 2 to 24 inches thick, of yellow loamy sand; and (4) a substratum of pale-yellow or grayish incoherent sand or gravelly sand. Most of the soil material is medium sand, but probably some fine sand is included. The cultivated topsoil is loose, barely coherent when wet, and contains only sufficient organic matter to give the soil a light-brown color. The moisture content apparently does not exceed the average for well-drained sands, and the soil presents no evidence of being very fertile. The surface soil is commonly acid, though in places it is alkaline. A soil less mature and the presence in the substratum of considerable coarse sand and gravel originating from basic rocks, such as limestone, were the distinctions observed in the field between this soil and Rubicon sand. The more gravelly areas of this soil are indicated on the soil map by gravel symbols.

Eastport sand occurs on the nearly level sandy plain or bench along Grand Traverse Bay, and elsewhere in places bordering Elk Lake and Torch Lake. The water table is probably at depths greater than 10 feet.

The original vegetation consisted principally of hardwood trees, mainly hard maple, beech, elm, and ironwood. There was also some hemlock, Norway pine, and white pine. In places some of the original hardwood remains as remnants of the original forest; but over most of the uncultivated land, there is a second growth of red oak, scarlet oak, poplar, red maple, cherry, and white birch.

In a few places, where the land has been brought under cultivation, fair stands of alfalfa and sweet clover have been obtained, and elsewhere cherry and apple orchards do well. Probably the chief deficiency of the soil is its low power of holding moisture. The more gravelly areas apparently represent the more productive land.

GENESEE LOAM, COLLUVIAL PHASE

Genesee loam, colluvial phase, includes soils in swales and in narrow, dry valleys, together with a small acreage of alluvial soil which occurs in valleys occupied by streams. Some of it consists of sediments washed from adjacent slopes and deposited on the margins of the valleys or spread out over their floors. The soil is not very uniform in the texture of the surface soil nor in the nature of the subsurface material. Most of it is light-brown loam or sandy loam not rich in organic matter, which may be underlain by either clay or sand and gravel. It differs from Bergland loam and Saugatuck sand in that it has fair drainage, although wet spots are included in which the soil is not materially different.

The vegetation or forest growth originally possessed no uniformity or distinctive character, but consisted of patches of the common hardwoods or mixed hardwoods, white pine, and hemlock, together with spruce, fir, and cedar in the wetter places. White pine attained a large individual growth. The cutover land is now covered principally with aspen. Most of this kind of soil is found in the hilly or more rolling sections in the central and western parts of the county. The aggregate acreage is very small and the land is comparatively unimportant for farming, although naturally it is a little more fertile than associated higher land, particularly Emmet sand and Emmet sandy loam. Where it is included within the limits of farms, some of the land has been utilized both for pasture and for growing the common cultivated crops of the county.

GENESEE SANDY LOAM, COLLUVIAL PHASE

Genesee sandy loam, colluvial phase, includes the lighter sandy soils, loamy sand, and sandy loam, in the narrow valleys and coves in the hilly, central part of the county, which have received more or less sandy sediments washed from the adjacent higher land. The soil is perhaps a little more productive than the associated soils on higher land, but as the total acreage is not great, it is of little agricultural importance. Most of the land apparently supported a growth of hardwoods and hemlock and some white pine.

BRIDGMAN SAND

Bridgman sand consists of medium and fine incoherent grayish or faintly yellowish sand which is uniform in texture to a depth of several feet. The surface soil is stained dark gray from organic matter, to a depth of 4 inches. Below this, the sand shows a yellowish coloration to variable depths, but it is rarely cemented or coherent. In many places the sand is alkaline, and under natural conditions it apparently contains sufficient plant nutrients and moisture to support a fairly dense and varied growth of trees and shrubs.

Bridgman sand occurs as dunes and recently deposited sands, for the most part directly along the shore of Grand Traverse Bay. The soil has little or no value for cultivated crops, because of its tendency to shift under wind action when the natural protective cover is removed.

Practically all the trees and shrubs common to this region are found intimately associated on the dunes and along the shore of Grand Traverse Bay. Coniferous trees predominate, and white pine, hemlock, and Norway pine grow to fairly large size.

Mapped areas of this soil include some barren beach sand, shifting dunes, and a few small spots of wet dark sand lying in pockets between the ridges of dry sand.

NEWTON SANDY LOAM

Newton sandy loam has a topsoil which contains a high percentage of organic matter and grayish water-logged sand underlying it. It is distinguished from the Bergland soils by its more sandy nature and the greater depth to clay, and it is similar in its drainage and surface features. It was not practicable in the present survey to indicate with precision, fine textural distinctions, and differences between the Bergland and Newton soils; but in general the areas mapped as Newton sandy loam represent the more sandy land.

The soil is slightly alkaline or only slightly acid, and may be fairly fertile; but it is of comparatively small extent and of minor value for farming. It will support a heavy growth of trees.

ORGANIC SOILS (MUCK AND PEAT)

Organic soils are composed largely of plant matter, and in this respect constitute a class distinct from the more common soils which are composed largely of mineral or inorganic matter. In this region organic soils occur in swamps, heath bogs, and marshes. The parent materials of such soils consist of the preserved remains of plants which have grown in successive periods upon a particular site. They have accumulated in such permanently wet places as (1) flats or valley floors, (2) slopes wet from seepage springs, and (3) lakes in which the water is comparatively calm, and the water level not subject to any considerable fluctuations. Those in situations under the first division greatly predominate in Antrim County.

The organic soils vary in their physical and chemical character, in the thickness of various layers, in the depth to the water table, in age, and in the degree of decomposition of the plant remains. Boundaries could not be so accurately determined as with the mineral soils. The total acreage of organic soils comprises 7.6 per cent of the total area of the county.

Organic soils are characterized by low specific gravity, high water-holding power, high specific heat, and much shrinkage on drying. They usually contain considerable nitrogen, little potassium, and variable quantities of calcium (lime) and phosphorus. Most of the organic soils in Michigan are classed as high-lime mucks. Under cultivation, they undergo change from their virgin condition much more rapidly than do mineral soils, and they are peculiar, in that they are combustible. When they are drained the organic layer may be burned off almost completely.

LUPTON MUCK

Lupton muck includes the black and brown loamy or granular mucks which are rich in organic matter, and which are alkaline, nearly neutral, or only slightly acid. The darker soil may continue to a depth of 2 or 3 feet before the usual coarser and less decomposed or more peaty material is encountered, or to the average depth of the water table. In places, the more loamy, granular surface material is underlain at a depth of a few inches by a denser, more compact, plastic material which becomes hard on drying. When compared with Rifle peat and Greenwood peat, there is greater decomposition and disintegration of plant matter in Lupton muck, and a higher content of ash. Most of the deposits range from 3 to 10 or more feet in thickness, and are usually underlain by marl or clay; but in places they may be underlain by sand. Muck of this type is mostly in swamp forest. The vegetation consists of more or less elm, black ash, soft maple, birch, hemlock, white pine, and basswood, intermingled with the predominating arbor vitæ, spruce, balsam fir, and tamarack. The vegetation is dense and junglelike. Where the trees have been cut or have been destroyed by fire, the second growth is of poplar, alder, and willows. Individual trees attain large size and the total volume of growth is greater on this muck than on Rifle and Greenwood peats.

Lupton muck comprises 55 per cent of the organic soil of this county. It occurs mainly in long, winding bodies on the floors of valleys or old glacial drainage ways, most of which are occupied by streams. However, there are also small, irregular bodies on the borders of lakes and on slopes abounding in springs.

There is practically no agricultural utilization of this soil at present other than a limited use of stump land for pasture. Its chief value seems to be in the timber that it can produce.

RIFLE PEAT

Rifle peat is dark-brown or brown, coarsely granular or woody material, very high in organic matter and consequently containing very little admixed foreign mineral matter. It varies in reaction from alkaline to acid. The more decomposed and disintegrated,

darker surface layer usually ranges in thickness from 6 to 12 inches. In the thicker deposits it is underlain by fibrous, or coarser and incompletely decomposed peat. The average depth to the water table is between 1 and 2 feet. The deposits in general are more than 4 feet thick and may be directly underlain by either clay or sand. Marl is present in places.

The vegetation consists of a dense growth of arbor vitæ, spruce, balsam fir, and tamarack, and either the cedar or the tamarack may greatly predominate. Aspen, alder, willow, and red osier dogwood occur also in dense thickets. Some open marshy land is included, which may or may not have been originally forested. Here the surface soil is spongy or fibrous, owing to the growth of sedges and grasses, and is not strongly acid.

Organic soil of this type occurs mostly in valley areas and is similar in origin to the Lupton soil. The difference is apparently a different depth to the water table.

The land has little or no agricultural value other than for the timber it can produce.

GREENWOOD PEAT

Greenwood peat is brown or yellowish, fibrous or coarse-textured peat, which is nearly pure organic matter, exhibiting very little decomposition. It is strongly acid. The water table is normally at the surface or within a few inches of it; but during very dry periods, it may sink as much as 3 feet. The deposits vary in thickness and may attain a depth of 30 or more feet.

Organic soil of this type occurs in heath bogs, in which such plants as leatherleaf, Labrador tea, blueberry, cranberry, and sphagnum moss are present. A small growth of tamarack and black spruce may also appear, and in places there is a dense cover of sedges. Here the surface soil is composed of a feltlike or spongy mat of sedge roots.

Greenwood peat has accumulated mostly in lakes. There are only a few scattered small bodies, and the land has no agricultural value.

EDWARDS MUCK

Edwards muck is dark-brown or black, granular, loamy muck, rich in organic matter, and either markedly alkaline or nearly neutral in reaction. An underlying bed of marl, at a depth varying from 1 to 3 feet, is characteristic of these deposits. In many places the dark, coarse, or woody muck rests almost directly on the marl, with no raw, undecomposed peaty material between.

The principal area is in the valley of Jordan River, in the northeastern part of Echo Township. Smaller scattered bodies occur principally on the borders of the large lakes in the western part of the county.

Most of this muck land is, or was originally, forested with arbor vitæ, spruce, fir, and tamarack, and more or less black ash, elm, hemlock, and white pine. The trees attain a fairly large size.

The land is not utilized to any extent for agricultural purposes, except for pasture where the trees have been cut.

SOILS IN RELATION TO NATIVE VEGETATION

The following table shows the relation of the soils of Antrim County to the native vegetation.

Soils in relation to native vegetation, Antrim County, Mich.

MINERAL SOILS

Soils	Characteristics	Original and later vegetation
Onaway	Loam and sandy loam, underlain by comparatively heavy, alkaline clay at shallow depths; fertile and durable, well-drained soils.	Dense stand of hardwoods, principally hard maple, beech, elm, basswood, ash, yellow birch. Original forest almost entirely removed, except on very small tracts, and small wood lots of hard maple and beech. Land mostly in farms, part in stump-land pasture, with good growth of native and introduced forage plants.
Emmet	Deep, penetrable sandy soils; fair moisture retention; slightly to moderately acid; fair content of calcium and other bases; on rolling or hilly land.	Dense stand of hard maple, beech, elm, yellow birch, hemlock, white pine. Stumps on old cut-over land mainly white pine and hemlock. Good growth of grasses on open stump land. Wood lots composed mainly of hard maple. Old burned-over land grown up to cherry, aspen, white birch, and oak.
Mancelona	Sandy loam and loam, gravelly or cobbly, underlain by brown loamy or clayey layer, and coarse gravelly substratum. Alkaline or not highly acid. Level lands, moderately productive, dry, and well drained.	Hard maple, beech, elm, yellow birch, hemlock, white pine. White pine and hemlock stumps on old cut-over land. Good growth of grasses on open stump land. Wood lots composed mainly of hard maple.
Rubicon	Very thin humus layer; dry, strongly acid sandy soils; low fertility. Level lands.	White and Norway pine, mixed in places with hardwoods. Conifers of fairly large growth; hardwoods only poor growth; cut-over land thickly set with pine stumps. Second growth principally aspen and small oaks. Sweet fern, bracken, and blueberry common. Bluegrass and wild oats or "buffalo grass" principal forage species.
Saugatuck	Dark sandy soils; brownish sand at shallow depths and in places a hardpan; highly acid. Low fertility; poor drainage.	Mainly white pine, with variable quantity of arbor vitæ, spruce, fir, aspen, willow, and alder brush. Very large pine stumps on cut-over land.
Antrim and Ogemaw	Dark sandy soils underlain by sandy gravelly loam or by clay. Fair moisture; not highly acid; moderately productive. Level or gently sloping lands in valleys and on benches.	Mainly beech, hard maple, basswood, elm, and ash, with variable quantity of white pine and hemlock. Cut-over land thickly set with stumps.
Eastport and Bridgman	Loose, dry sands, some in dunes. Not highly acid and frequently alkaline.	Mixed growth of hardwoods and conifers, notable for the great variety of species. Land mostly in dense second-growth and virgin forest. Oaks and white birch common. Poor grass growth.
Bergland and Newton	Dark soils at the surface, comparatively high in organic matter, in part underlain by clay. Alkaline or only slightly acid. Poor drainage, shallow, wet swales and valleys. Level land along borders of lakes and swamps.	Arbor vitæ, white spruce, fir, and aspen with some elm, ash, white pine, hemlock, and basswood. Fair second growth of original species, and culls of original forest, or alder and some willow and aspen.
Genesee sandy loam, colluvial phase.	Light-colored sandy soils, occurring in small bodies in swales and narrow valleys; composed partly of wash from adjacent slopes but not definitely alluvial. Dry to moderately well supplied with moisture.	Mainly hardwoods, white pine, and hemlock. Old cut-over land thickly set with large stumps. Patches of second growth of aspen and cherry.
Genesee loam	Loam or heavier soil partly alluvial, in swales and stream valleys, variable texturally. Not highly acid. Fair drainage. Small bodies and in narrow winding strips. Moderately fertile.	Mixed growth of hardwoods, white pine, hemlock, arbor vitæ, and spruce. Thickly set with stumps where cut over. Good growth of grasses and fair pasture where free from second-growth brush.

Soils in relation to native vegetation, Antrim County, Mich.—Continued

ORGANIC SOILS

Soils	Characteristics	Original and later vegetation
Lupton and Edwards mucks	Dark, loamy, decomposed, high-ash alkaline mucks. Deep or underlain at shallow depths by clay or marl. Water table from 2 to 3 feet below the surface.	Conifer swamp. Intermingled white pine hemlock, ash, elm, red maple, and basswood White pine and arbor vitæ attain large size. Dense growth. Very little herbaceous growth.
Rifle peat	Brown, coarse, loamy, or woody mucks, underlain at shallow depths by fibrous or less thoroughly decomposed peaty material. Alkaline to acid. Water table from 1 to 2 feet below the surface.	Swamp with dense growth of conifers—arbor vitæ, tamarack, spruce, and balsam fir.
Greenwood peat	Brown peaty mucks; fibrous, spongy or felt-like; very slightly decomposed; highly acid. Water table at or very near the surface.	Principally grown up with heath shrubs such as Cassandra, Labrador tea, and blueberries; a variety of sedges, and tamarack and black spruce trees. Sphagnum moss common.

LAND CLASSIFICATION

The classification of the lands in Antrim County may be shown as follows:

Classification of land in Antrim County, Mich.

Grade	Approximate area	Present condition and extent of occupation	Soil type
	Sq. mi.		
A. Moderately fertile, durable, "high lime" soils, not excessively hilly nor stony. Present experience indicates that farming may be carried on with some assurance of success. Lands adapted to a diversity of cultivated crops, dairying, and orchards. Good wild pasture where land is cleared of brush and tree growth.	100	Practically all in farms and owned in small tracts; estimated that 70 or 75 per cent has been cleared of stumps and trees and cultivated. Unplowed land partly in stump pasture, partly in second growth and culled wood lots of hardwoods, a few small lots of virgin hardwood.	Onaway soils and small areas of other soils.
B. Low or only moderate fertility. Both level and steeply sloping land. In part well adapted to special crops such as potatoes. Deficient in moisture, stony, or lacks permanency in productiveness; can be farmed successfully under present conditions with use of fertilizers and with skillful management. Poor or only fair pasture.	150	Mostly in farms or owned in small tracts. Estimated that 40 or 50 per cent has been cleared and cultivated, but many of the fields have been abandoned. Uncultivated land mostly cut-over hardwood forest, with very little merchantable timber remaining.	Mancelona gravelly sandy loam. Antrim. Emmet sandy loam. Emmet sand. (More level and less stony phases.) Eastport. Genesee loam.
C. Low agricultural value or non-agricultural under present conditions because of very low moisture; low fertility combined with excessively steep slopes or rough surface relief. Permanently wet and swampy land which does not justify the cost of reclamation under present conditions. For the most part poor pasture. Including lake surface.	236	Very small percentage in farms. Estimated that less than 5 per cent is cleared and cultivated. A few large tracts of mixed hardwood and hemlock forest remain, but this is in part cut-over land desolated by fires and grown up to a brushy growth of aspen, oaks, pin cherry, and briers; in part a thin growth of original hardwoods and pines. Swamps for most part densely timbered.	Rubicon sand. Bridgman sand. Most of Emmet sand. Bergland loam. Saugatuck sand. Organic soils or muck and peat swamps.

SUMMARY

Antrim County is in the northwestern part of the southern peninsula of Michigan, fronting upon Grand Traverse Bay of Lake Michigan. The area of the county is 486 square miles, which includes about 50 square miles of lake surface. The surface features are varied; there are numerous lakes and comparatively few streams.

Settlement began in the western part of Antrim County about 1850, the earlier settlers engaging in lumbering, in the manufacture of "charcoal" iron, and in trapping. By 1880 the population of the county had increased and agriculture was more extensively practiced. This increase continued until about 1920, when, owing to depletion of the timber resources, the population began to decrease. The Pere Marquette Railway and the Pennsylvania Railroad pass through the county. Bellaire is the county seat.

The climate is characterized by rigorous winters and short, mild summers. The mean annual temperature is 43.3° F.; the average annual precipitation (including melted snow) is 28.32 inches; and the average annual snowfall 88 inches. The frost-free season ranges from about 120 to 150 days.

The sands and sandy loam soils are by far the most extensive in the county. There are also organic soils and small areas of loams, clay loams, and clays. Fifteen types of mineral soils and four of organic soils have been mapped in the county.

The well-drained soils are gray or podsol soils. This group includes Onaway loam, Onaway sandy loam, Emmet sandy loam, Mancelona gravelly sandy loam, Antrim gravelly sandy loam, Rubicon sand, Emmet sand, Eastport sand, and Bridgman sand. The Genesee soils include recently deposited alluvial and colluvial materials. The more poorly drained soils include Saugatuck, Ogemaw, Bergland, and Newton soils. Of the organic soils, Lupton and Edwards mucks and Rifle and Greenwood peats are represented. The well-drained loams and sandy loams are the agricultural soils of the county, and about 50 per cent of such land is cleared and cultivated. The sands and the poorly drained soils are at present little utilized for agriculture.

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