conjunction with proper crop rotation and use of commercial fertilizers in developing a system of permanent agriculture.

SOILS.

The soils of Marinette County are predominantly sandy, ranging from light sand to a moderately heavy loam. The upland soils are very commonly grayish or brownish at the surface, and are generally well drained throughout.

The soils of the county are formed mainly from glacial and alluvial deposits overlying granite, sandstone, and limestone. The glacial deposits are very largely composed of the ground-up material of the underlying bed rock, and hence these soils in the area of the limestone are very largely of limestone debris, and in the areas of sandstone and granite are largely of sandstone and granitic material, respectively. On the other hand, the soils of the alluvial deposits consist largely of sand and gravel without regard to the underlying rock, and are of very similar composition over the entire area.

The granite and other crystalline rock of the northwestern part of the county are the oldest formations and are of pre-Cambrian age. The first formation next overlying the crystalline rock is the Potsdam sandstone, of Middle Cambrian age, whose area of outcrop lies in a belt or zone from 6 to 10 miles wide extending northeast and southwest and reaching in a general way from the vicinity of Wausaukee to Lake Nocque Bay. The next formation above the Potsdam sandstone is the Lower Magnesian limestone, forming a zone 5 to 6 miles wide, lying southeast of the vicinity of Beaver and Left Foot Lake. The next overlying formation is the St. Peter sandstone, extending in a narrow belt about one-fourth to 1 mile wide along the east margin of the Lower Magnesian. The next formation, the uppermost in the county, is the Trenton limestone, forming a zone from 10 to 15 miles wide in the southeast part of the county, extending from the vicinity west of Porterfield to Marinette and the Green Bay shore. Overlying the bed-rock formation are the surface deposits of glacial drift and the alluvial sands and gravel.

In the northern and northwestern part of the county are belts of terminal moraine, characterized by billowy drift hills and
swamps. These belts were formed at the margin of the ice sheets in their retreat across the county, and trend in a northeast-southwest direction. The soils of the terminal moraines generally contain numerous bowlders, these being commonly granite.

A common feature of the southeastern one-third of the county are hogback ridges of gravel or sand "eskers," which were formed by streams flowing in ice tunnels beneath the glaciers. Most of these eskers run in a northeast-southwest direction and usually extend along or through swamps.

The level plains of sandy soil, generally containing more or less gravel in the subsoil, are stratified deposits and were formed in water, which may or may not have been connected with the ice sheets. The sand plains are quite variable in area and have their greatest length in a northeast-southwest direction.

In the northwestern part of the county in the vicinity north and south of Dunbar are small patches of red calcareous clay evidently old lacustrine deposits like those occurring along the shores of Lake Superior and Lake Michigan and in the Fox River Valley.

In this connection may be mentioned the old shore line of Green Bay which extends across the southeastern part of the county and forms the approximate border of the level tract of sand and peat soil lying between Peshtigo and Marinette. This abandoned shore line, 40 feet above the present level of Green Bay and Lake Michigan, was the border of the lake at the Algonquin stage of the Great Lakes. This shore line may be seen near Wilcox Station, also about 2 miles west of Peshtigo, and about 2 miles south of Bagley Junction, whence it turns to the northeast passing through the county 3 or 4 miles north of Marinette and Menominee. It marks a much later stage in the history of the Great Lakes than the one during which the red calcareous clays about Dunbar were deposited.

Considering the geological derivation and process of formation of the various soils, all the principal soils are formed either by weathering of glacial till overlying the bed-rock formation, or by weathering of water-deposited sands in old stream or old lake bottoms. The Miami fine sandy loam is derived from glacial till over the Trenton limestone and the
subsoil consists almost wholly of limestone débris, varying from fine powder to large fragments and boulders, the bed rock being generally from 5 to 20 feet below the surface.

A light phase of the Miami fine sandy loam is derived from glacial till overlying Lower Magnesian limestone, St. Peter sandstone, and the Potsdam sandstone, the subsoil consisting mainly of limestone débris and sand. The Coloma loam is derived from glacial deposits overlying the crystalline formations, and consists wholly of débris of granitic rocks. The Coloma fine sandy loam and the Coloma fine sand are derived from glacial material within the general area of the sandstone and granitic formations, and are largely of terminal moraine deposits. The Superior fine sandy loam is derived from alluvial sand associated with and overlying red lacustrine clay.

The Plainfield sand is derived from the weathering of alluvial sand and gravel overlying various rock formations. The Dunkirk fine sand is derived from the weathering of delta or estuarine sands deposited in former Lake Algonquin, whose shore lines are about 40 feet above the present level of Green Bay.

Of the unclassified soils Peat consists of decomposed humus and marsh vegetation; Muck consists of a mixture of humus with sand and clay; and Rock outcrop consists of areas of abundant rock exposures, mainly of granitic character, in the northern parts of the county.

With relation to the native forest growth developed on the various soils, the nature of which was used as a general index of the character of the soil, the Miami fine sandy loam and the Coloma loam are characterized by relatively dense growths of hardwoods and hemlock, with large white pine in local areas. The Coloma fine sandy loam and the Superior fine sandy loam support a mixture of hardwoods and pine, the pine predominating. The Coloma fine sand is characterized by a growth of pine including white, Norway, and some jack pine. The Plainfield sand is characterized typically by a growth of jack pine and some Norway pine. The Dunkirk fine sand, relatively low sandy land, is characterized by a rather dense growth of white and yellow poplar, soft maple, scrub oak,
white birch, jack pine, some Norway pine, and in low wet places mixed tamarack and cedar.

Below is given a table stating the actual and percentage area of the various soils of the county as shown on the accompanying soil map.

<table>
<thead>
<tr>
<th>Soil</th>
<th>Acres.</th>
<th>Per cent</th>
<th>Soil</th>
<th>Acres.</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coloma fine sand</td>
<td>199,872</td>
<td>22.1</td>
<td>Coloma loam</td>
<td>59,176</td>
<td>6.4</td>
</tr>
<tr>
<td>Coloma fine sandy loam</td>
<td>163,008</td>
<td>18.0</td>
<td>Dunkirk fine sand</td>
<td>29,852</td>
<td>3.3</td>
</tr>
<tr>
<td>Miami fine sandy loam</td>
<td>43,775</td>
<td>17.4</td>
<td>Peat</td>
<td>21,312</td>
<td>2.4</td>
</tr>
<tr>
<td>Light phase</td>
<td>144,048</td>
<td></td>
<td>Superior fine sandy loam</td>
<td>1,738</td>
<td>.2</td>
</tr>
<tr>
<td>Plainfield sand</td>
<td>151,488</td>
<td>18.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muck</td>
<td>129,960</td>
<td>13.4</td>
<td>Total</td>
<td>904,329</td>
<td></td>
</tr>
</tbody>
</table>

MIAHII PINE SANDY LOAM.

The Miami fine sandy loam consists of a gray sandy to silty loam containing some small stone to a depth of 8 or 10 inches, underlain with silty loam containing somewhat larger rock fragments and extending to a depth of 24 to 30 inches. Below 24 to 30 inches stones and boulders are generally abundant. The bed rock of limestone is struck at depths of 3 to 15 feet of the surface over large portions of the area. The loose stone is almost wholly of limestone material from the underlying formation. Stone piles are a characteristic feature over much of the cultivated parts of this type.

The soil type occurs mainly in the town of Grover and in the southern part of Porterfield. It is derived from the weathering of glacial drifts over limestone, and like most soils of glacial origin is somewhat variable in composition from place to place.

The surface varies from gently sloping and undulating to nearly level. The type quite generally occupies upland areas and slopes above the stream beds and swampy tracts. The slopes are so gentle that such objectionable features as rapid soil erosion and gullying are not likely to be developed. They are nowhere too steep for cultivation. Occasionally fields of
this soil type are so level that the use of tile drainage would be beneficial. In general, however, the loose texture of the soil, as well as the undulating surface, gives such good natural drainage that underdrainage is unnecessary. A typical farm on this soil is shown in Plate I.

This soil was originally heavily timbered with hard woods and white pine. The pine has been cut for years, but in many places the hardwoods still remain. The latter consist mainly of sugar maple, birch, and beech, with a variable amount of hemlock, oak, elm, ash, basswood and poplar. Three of the earliest agricultural settlements in the county were established upon this type of soil in the town of Grover. They were locally known as the Lower, Middle, and Upper Sugar Bushes, on account of the abundant growth of sugar maples in the settlements.

The forest growth of white pine and hard woods was not uniformly distributed over this soil. Over considerable areas dense hardwood forests predominated, but in some places, usually in areas of small extent, the white pine grew in great abundance even to the exclusion of the hard woods. Where the pine greatly predominated the surface soil generally contains more sand than elsewhere, but the subsoil conditions are much the same as in areas covered with hard woods.

The groundwater level in this soil is generally from 10 to 30 feet below the surface. Sufficient water for domestic purposes, therefore, can be obtained generally in the drift overlying the limestone or a few feet in the limestone. Occasionally, however, wells are drilled from 50 to 100 feet into the limestone before a sufficient supply can be obtained. Much of the soil is underlain by a clayey subsoil which tends to hold the moisture sufficiently near the surface to be available for the growing of crops.

The Miami fine sandy loam is the most fertile soil in the county, and all the staple farm crops are successfully grown upon it. Oats is the principal grain crop, the acreage greatly exceeding that of all other grains combined. The yield varies from 25 to 40 bushels per acre, the average yield being about 30 bushels. Corn is the next most important crop, the yield per acre being about the same as that of oats. In growing corn on this soil, as well as on other soils in the county, the average length of the period
of immunity from frost should be taken into consideration, and only such varieties selected as will ripen within this period. The Early Yellow Dent (Wis. No. 8) and Golden Glow (Wis. No. 12) as well as flint corn, will ripen within the average period of freedom from frost. Wheat and barley are grown to a slight extent, the usual yield of wheat being 15 bushels and of barley about 20 bushels per acre. Some rye is grown, the average yield being about 16 bushels per acre. The yield of potatoes ranges from 125 to 150 bushels. Pease do exceptionally well, the yield being 15 to 20 bushels per acre. Apples and the various kinds of berries can be readily grown. Sugar beets are successfully grown on many farms.

This loamy soil is especially well adapted to apples. The climatic conditions, due to the moderating influence of Green Bay and Lake Michigan, as well as the character of the soil, with its high content of limestone material, are very favorable to their culture. Most of the apples grown in the county are on this soil type. By properly spraying and otherwise caring for the trees, there are good prospects for the successful raising of such varieties of apples as the Dutchess, Hiberna, Patten Greening, Charlamoff, Longfield, and Wealthy for the home as well as for the market.

Dairying is important on this soil, although only a relatively small number of farmers have silos. The principal feed of cows is mixed hay. Hay is an important crop, averaging about 1 and one half tons per acre. Clover is grown to some extent, but not extensively. Millet and some small grains and corn are occasionally grown for forage. The soil is well adapted to dairying and this industry should be developed. Alfalfa has been successfully grown on this soil, and it should be more widely raised.

Because of its adaptation to all the ordinary crops and because of its location this type constitutes the highest priced land in the county, the prices usually ranging from $50 to $90 an acre.

Light phase.—There is a light phase of the Miami fine sandy loam which is of extensive occurrence. It is found in the southeastern half of the county. The main area lies in a belt trending northeast-southwest through the town of Pound, eastern
MIAMI FINE SANDY LOAM.

Beaver Lake, and northern Porterfield. Isolated areas lie farther west in the western half of Beaver and in Wausau. The surface soil consists of a grayish medium to fine sandy loam, with depth of 6 to 10 inches, resting usually on a brownish fine sandy loam, which extends to a depth of 24 to 36 inches. The character of the subsoil is somewhat variable, ranging from fine sandy loam to a sandy clay mixed with some stones. Below 24 to 36 inches there is generally a mixture of sand, gravel, and boulders. This phase of the Miami fine sandy loam contains more sand and less stone than the other phase of this soil. Usually the more clayey phases of the soil are the most stony.

The surface is usually very gently sloping, though in places it is undulating to hilly. The more undulating areas are in the vicinity south of the village of Wausau and in the western part of the town of Beaver. Even in the most uneven areas, however, the slopes are not too steep for cultivation. Over most of the areas in the towns of Pound and eastern Beaver Lake the surface rises gently from 10 to 40 feet above the adjacent low tracts and swampy areas along the stream beds.

The soil has its origin in the weathering of glacial drift over a sandy limestone and sandstone. Being derived from glacial drift, it is somewhat heterogeneous in character and the texture and composition of the subsoil lacks uniformity. The lower Magnesian limestone formation which underlies the main area of this soil contains considerable sand, and the weathering of the glacial débris worked up from this formation has resulted in a soil consisting of sand and limestone material varying in fineness from flour and small fragments up to large boulders of lime rock. Mixed with the local limestone are a few boulders of crystalline rock derived from more distant sources. Along the streams, especially the larger ones, such as Beaver Creek, Little Peshtigo River, and Peshtigo River, these are sandy tracts due to the action of these streams. In the areas of this soil are some gravel and sand ridges, locally known as “hogbacks,” which owe their origin to glacial streams flowing in tunnels beneath the glacial ice sheets. Most of the important sandy tracts along the streams and the sand and gravel ridges of subglacial origin are shown on the soil map.

Probably about one-third of this light phase of the type is
under cultivation. Originally it was covered with dense hardwood and white-pine forests. In some areas the pine greatly predominated, in others the hardwoods. The principal hardwoods are beech, maple, and birch, with a variable amount of hemlock, oak, elm, and basswood.

The level of ground water is quite generally from 10 to 40 feet below the surface. Abundant water for all domestic purposes can usually be obtained from the surface formation overlying the bed rock. In some places the wells penetrate the underlying formation of limestone.

About the same crops are grown on this light phase as on other parts of the Miami fine sandy loam. Oats constitute the principal grain crop with wheat next in importance. Potatoes are also an important crop. The yield of oats per acre varies from 30 to 40 bushels and potatoes from 125 to 195 bushels per acre. Barley is grown to some extent, yielding between 20 and 30 bushels per acre. Peas do exceptionally well, yields of 25 to 35 bushels per acre being often reported. Hay is a good crop, mixed clover and timothy usually yielding 2 to 3 tons per acre.

Dairying and stock raising are not as important as they should be. While there are two or three cheese factories within the area of this soil, the average amount of milk obtained from the cows is small, as compared with average conditions over the State. The breed of milch cows should be improved and more attention paid to care and feed of the herds.

The farm values usually vary between $50 and $85 an acre for improved land and about $15 to $20 for unimproved land.

The following table gives the average results of mechanical analyses of the soil and subsoil of the Miami fine sandy loam:

---

**Mechanical analysis of Miami fine sandy loam.**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Pine gravel</th>
<th>Coarse sand</th>
<th>Medium sand</th>
<th>Fine sand</th>
<th>Very fine sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>22753, 22755</td>
<td>Soil</td>
<td>0.9</td>
<td>5.9</td>
<td>9.4</td>
<td>24.6</td>
<td>18.5</td>
<td>38.1</td>
<td>7.4</td>
</tr>
<tr>
<td>22754, 22756, 22759</td>
<td>Subsoil</td>
<td>1.7</td>
<td>7.0</td>
<td>8.4</td>
<td>24.5</td>
<td>19.5</td>
<td>27.5</td>
<td>11.1</td>
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<tr>
<td>Light phase:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22745, 22747, 22751</td>
<td>Soil</td>
<td>0.7</td>
<td>6.2</td>
<td>12.5</td>
<td>29.4</td>
<td>14.8</td>
<td>29.9</td>
<td>6.3</td>
</tr>
<tr>
<td>22746, 22748, 22752</td>
<td>Subsoil</td>
<td>1.3</td>
<td>7.3</td>
<td>13.3</td>
<td>28.7</td>
<td>16.5</td>
<td>22.7</td>
<td>10.2</td>
</tr>
</tbody>
</table>
COLOMA FINE SAND.

The Coloma fine sand, to a depth of 8 to 12 inches, consists of yellowish-brown fine sand. The subsoil, to 36 inches, is a yellow fine sand, which becomes slightly coarser in the lower depths. In the lower subsoil rock fragments and boulders are sometimes found, and to some extent these are scattered over the surface. This type owes its origin to the last ice sheet and is largely cleared from terminal moraine. In some places it does not differ materially from the Plainfield sand, except in topography, which in the case of the fine sand is rolling to moderately hilly. Natural drainage is good; in fact there is more likelihood of excessive drainage than of lack of drainage.

The fine sand is preeminently the pine soil of the area, it having been originally covered with a heavy growth of white pine, with some Norway. At present, the timber growth consists largely of scattered white pine, considerable Norway pine, and in some local areas jack pine and small oak. Like the Coloma fine sandy loam, the fine sand occurs in northeast-southwest belts, with alternating areas of Plainfield sand, the latter mainly representing an older soil covering of the region on which the fine sand was deposited by the latest ice sheets.

Also like the Plainfield sand and Coloma fine sandy loam, the Coloma fine sand is in a practically undeveloped state. Nearly all these types, together with the Coloma loam, Superior fine sandy loam, Muck, and Peat, are in their virgin state, except that the timber is largely removed. On the surface of much of the upland areas is found a layer from one-half inch to 2 inches in thickness, of dark or black material, representing accumulations of organic material.

The Coloma fine sand, like the Plainfield sand, is probably best adapted to a system of general farming restricted to certain grain crops and to dairying. It is a typical truck soil, but under the present condition of agricultural development and settlement of the region, location of markets, etc., it can not be utilized to advantage for the growing of truck. It is a soil which needs "body" added to it in the shape of manure and green crops plowed under. Early maturing crops, such as green corn, peas for canning, tomatoes, cucumbers, etc.,
should do well on this type. At present it gives moderate yields of excellent potatoes, and fair yields of rye, mixed hay, oats, and corn.

By proper management the farms on this soil can be made to yield good returns, many thrifty farms having already been developed upon it. Legume crops, to add nitrogen to the soil, should be included in the crop rotation. Following clover, good crops of peas and beans can probably be grown.

Average yield on the Coloma fine sand are about as follows: Corn, 20 to 35 bushels; oats, 25 to 35 bushels; peas, 12 to 18 bushels; potatoes, 100 to 150 bushels; and rye, 12 to 18 bushels. Practically no barley or wheat is grown.

Unimproved or wild land is held at about the same price as the Plainfield sand, viz., $5 to $20 an acre. Improved farms are sold at $30 to $50 an acre.

The following table gives the average results of mechanical analyses of the soil and subsoil of this type.

**Mechanical analysis of Coloma fine sand.**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Fine gravel</th>
<th>Coarse sand</th>
<th>Medium sand</th>
<th>Fine sand</th>
<th>Very fine sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>22,733, 22734</td>
<td>Soil .........</td>
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<td>14.6</td>
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<td>5.2</td>
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<tr>
<td>22,735, 22736</td>
<td>Subsoil .......</td>
<td>1</td>
<td>4.6</td>
<td>13.6</td>
<td>41.9</td>
<td>29.9</td>
<td>7.1</td>
<td>2.4</td>
</tr>
</tbody>
</table>

**COLOMA FINE SANDY LOAM.**

The Coloma fine sandy loam has a top soil, 10 to 12 inches deep, of yellowish-brown, smooth, mellow, fine, to medium sandy loam. The subsoil to a depth of about 24 inches is a light-colored sandy loam, while from 24 to 36 inches is found a light yellow medium sand. The type is by no means uniform, being of glacial origin, and varies from neary pure sand to a heavy sandy loam. The major portion, however, is as described above.

The Coloma fine sandy loam is a terminal morainic type, and has a rolling to hilly topography. It is naturally well drained, but is rarely too hilly to be easily cultivated. Stones and bowlders are more or less plentiful, but seldom occur in
such quantities as to interfere with cultivation. This soil, like most of the important types in Marinette County, lies in north-easterly-southwesterly belts, that being the general distribution of the formations left by the last sheet of ice.

The timber growth is mixed pine and hardwood, being largely white and Norway pine, white birch and red oak. Hemlock, basswood, maple, and elm do not thrive as they do on the heavier Miami fine sandy loam and the Coloma loam.

Very little of the Coloma fine sandy loam is under cultivation, as is true of all the types in Marinette County, with the exception of the Miami fine sandy loam and the Dunkirk fine sand. The home of a new settler on this type is shown in Plate II. However the few farmers located on the type are well satisfied with it and report fair yields, as follows: Oats, 20 to 40 bushels; potatoes, 100 to 200 bushels; pease, 15 to 20 bushels; and hay, 1 ton to 1½ tons. This soil, like practically all the other sandy soils in the county, is low in organic matter, and after the first few years of cultivation should be liberally manured. Potatoes are the crop probably best suited to this type, and rye, buckwheat, and bush fruits should be profitable crops. The incorporation of organic matter should not be neglected, as is so often the case in newly settled districts, because of the scarcity of stock. Crops of rye, vetch, and clover, plowed under, preferably in the fall, would greatly benefit and build up such soils. One or more legumes should be included in the rotation, and all manure carefully saved and used. By judicious management the soil can be made to increase instead of decrease in productiveness and value. At present the Coloma fine sandy loam can be bought for $10 to $20 an acre in an uncleared state. The improved lands sell from $40 to $60 an acre.

The following table gives the average results of mechanical analyses of the soil and subsoil of this type:

**Mechanical analyses of Coloma fine sandy loam.**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Fine gravel</th>
<th>Coarse sand</th>
<th>Medium sand</th>
<th>Fine sand</th>
<th>Very fine sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>22741.22749</td>
<td>Soil</td>
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<td>6.5</td>
<td>10.8</td>
<td>20.4</td>
<td>20.6</td>
<td>34.0</td>
<td>6.8</td>
</tr>
<tr>
<td>22749.22750</td>
<td>Subsoil</td>
<td>1.4</td>
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<td>17.6</td>
<td>24.0</td>
<td>32.9</td>
<td>7.2</td>
</tr>
</tbody>
</table>
PLAINFIELD SAND.

The Plainfield sand to a depth of 6 to 8 inches, consists of yellow medium to coarse sand, sometimes slightly loamy. From 8 to 36 inches the material is a yellow medium to coarse sand, growing lighter in color and coarser in texture with depth. Some pebbles and fine gravel are found in the lower subsoil.

As a whole, the soil is free from stones and boulders, although outcrops of rock are sometimes found within the general soil area, and also an occasional erratic or glacial boulder. The material composing this type was deposited by streams, and probably antedates the soils in the area which were formed as a result of the latter glacial action.

The soil is locally known as “sandy land,” “jack-pine land,” “sand plains,” etc. The typical timber growth consists of jack pine and scrub oak, with occasionally some Norway and a very few white pines. The surface of the ground is usually covered with brake, sweet fern, blueberry bushes, and wild oat grass.

Jack pine is characteristic of the type. The jack pine occurs sometimes on other soils, but only to a limited extent, the medium to coarse sand being its natural habitat.

The topography is level to gently rolling, being usually nearly level, as its alluvial origin would indicate (Pl. III, fig. 1). In some localities, however, as in the area southeast of High Falls, windformed dunes occur in such numbers as to give the type a rolling surface. These dunes are often of slightly finer texture than the soil of more level areas, consisting of clean, loose sand, and are considered less valuable than the main type. Other and larger sand hills occur less frequently, being eskers, or deposits formed by glacial water under ice.

The Plainfield sand is an extensive type, covering an area of 151,488 acres, or 16.8 per cent of the county. Although the surface is level to undulating, the porous character of the soil and the depth and coarseness of the subsoil give good natural drainage. The level character of the land and the comparative ease of clearing often impress newcomers, especially those from the prairie States, so favorably that they purchase farms on this type in preference to those supporting hardwood, although the prices may be nearly the same. Satisfactory yields
Fig. 1. TYPICAL VIEW OF PLAINFIELD SAND, UNDEVELOPED, JACK PINE PLAINS. SEC. 4, T. 36, R. 20 E.

Fig. 2. VIEW OF FARM DEVELOPED ON THE PLAINFIELD SAND. SEC. 5, T. 34, R. 20 E.
Fig. 1. VIEW OF COLOMA LOAM SHOWING TYPICAL DENSE HARDWOOD FOREST NEAR GOODMAN.

Fig. 2. VIEW OF NEWLY CLEARED FIELD ON COLOMA LOAM AT GOODMAN.
can be produced on the Plainfield sand only with heavy applications of manure. Green manures, especially legumes, are highly beneficial and should be more generally used. A common mistake is to grow several crops of oats or other grains upon newly cleared land, thus reducing the productiveness to a low stage before a system of building up the soil by growing clover and other legumes is begun. By proper farm management good stands of clover can be produced. Clover can be followed by a money crop which will do well. The bean crop, though rarely grown on this soil in Marinette County, is well adapted to sandy soils of this character and could be grown with profit.

While a good living can be obtained by farmers on this soil, it should be emphasized that the type is not especially productive and that care should be taken at the outset not only to maintain the original productiveness of the land but to practice some system of farming that will tend to increase this productiveness from year to year. That prosperous farms can be developed on the Plainfield sand, when rightly managed, is shown by the presence of some thrifty farms in a number of places. (Pl III, fig. 2.) At the same time there are some abandoned farms on the type which may be expected with poor management.

The type seems best adapted, when operated along general lines, to potatoes, rye, and clover. Fair crops of potatoes are readily grown, the tubers being of excellent quality. More satisfactory yields of buckwheat and rye are secured under the prevailing farm management than of oats or corn. The type is entirely too light for either wheat or barley or sugar beets, although what few beets are grown on the light soils in the area have the compensating factor of a higher sugar content.

But little corn is grown on this type, and much of the product is used for fodder. Twenty to 30 bushels per acre is a good yield. Other crops yield as follows: Oats 20 to 30 bushels; rye, 10 to 15 bushels; buckwheat, 12 to 15 bushels; peas, 10 to 15 bushels, hay, three-fourths ton to 1 1/2 tons; and potatoes, 75 to 150 bushels per acre. A rotation quite commonly followed is corn or potatoes, oats, and hay, the mowing lands being left as long as they are considered profitable. Rye usu-
ally is put on the new fields, followed by corn or potatoes. A rotation better adapted to this type would be potatoes, field peas, and mixed hay, leaving the sod not longer than two or three years. The peas could be sold at a good price, the oats or other concentrates purchased. As more land is broken up and more stock kept, fodder corn could be grown in the same place in the rotation as potatoes. This rotation is only tentative; more satisfactory ones may be suggested by practice. There is no question, however, that better rotations than of corn, oats, and grass, leaving the grass down for a long period, can be worked out and used on this soil.

At present prices for the Plainfield sand range from $5 to $18 an acre for "wild" or unimproved land, depending on the location, and $30 to $50 for cleared land.

The following table gives the average results of mechanical analyses of the soil and subsoil of this type:

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Fine gravel</th>
<th>Coarse sand</th>
<th>Medium sand</th>
<th>Fine sand</th>
<th>Very fine sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>22727, 22729, 22731, 22733</td>
<td>Soil ....</td>
<td>0.5</td>
<td>17.8</td>
<td>30.9</td>
<td>33.9</td>
<td>5.8</td>
<td>6.5</td>
<td>4.5</td>
</tr>
<tr>
<td>22728, 22730, 22732, 22740</td>
<td>Subsoil</td>
<td>.5</td>
<td>17.2</td>
<td>31.1</td>
<td>38.8</td>
<td>6.5</td>
<td>2.7</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**DUNKIRK FINE SAND.**

The soil of the Dunkirk fine sand consists of a gray to dark brownish-gray fine sand to fine sandy loam, with a depth of 8 to 10 inches. From this depth to about 18 inches occurs a pale yellow fine sand and from 18 to 36 inches a brighter yellow, fine sand, sometimes slightly mottled.

The topography is level to gently undulating, although in some local areas sand dunes and eskers are so numerous as to give a hummocky surface. The type seems to be a delta deposited in glacial Lake Michigan or Lake Algonquin by streams from the ice sheet to the north and west. There is only one area of this character in Marinette County. It extends from a few miles north of Marinette south along Green Bay to the county
DUNKIRK FINE SAND.

line and is about 6 miles wide. Beyond the county limits it reaches south along the shore nearly to the city of Oconto, retaining practically the same width as in Marinette County. The western edge of this area is somewhat more loamy than the rest, being influenced by the Miami sandy loam. The old beach line of Lake Algonquin constitutes the boundary and is sharply defined in only a few places, being about 40 feet above the present level of Lake Michigan, while the average elevation of the Dunkirk fine sand is probably about 10 to 20 feet above the lake.

In its primitive state this type was covered with a thick growth of jack pine, red oak, and white birch, white and yellow poplar, and some white and Norway pine, and in the wet places with tamarack and cedar. Many scattered areas of Peat, slightly lower than those of the surrounding soil, occur. These, when cleared, or where not forested, are used for hay, of which from three-fourths ton to 11/2 tons per acre of rather coarse quality is secured. Where forested, peat supports tamarack, cedar, alder, and a little elm, birch, and ash. The Dunkirk fine sand, as a whole, has a very flat surface. The water level is only 5 to 10 feet below the surface, and in many minor depressions the soil shows grayish white mottling, due to imperfect drainage. In wet seasons the higher lying fields give much the better results, while in dry seasons the reverse is true.

This soil is a typical truck soil, but it is used at the present time mainly for general farming. Rye, hay, and potatoes are the leading crops; oats and little corn practically complete the list. The average yield of rye is 15 to 18 bushels; of hay 1 to 2 tons, and of potatoes from 100 to 125 bushels per acre. Oats do not yield especially well, ordinarily 20 to 30 bushels per acre. Corn yields from 25 to 40 bushels, depending largely on the season.

Owing to its proximity to the towns of Marinette, Menominee, Mich. and Peshtigo, to its productiveness under judicious management, and ease of cultivation, the Dunkirk fine sand is held at rather high prices—from $50 to $75 an acre. It is a type which responds readily to manure, and this fact, together with its nearness to market, makes the keeping of cattle especially profitable. Dairying, mainly for the production of butter, is prominent on this type. A few are starting in the truck business on a small scale and doubtless in a short time the adapt-
ability of this soil to the trucking industry will be more clearly recognized, and an important business will be developed, with the cities of Marinette and Menominee as the primary markets. Chicago and North Western Railway traverses the type, and this fact, together with direct water transportation to Milwaukee, Chicago, and other large Lake cities, will have an important bearing on the development of the soil in the production of the less perishable kinds of truck crops.

The following table gives the average results of mechanical analyses of the soil and subsoil of this type:

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Fine gravel</th>
<th>Coarse sand</th>
<th>Medium sand</th>
<th>Fine sand</th>
<th>Very fine sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>22717, 22719, 22721, 22722</td>
<td>Soil</td>
<td>0.1</td>
<td>0.6</td>
<td>2.9</td>
<td>59.8</td>
<td>18.5</td>
<td>11.8</td>
<td>6.0</td>
</tr>
<tr>
<td>22718, 22720, 22722</td>
<td>Subsoil</td>
<td>0.0</td>
<td>0.2</td>
<td>5.4</td>
<td>73.6</td>
<td>16.3</td>
<td>2.5</td>
<td>1.8</td>
</tr>
</tbody>
</table>

**SUPERIOR FINE SANDY LOAM.**

The soil of the Superior fine sandy loam consists of 6 to 8 inches of gray to reddish medium textured sand. Underlying the sand, and rather sharply separated from it, occurs a stiff, tenacious, very impervious red clay, the red color having a peculiar pinkish red or light chocolate tinge. The clay subsoil is lacustrine in origin, having doubtless been laid down at the same time as the Superior clay near Green Bay, Duluth, and Superior. The sandy topsoil is of latter glacial origin, having been deposited on the clay by subsequent glacial action. This covering of sand is of varying thickness; in some places the clay subsoil lies practically at the surface, while in others the sand is 2 feet deep.

This type is found only in limited areas in Marinette County. The different isolated patches, north and south of Dunbar, evidently lie in an old drainage basin or depression. In general the topography is level to gently undulating, but the soil is nevertheless fairly well drained, as is indicated by the original timber growth of white pine.

The Superior fine sandy loam is a very good general farming soil. Its areal extent in Marinette County is so limited.
as to make it comparatively unimportant, but it is known to be well adapted to clover and timothy for hay and pasture, to potatoes, and root crops. It is especially suited to strawberries and raspberries and other bush fruits. Some such special industry will doubtless be developed on it in time, as the mining country to the north furnishes an excellent market for the fancy as well as the staple farm products.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

`Mechanical analyses of Superior fine sandy loam`

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>22757</td>
<td>Soil</td>
<td>0.3</td>
<td>5.5</td>
<td>14.7</td>
<td>52.3</td>
<td>13.6</td>
<td>11.1</td>
<td>3.2</td>
</tr>
<tr>
<td>22758</td>
<td>Subsoil</td>
<td>0.0</td>
<td>0.4</td>
<td>1.0</td>
<td>3.3</td>
<td>4.0</td>
<td>53.6</td>
<td>37.7</td>
</tr>
</tbody>
</table>

**COLOMA LOAM.**

The soil of the Coloma loam is a brownish fine sandy to silty loam, with a depth of 6 to 8 inches. The surface 2 or 3 inches often has a grayish color. From 8 to 18 inches the subsoil consists of brown sandy loam to loam. Below 18 inches there occurs an increase in the content of sand, and the subsoil as a whole is generally lighter and more sandy than the surface soil. Throughout the soil and subsoil are found many stones and boulders.

This stony loam soil, which is known locally as heavy hardwood land, lies in the northwestern part of the county. It is derived from the weathering of glacial drift overlying granitic rocks of various kinds. The surface is very gently undulating. There is a difference of 10 to 50 feet between the elevation of the lower lands along the streams and the adjacent higher land, but the gentle slope as well as the character of the soil tends to prevent damaging erosion.

This soil covered with dense forests of hardwoods and hemlock (Pl. IV fig. 1), has a wide extent over Forest County and the adjacent region to the west. In Marinette County it is undeveloped agriculturally, and is still heavily timbered with hard-
woods and hemlocks, mainly the latter-named tree. Prominent among the hardwood species are sugar maple, birch, elm, oak, and some basswood. Inroads upon the forest are now being rapidly made by the lumber companies at Goodman and Wausaukee. There are one or two farms upon the type in the vicinity of the village of Goodman. (Pl. IV, fig. 2.)

The level of ground water in this soil is probably from 10 to 50 feet from the surface, and sufficient well water for domestic purposes can very generally be obtained from the drift overlying the hard crystalline rock. The water is excellent, being typical soft water.

The Coloma loam, as just stated is still a virgin soil, unopened to agriculture. The dense stand of hardwoods found upon it, however, is a good indicator of considerable natural fertility. The excessive quantity of stone in places is an objectional feature. On almost every section are areas too stony for successful cultivation, but such stony areas are generally small and can be conveniently devoted to wood lots or pasture lands, and most of the type is sufficiently free from stone to be used for farming.

All the general farm crops can be grown on this soil, but it is probably best adapted to potatoes, oats, rye, peas, clover, and grasses. It is a favorable type for dairying, and a system of agriculture built about dairying as a leading industry is probably the most promising. Corn for ensilage and also other forage crops can be grown successfully. By developing dairying as a leading industry, and giving some attention to sheep raising, the productiveness of the farms can be maintained or increased.

The hardier varieties of apples can undoubtedly be grown for home use, and all kinds of garden berries and vegetables can be produced.

No values can be given for cleared farm lands on this type. Unimproved cut-over lands containing little or no merchantable timber, are held at $5 to $15 an acre.

The following table gives the average results of mechanical analyses of the soil and subsoil of this type:
MUCK.

Mechanical analyses of Coloma loam.

<table>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>22723, 22725</td>
<td>Soil</td>
<td>0.4</td>
<td>3.5</td>
<td>5.5</td>
<td>9.4</td>
<td>19.9</td>
<td>52.2</td>
<td>8.6</td>
</tr>
<tr>
<td>22724, 22726</td>
<td>Subsoil</td>
<td>1.1</td>
<td>5.1</td>
<td>7.6</td>
<td>12.8</td>
<td>24.6</td>
<td>40.1</td>
<td>7.8</td>
</tr>
</tbody>
</table>

Muck consists of a mixture of organic matter with a relatively small though varying proportion of mineral materials. It has been formed in areas of deficient drainage where a rank vegetation flourished. The organic part of the soil represents the accumulated decaying remains of plants and the mineral portion the more or less finely comminuted rock particles carried into the depressions by streams or by the wind. The deposits are often many feet in depth.

The Muck is generally in a swampy condition. There are many such areas in Marinette County. They usually lie along the smaller streams, but occasionally form interstream areas of considerable extent.

Some of the wet lands along the streams are treeless and called "hay marshes" while other, generally overflow land, support a growth of swamp maple, alder, white birch, and water elm. Much of the marsh and swamp areas comprise soils ranging texturally from Muck to sandy loam, the determining factor in separating this type being lack of drainage rather than texture. When drained some of the areas of swamp will be practically the same as the surrounding type, while others will be more like true alluvial soil. Some of the overflow lands are very fertile and when cleared and drained will constitute the best soils on many farms. A few areas were cleared and used for wild hay.

In addition to the swamps along the rivers and small streams, there are numerous swamps of greatly varying size, over interstream areas, paeically all of which are covered with a more or less valuable growth of cedar, tamarack, or both. The largest of these forested swamps does not exceed 4 square miles in area,
and most of them could be drained, adding a large area to the valuable agricultural land and taxable resources of the county.

None of the heavy black Muck in the county is under cultivation, but when drained this type is valuable for truck crops, such as celery, onions, spinach, lettuce, and peppermint.

PEAT.

Most of the Peat in Marinette County is situated in the southeast corner adjacent to, or surrounded by, the Dunkirk fine sand. Locally the areas are called "peat bogs" or "hay marsh," to distinguish it from the swamps in which cedar or tamarack is always found. The true Peat is a level, usually treeless expanse, very wet in the spring and early summer, and supporting a rank growth of marsh grass, cat-tails, mosses, and other water-loving plants and shrubs.

The soil in these areas consists of organic matter in various stages of decomposition, and of varying depth, underlain by a medium to coarse grayish-white sand. The average depth of the organic material is about 2 feet. In places this covering has largely the character of Muck, but for the most part it is more accurately described as Peat, being a brownish or dark brown mass of partially rotted moss, leaves, and other vegetable remains of a spongy, coarse consistency.

Much greater progress has been made in developing this type than in the case of Muck, owing to the proximity of the former to the cities of Marinette and Peshtigo. About 2 miles west of Marinette a number of progressive farmers have formed a drainage district and have successfully drained a large area of Peat by digging a deep canal through it. Considerable difficulty has been experienced during the last year, however, owing to filling in of the ditches by sand, brought in by seepage waters from the sides. Diking or riprapping may have to be resorted to.

The State experiment station has had a cooperative station located on the Peat west of Marinette. Various experiments have been conducted there by the resident farmer, under direction of the station.

Where farmers have both the Peat and the sandy soils it is best to reserve the manure to be used on the sandy soil and ap-
Summary.

The summary mentions several important points:

1. Phosphorus: It is necessary to supply wood ashes and phosphate fertilizers to the Peat, because the sandy soils are benefited by all the constituents, especially the nitrogen contained in the manure, while the Peat, rich in nitrogen, responds to the potash, phosphate, and lime contained in the ashes. The ashes can be obtained in considerable quantities from the mills in Marinette and Menominee.

2. Rock Outcrop:
   - There are a few local areas in Marinette County in which ledges of the underlying rock outcrop in sufficient number to make such areas practically worthless for agricultural purposes. These have been shown on the map by symbols but are included in the areas of other soil types. The principal areas of this character occur in Tp. 37, R. 21, Tp. 38, Rs. 20 and 21, and Tp. 37, R. 18, although there are several smaller areas in other townships in the northern part of the county. The material composing these outcrops is mostly red and gray granite, and to some extent greenstone.
   - In the areas mentioned above, the rock does not appear at the surface over the entire area, but does appear so frequently and is often so near the surface in the spaces between the actual outcrops, that little can ever be done with the land agriculturally. The only practical use is for forestry or pasturage. Outcropping ledges are by no means uncommon all over the area underlain by crystalline formations, which embrace approximately the northern three-fifths of the county, but except where indicated on the map, are so infrequent as to be practically negligible.

3. Summary:
   - Marinette County is located in the northeastern part of Wisconsin, and has an area of 1,413 square miles.
   - The surface varies from nearly level plains to low undulating hills. The altitude adjacent to Green Bay is 580 feet, and in the northwestern part of the county about 1,500 to 1,600 feet. The drainage is through the Menominee and Peshtigo rivers.
   - The climate is rigorous in winter and warm in summer, the mean winter temperature being 15.7° F., and the mean