SOIL SURVEY OF THE MUNISING AREA, MICHIGAN.

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LOCATION AND BOUNDARIES OF THE AREA.

The Munising area lies in the north-central part of the upper peninsula of Michigan, and borders the southern shore of Lake Superior. It comprises all of the northern part of Alger County, with the exception of Burt Township, and includes T. 46 N. to T. 48

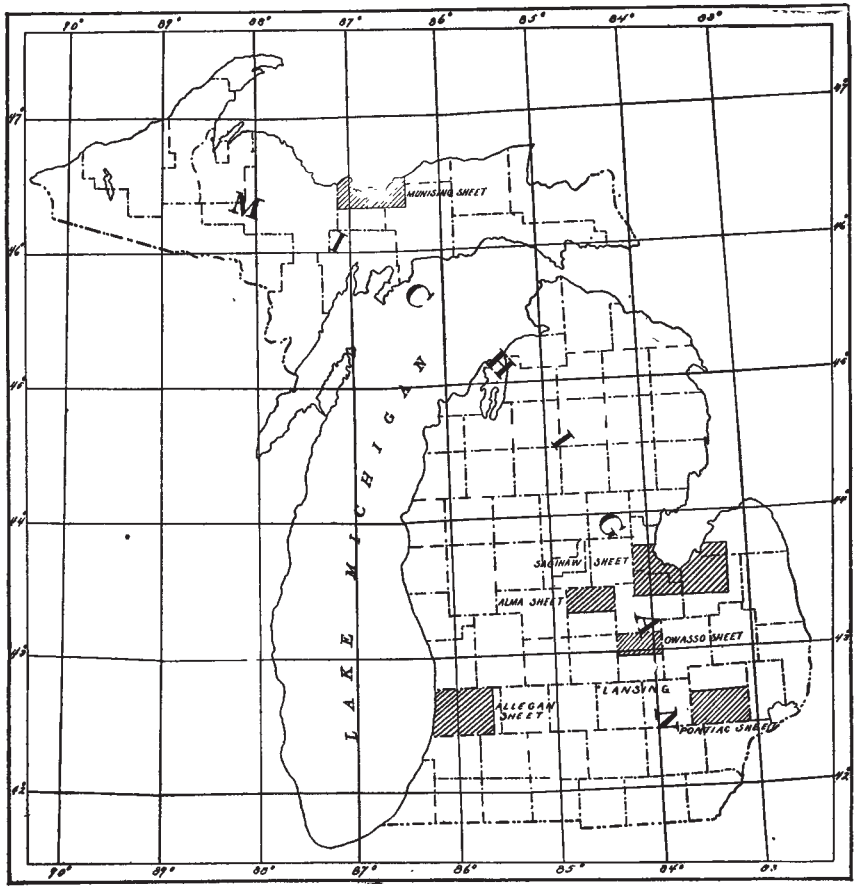

FIG. 24.—Sketch map showing location of the Munising area, Michigan.

N., R. 17 W. to R. 22 W., inclusive. Grand Island, with an area of about 13,000 acres, and several smaller islands near the coast are a part of the area surveyed. The total land surface of the area is 260,608 acres, or, approximately, 407 square miles.

Munising, a town of about 3,000 inhabitants, is the county seat of

Alger County. It has a splendid location on Munising Bay, which is the best natural harbor on the Great Lakes. Chatham, Wetmore, Autrain, and Shingleton are small towns engaged principally in the lumber business.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

Farming has not yet become the occupation of any considerable number of the inhabitants of the Munising area, yet the possibilities of the soil have been demonstrated and a beginning made that augurs well for future development. Alger County was formed in 1885 from a part of Schoolcraft County, and Autrain, the largest lumbering village of the new county, was chosen as the county seat. In order to understand properly the subsequent development of the county it is necessary to know the conditions that prevailed at that time and to understand something of the earlier history of the county. The first commercial enterprise in the area was the marketing of the pine timber, but as there was little pine in the northern part of the present county of Alger this industry was short lived. Later the demand for charcoal to be used in the manufacture of charcoal pig iron led to the consumption of vast quantities of hardwood. Iron was made at two points on Munising Bay, for which the charcoal was prepared in the vicinity, while the ore was brought by water from the iron region about Marquette. When the available timber was consumed the manufacture of iron was transferred to the vicinity of the iron mines, but the burning of charcoal continued to be an important industry of the area until after the formation of Alger County. In the meantime other lumbering industries had started. Cedar was cut for ties, poles, and posts, and the hardwoods for lumber for the wood-working plants. The construction in the iron regions of large charcoal furnaces for the destructive distillation of the wood and the utilization of the by-products made the smaller kilns unprofitable, and it is now necessary to transport the wood to the furnace. The Munising Railway was built in 1895, largely for the purpose of exploiting the dense hardwood forests through which it passes. The town of Munising grew up at the railroad terminal on Munising Bay, and in 1900 the county seat was removed from Autrain to Munising.

Agriculture was begun in a small way about the lumbering towns, but as few of the inhabitants made agriculture their sole occupation the spread of farms was slow. Too often homesteads were taken in the public lands, to be abandoned as soon as the timber could be sold. The little farming that was done was so inefficient that it was productive of no good results and discouraged prospective immigrants. In 1900 the legislature established an experiment station on the upper peninsula, and Chatham was chosen as the site. The

resources of the station have been small, but under efficient management much has been done to demonstrate the agricultural possibilities of the region. Encouraged by the results of these experiments, settlers are coming in and taking up and clearing land in the vicinity of Chatham.

The farming population of the area is composed of a small proportion of native-born farmers, mostly from the southern part of the State, and a larger foreign element, chiefly immigrants from Sweden, Norway, and Finland. These people, as a rule, are industrious and thrifty, but as most of them had no capital to begin with progress has necessarily been slow.

CLIMATE.

No complete or extended weather records have been kept in the Munising area. Observations are now taken at two points, Wetmore and Chatham, but as continuous records have been kept only a short time normals have not yet been established. The table given below is compiled from the records of the Weather Bureau stations at Marquette, on Lake Superior, and Manistique, on Lake Michigan, and may be considered as fairly representative of climatic conditions in the area surveyed.

Normal monthly and annual temperature and precipitation.

Month.	Marquette.		Manistique.		Month.	Marquette.		Manistique.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	° *F.*	*Inches.*	° *F.*	*Inches.*		° *F.*	*Inches.*	° *F.*	*Inches.*
January	16.0	2.04	20.2	1.52	August	63.6	2.89	63.6	3.15
February	17.1	1.78	16.3	1.41	September	56.8	3.88	57.4	2.73
March	23.2	1.84	23.1	1.89	October	45.1	3.26	44.3	3.72
April	37.2	2.01	38.7	2.46	November	31.4	2.72	33.8	2.53
May	49.0	2.98	49.1	3.49	December	22.8	2.46	22.5	1.47
June	59.0	3.51	57.6	4.16	Year	40.5	32.37	40.9	31.97
July	64.9	3.00	64.1	3.44					

It will be seen that the annual precipitation is not heavy, but is well distributed throughout the growing season. Long droughts during the summer months are unknown, and to this fact is due the uniform success that attends the cultivation of the sandy soils of the area.

The upper peninsula of Michigan has a wide range of temperature between the most intense cold of winter and the extreme heat of summer. The brief records of the experiment station at Chatham show a maximum of 92° and a minimum of — 30° F. The mean annual for the region is less than 41° F. For four and often five months of the year the normal average temperature is below freezing. The sum-

mers are moderately warm, except for occasional hot days. The nights are nearly always cool. Killing frosts may occur as early as the middle of September. Snow falls in November or the first part of December, and the smaller streams and lakes are soon frozen over. In Lake Superior ice does not form, even along the shores, until January, but the ice, in the shape of floes driven across the lake by the north winds, may remain until the first or middle of June, and the water is cold throughout the summer.

While the length and coldness of the winters may discourage the immigration of a farming population from regions farther south, there are certain favorable climatic features which counteract in a large measure such disadvantages and guarantee to the farmer fully as large profits in many lines of agriculture as may be secured in good farming communities elsewhere. The winter may be said to begin with a heavy fall of snow, which remains continuously on the ground until late in the spring, accumulating at times to a depth of 3 or 4 feet. The effect of this mantle of snow is to prevent the freezing of the ground and to protect tender vegetation that would otherwise be killed, as is the case in regions farther south where this protection is lacking when cold weather sets in. The importance of this feature is that grasses can get an early start in the spring, the conditions are favorable for the growth of winter wheat, making it a safe and remunerative crop, and root crops may be safely left in the ground all winter. The fall planting of potatoes has been successfully practiced by the Chatham station. Sugar beets left over winter seem to lose neither in weight nor in sugar content. The influence of this fact upon the development of the sugar-beet industry in this region will be discussed in another chapter. Another effect of the deep snows is to check the hasty growth of vegetation in the spring before the danger of killing frost is past. The lake also has a tendency to even the temperature at this time and retard plant growth. The warm weather finally comes very suddenly, and as the ground is entirely free from frost, plants put forth a wonderful growth and crops mature so quickly as to offset the shortness of the growing season.

PHYSIOGRAPHY AND GEOLOGY.

The Munising area is a part of the region which was scoured off by the encroachment of the great ice sheet during the Glacial period, covered by the debris left by the retreat of the ice, and subsequently altered by the atmospheric agencies of erosion. These processes have produced a wide variation in topography. In some parts of the area the hills are gently rolling; in others, rough and precipitous; and there are nowhere any considerable areas of level land aside from the swamps and marshes. The area attains

in places an elevation of about 400 feet above Lake Superior. This rise in elevation is not gradual, but at intervals steep slopes lead to higher general levels, which gives to the topography a general terracelike formation.

Beginning with Lake Superior we find an irregular shore line faced along the greater part of its length by cliffs of sandstone rising abruptly from the water's edge. These cliffs, ranging from a few feet to nearly 200 feet in height, are but the margin of a great sandstone plateau. The greatest height of the cliffs is attained at the Pictured Rocks. At only a few places along the entire coast is the rocky wall broken so as to allow an easy approach to the water's edge. The beach formation occurs near the mouths of some of the small streams, and consists of a coarse yellow sand, which is described in this report as Dunesand. Above it are loose piles of a similar sand, slightly cemented and made stationary by a sparse growth of vegetation. Farther back are long, narrow, parallel ridges of the sand, on which a considerable growth of grasses, shrubs, and even forest trees has taken a stand. These low-lying littoral deposits are inclosed by steep hills, composed either of the sandstone formation or of loose glacial drift. At the top of the plateaulike formation we find the sandstone covered nearly everywhere by unconsolidated drift material to a greater or less depth. Areas where the overlying material is thin and the sandstone outcrops so frequently as to prevent cultivation have been indicated on the soil map as Rough stony land.

The drift over much of the area is of great depth; it reaches to the summits of the highest hills and covers the slopes to the bottom, some of the hills being composed entirely of it. In composition the drift varies from a fine clay to the coarsest sands and gravels. No rule can be laid down for the occurrence of the several grades of material, as beds of sand and of sandy loams alternate within short distances, but as a rule one texture is predominant over extensive areas and gives a general character to the surface soil. Three types of soil have been recognized and mapped in the purely glacial deposits—the Miami sand, the Miami sandy loam, and the Superior clay.

The sandstone has not weathered sufficiently to affect the character of the drift soils, but its weathered product enters into the composition of the thin soil of the Rough stony land. This sandstone is the characteristic red coarse-grained sandstone of the Potsdam formation of the Cambrian. It is overlapped in the southern part of the area by the Calciferous group of the Silurian age, which is here represented by a sandy dolomite. The drift materials cover the Calciferous to such an extent that in only a few areas about Chatham does the rock outcrop sufficiently to have its weathered products mod-

ify the surface soil. The soil derived wholly or in part from the dolomite has been called the Fort Payne sandy loam.

The area has no general drainage system. The greater part of the rainfall finds its way to Lake Superior by a number of small streams, of which Sable, Rock, and Train rivers and Millers Creek are the most important. Both the southeastern and southwestern parts of the area surveyed are drained southward toward Lake Michigan. The streams of the area have winding courses through the hills and, as a rule, have sharply cut channels.

It would seem that with a hilly topography and pervious soils the entire country should be completely drained, but such is not the case. The area is characterized by a feature of topography developed in glacial regions, in which depressions formed during the retreat of the glacier or due to post-Glacial erosion have been converted into lakes, marshes, and swamps. The swamps, usually along streams, have been filled with beds of muck and peat. The small lakes are fast being filled with organic matter and sediments, and the existence of numerous small swamp areas indicates that in some cases the filling-in process has been nearly completed.

With the exception of the marshes the entire area was originally forested. The beach sand supported a sparse but valuable growth of pine. On the loamy soils of the uplands were heavy forests of hardwoods, including maple, elm, birch, ash, cherry, and red oak, while on the more sandy soils the hemlock and an occasional pine were found in addition to the hardwoods, and on the very sandy soils of the pine plains the pine alone was found. The swamps were and are still covered by a dense growth of cedar, tamarack, and ash.

SOILS.

The soils of the Munising area have been divided into eight types. The soils grade into one another so frequently that it was often difficult to determine their boundaries, and the difficulty was further increased by the heavy forests and the lack of roads over a large part of the area.

The following table shows the extent of each type and the percentage of the total area which it occupies:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Miami sand	166,464	63.9	Dunesand	7,424	2.8
Miami sandy loam	39,552	15.2	Superior clay	704	.3
Muck	20,480	7.8	Marsh	704	.3
Rough, stony land	17,344	6.7	Total	260,608	
Fort Payne sandy loam	7,936	3.0			

ROUGH STONY LAND.

The term Rough stony land has been applied to areas that are rough, broken, and so covered with rock outcrops and broken stone that cultivation is extremely difficult or impossible. Such areas are found in the northeastern part of Alger County, where the glacial drift is so thin as to allow the exposure of the underlying rock on every hillside.

The largest and only important area of this type lies between Sand and Rock rivers, on both sides of the Duluth, South Shore and Atlantic Railroad. In this region, wherever the streams have cut deep ravines or railroad cuts have been made, it can be seen that the hills are composed of solid sandstone of the Potsdam formation. The bare rock outcrops on the surface are never of any great extent. In some places the undisturbed rock is quite near the surface and covered by only a few inches of soil and vegetable mold, but it is more common to find great fragments and blocks of stone throughout the soil and scattered over the surface. The soil of the broken stone areas is a sand composed of the weathered product of the sandstone mixed with glacial materials. It is usually a red sand of fine to medium texture. On the lower hill slopes the sorting action of the water has in some places produced a more loamy soil, but such spots are small and of no agricultural importance.

Throughout the areas occupied by this type are small patches, from 1 to 5 acres in extent, which are comparatively level and free from stone, and are suitable for farming purposes. Such patches may be seen in cultivation about Onota and Deerton.

Wherever this soil can be cultivated oats, hay, and potatoes can be successfully grown. All root crops do especially well. Timothy grows without much attention, and a considerable amount of timothy hay is cut near Onota.

The greater part of the type is so rough that cultivation is out of the question. The streams have eroded deep valleys and left the hillsides steep and stony. In the vicinity of Deer Lake the rocks rise up as great cliffs, and the country to the north is almost impenetrable.

Notwithstanding the thinness of the soil in many places, nearly all of the Rough stony land was originally covered by a heavy growth of hardwood trees, spruce, pine, and hemlock. The hardwood forests have been extensively cut to furnish wood for the charcoal furnaces.

The Rough stony land will never be utilized to any extent for general farming. The rougher areas admit of but two possibilities—a considerable portion could be converted into pasture, or nearly all

could be systematically forested. The land is cheap and the soil is especially adapted to spruce, and it might be a profitable enterprise for the large paper manufacturing companies to reforest this region and provide for the paper industry of the future.

DUNESAND.

The term Dunesand has been applied to the incoherent sand, locally known as "beach sand," deposited along the shore of Lake Superior. Near the water the more recent deposits consist of a clean yellow sand of medium and fine grains, which closely resembles the Dunesand of the Allegan area, on the eastern shore of Lake Michigan. Beyond the reach of wave action there are heaps of the same sand, held only by a sparse growth of coarse grasses. Behind these are narrow ridges parallel to the lake shore and to each other. The ridges are no longer subject to wind or wave action, but have been consolidated by a scattering growth of pine, maple, and birch, and an undergrowth of shrubs, ferns, and grasses. In a few places near the edge of the water the sand gives forth a creaking sound when suddenly compressed, in the same manner as the "musical sands" of the Allegan area.

The largest areas of Dunesand are found at the mouths of some of the streams that empty into Lake Superior. At the mouth of Train River Dunesand covers an area of several square miles, and extends back to the base of the morainal bluff. No dunes of any size are forming and moving inland, as is the case in the southern part of the State, because here there is but little space on which the dunes can collect, and their progress is everywhere checked by clifflike hills. Sand closely resembling the beach sand is found in narrow strips along the top of the Pictured Rocks, at an elevation of nearly 200 feet above the present level of Lake Superior. The peculiar position of this sand and the presence of gravel would seem to indicate that it is of glacial origin.[a]

But few attempts have been made to cultivate the Dunesand, on account of the inability of the sand to retain moisture and plant food. Success could be expected only with such fruit and vegetable crops as thrive on the very lightest sandy soils. The better class of timber has long since been removed, and only small and inferior trees remain. Among the shrubs which make up the undergrowth, the blueberry is the only one of value. A large number of people are employed along the coast during the summer in picking and marketing the berries.

[a] Foster and Whitney's Report of 1850.

The following mechanical analysis shows the texture of a typical sample of the Dunesand:

Mechanical analysis of Dunesand.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
12107	1 mile W. of Autrain.	Yellow sand, 0 to 36 inches.	0.1	8.1	47.9	43.2	0.2	0.1	0.3

MIAMI SAND.

The soil of the Miami sand, to a depth of 12 inches, is a slightly loamy sand, interspersed with a small amount of gravel. All grades of sand enter into the composition of the soil, but as a whole it may be said to have a medium texture. The proportion of silt and clay ranges from 4 to 10 per cent, and this, combined with the usually small percentage of organic matter, gives the sand its loamy character. In the subsoil the finer grades of sand usually predominate, the sand, however, being looser and of a lighter color, owing to the lack of organic matter. The gravel content of the subsoil always equals, and in many cases exceeds, that of the soil. The gravel, which ranges from 5 to 15 per cent in both soil and subsoil, is characteristic of the type, and no considerable areas are without it.

A common feature of the Miami sand areas is the presence of ferruginous material within 12 to 18 inches of the surface. It may take the form of loose, finely divided, powdery material, or it may cement the sand grains to form a soft crust. In either case it makes the soil more compact and loamy, and renders it difficult in many places to determine whether the soil should be classed as a sand or a sandy loam. This iron accumulation is due to inadequate drainage, and is greatest where the land is level and heavily forested. It will gradually disappear when the land is cleared and drained.

The Miami sand is the most important soil type of the area, both by reason of the extensive tracts which it occupies and on account of its proximity to the largest towns. It is likely to be found in large or small areas wherever the glacial drift is distributed. Tracts too small to be indicated on the map are found scattered throughout the areas of the other drift types. The material composing the type is of great depth, reaching apparently to the undisturbed rock. There is also every reason to believe that it underlies the loams which have

been derived from the glacial debris. The largest and most uniform area of the Miami sand lies between Autrain and Munising, and southward to the southern border of the area. There are also large stretches of the type in the northeastern part of the area.

The topography of the type varies in different parts of the area from gently rolling to rough and hilly, but the former feature is the more prevalent. The extremely rugged tracts are found near Lake Superior, where the morainal material terminates in steep bluffs or cliffs. There are also localities where excessive stream action has cut up the surface of the country until farming is impossible. The more extensive rolling country is well watered by numerous small streams and affords beautiful farm sites.

The variations in productiveness in different parts of the Miami sand areas are due in large part to drainage conditions. On the more level stretches the soil retains moisture well and supports a dense growth of vegetation, chiefly hardwood trees, while on the higher and more completely drained portions there is a sparse forest growth, and pine and hemlock are more frequently found. With the exception of the distinctly marked pine plains, there are no areas so leachy as to allow ordinary crops to suffer, with the invariably heavy rainfall of the region during the growing season. On the other hand, the depressions can nearly all be easily drained and brought under cultivation.

Only a small proportion of the vast area of the Miami sand has been cleared and farmed, but enough has been done to demonstrate that the type is surprisingly fertile for so sandy a soil. The grains and grasses grow to a perfection usually expected only on soils of heavy texture. This productiveness is due to the water supply in the soil being available at all times for the growing crop, by reason of the frequent rains and the water-retaining power of the soil itself. The crops to which most attention has been paid are potatoes and timothy. Timothy hay is the chief money crop, owing to the good local demand. Potatoes come to maturity very quickly and large yields are secured.

The soil is adapted to a wide range of fruits and vegetables and the legumes and root crops do especially well. No experiments have been made with the sugar beet on this type of soil, but judging from experiments on the other sandy soils of the area large beets of a satisfactory sugar content should be grown.

Three sandy tracts, locally known as "pine plains," occur along the southern border of the Munising area. The soil is a loose gray sand to a depth of 5 inches, underlain by a yellow or brown sand. There is little difference in texture between soil and subsoil, both being composed of sand slightly coarser than that of the soil of the

remainder of the Miami sand. The percentage of clay and silt is also smaller. Gravel is always present in somewhat larger quantities than in other phases of the Miami sand.

The surface of the pine plains is uniformly rolling, but no streams traverse the areas. The original timber was a growth of rather small pines, but at present only small maple and cherry trees are to be seen. The blueberry grows nearly everywhere on these plains and is very prolific. The cultivation of these pine plains does not appear so hopeless as in some other parts of the State, but they are still of low agricultural value. Owing to the low price of better lands it will be poor economy to attempt at present the cultivation of these inferior lands.

The following table gives the results of mechanical analyses of the fine earth of the Miami sand:

Mechanical analyses of Miami sand.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
12083	2 miles SE. of Wetmore.	Gravelly sand, 0 to 12 inches.	1.7	20.3	26.9	38.3	5.9	5.2	1.3
12085	No. 3-40 of sec. 3, T. 46 N., R. 19 W.	Gray coarse sand, 0 to 10 inches.	2.1	21.1	31.7	30.8	8.9	2.1	3.3
11242	2 miles NW. of Wetmore.	Coarse sand, 0 to 14 inches.	1.9	16.6	23.6	44.9	5.6	3.4	4.2
12084	Subsoil of 12083	Yellow gravelly sand, 12 to 36 inches.	2.8	16.2	25.5	41.8	9.4	1.8	2.2
12086	Subsoil of 12085	Yellow gravelly sand, 10 to 36 inches.	1.6	21.0	32.9	33.5	7.8	.5	2.8
11243	Subsoil of 11242	Sand, 14 to 36 inches	.7	9.2	16.8	33.1	15.7	15.6	8.0

MIAMI SANDY LOAM.

The Miami sandy loam ranks second in extent among the soil types of the area, and parts of it stand first in agricultural possibilities. It is not a soil of uniform texture even in one locality, as it includes the heavier portions of the extremely variable drift deposits, which range from a very loamy sand to a heavy loam. The most common development of the type is a very sandy loam with a depth of 14 to 18 inches, underlain by a loamy sand of fine texture. The soil is naturally of a reddish-brown color, but the top soil is often black with organic matter. Both soil and subsoil contain a small proportion of gravel, the quantity being approximately the same as that in the Miami sand. The gravel, as in the latter type, may be round to subangular in shape, and of almost any mineralog-

ical character. The soil clods when plowed wet only on the heavier phases of the type, as the coarse sand and gravel impart a friable character and cause it to break readily under the plow. Over a large part of the type iron is found in the soil, either as a soft, sandy crust, or more often as a finely divided material, which gives the soil in some places a loamy or compact structure.

The Miami sandy loam may occur in almost any part of the area and in association with any other soil type except the Dunesand. The largest development of the type is found between Onota and Rumely. About Onota the soil is more sandy and hardly distinguishable from the Miami sand, but toward the south the clay content gradually increases until around Rumely the type attains its heaviest texture. Other extensive bodies are located east of Munising on each side of Millers Creek. There are also many areas of the type scattered throughout the sandy soils, some of which are too small to indicate on the soil map.

The surface of the country occupied by the Miami sandy loam is either gently or sharply rolling; the greater part, however, is level enough to be farmed without difficulty. Good drainage is insured everywhere by the slope and elevation of the land and the porous nature of the subsoil.

The Miami sandy loam is a part of the great glacial deposit. Below 3 feet there are usually beds of gravelly sand, which extend to the solid sandstone or limestone underlying the region. Wherever the sandy loam is shallow and the limestone has entered into the composition of the top soil it is classed with the Fort Payne sandy loam. Of the many square miles occupied by this type only a few acres have been cleared and brought under cultivation. The greater part of it is still covered by the original forests of maple, elm, ash, and other hardwoods, with a few hemlocks on the lighter phases. The efforts at cultivation have been almost confined to the land nearest Munising and Autrain, but with the spread of farms from Chatham westward it is certain that the most desirable portions of the type near Rumely will soon be taken up by settlers.

The Miami sandy loam is suited to the production of any crop that may be grown in this region. The soil is heavy enough with the prevailing climatic conditions to produce fair wheat and the shallow-rooted grasses, while root crops do as well as on the more sandy soils. The small areas of this type have been cultivated under such unfavorable conditions that any estimates of crop yields would be worthless, but the results already obtained give promise of profitable farming when the land is well cleared, drained, and cultivated. Timothy grows wherever it is at all favored, and good crops of hay are cut every year. Potatoes do so exceptionally well that they will doubt-

less continue to be the principle cultivated crop. The sugar beet has not been fully tested on this type of soil, but there is no reason to doubt that it will do as well as on the Fort Payne sandy soil, a soil of similar texture, on which large beets of a high sugar content have been obtained.

The following table shows the results of mechanical analyses of the fine earth of typical samples of the Miami sandy loam:

Mechanical analyses of Miami sandy loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
12087	Sec. 32, T. 47 N., R. 18 W.	Sandy loam, 0 to 12 inches.	1.6	11.7	16.0	34.7	16.9	11.7	7.1
12091	Sec. 23, T. 46 N., R. 22 W.	Brown sandy loam, 0 to 18 inches.	1.4	10.7	16.2	35.7	12.4	14.4	9.0
12089	Sec. 19, T. 47 N., R. 17 W.	Sandy loam, 0 to 16 inches.	1.5	12.5	16.0	33.7	12.4	12.8	10.8
12088	Subsoil of 12087	Heavy sand, 12 to 36 inches	1.5	9.2	18.1	39.1	16.7	8.9	5.5
12092	Subsoil of 12091	Sandy loam, 18 to 36 inches	.8	11.2	15.5	38.0	17.9	10.4	5.6
12090	Subsoil of 12089	Brown heavy sand, 16 to 36 inches.	1.3	12.1	16.6	34.9	12.2	13.0	9.6

SUPERIOR CLAY.

The Superior clay is distinguished from all other types of the Munising area in being the only soil with a heavy texture. It consists of a light-colored silty loam with an average depth of 12 inches, underlain by a red silty clay subsoil. The sand constituent of the top soil is of the finer grades, and the subsoil has only the finest sand, which, with the silt, gives the clay a somewhat friable character. When wet the subsoil material puddles, and it does not shrink to any extent in drying. Bricks of good quality are made of this clay.

The Superior clay occupies a small area about Hallston, 3 miles from Munising, on the line of the Munising Railway. Portions of it are rough and unfit for cultivation. The area is cut up by the deep channels of numerous small tributaries of Anna River, and tracts of only a few acres are uneroded. The clay owes its origin to a deposition of glacial material, but why a local deposit of clay should occur within such a vast area of sandy soils can not be determined.

The hilly topography of the Superior clay impairs its value for general farming, but it is well adapted to pasture and dairy farming, and its proximity to Munising adds to its value for that purpose.

At present hay is the only product obtained from the soil. No care is taken of the grasses, but timothy makes a thick, heavy growth wherever the land is cleared.

The following mechanical analyses show the texture of the soil and subsoil of the Superior clay:

Mechanical analyses of Superior clay.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
12101	1 mile NE. of Hallston.	Silty loam, 0 to 14 inches.	0.2	1.8	3.1	5.8	7.8	47.1	34.2
12099	¼ mile S. of Hallston.	Silty loam, 0 to 10 inches.	.0	.9	1.6	4.8	5.2	49.6	37.7
12100	Subsoil of 12099	Heavy silty clay, 10 to 36 inches.	.0	.9	1.5	5.3	3.3	51.2	37.5
12102	Subsoil of 12101	Heavy silty clay, 14 to 36 inches.	.0	1.1	1.1	3.4	3.7	51.7	38.9

FORT PAYNE SANDY LOAM.

The Fort Payne sandy loam is the only type of soil derived by weathering from the calcareous rocks which underlie a large part of the region. The soil, to an average depth of 6 inches, consists of a brown and very sandy loam, usually mixed with gravel and small fragments of stone. The subsoil is a sandy loam of lighter color, filled with rock fragments that have resisted weathering, and passing finally into the partly decomposed rock. The depth of the arable soil is variable; in places it attains a depth of 5 or 6 feet, while in others the unweathered rock comes to the surface. Over a part of the State farm at Chatham the soil is only a few inches deep, and blasting of the rock is necessary in the construction of drainage ditches. The soil is very productive, and maintains its productiveness under continued cultivation. Humus is perhaps better retained by the Fort Payne sandy loam than by any other type of the area.

Only two tracts of this soil were found in the Munising area, but the type covers a wide scope of country to the south of this area. The larger tract, which is located about Chatham, has a triangular shape, spreading to a width of 6 miles along the southern border. The other tract is a few miles east of Shingleton, but the type here is not so well developed as in the area around Chatham.

The topography, being more or less hilly, does not differ from that of the Miami sandy loam. The soil is usually thinner on the hillsides than on the more level land.

The Fort Payne sandy loam is the result of the weathering of the

sandy dolomite which is characteristic of the Calciferous group of the Silurian. The rock is broken up by the removal of the calcium carbonate by carbonated waters, leaving the sand and other difficultly soluble constituents of the soil. In some places the glacial drift has entered to some extent into the composition of this soil.

The agricultural value of the Fort Payne sandy loam has been demonstrated at the State Experiment Farm at Chatham, where various crops have been grown for four years with the view of determining what crops are adapted to this soil and what yields may reasonably be expected. The results have shown that for general farming wheat, oats, rye, and barley may be grown with good yields. Peas and all legumes adapted to the climate make a wonderful growth. Potatoes grown on this soil are of a superior quality, being large and smooth, and yielding about 200 bushels per acre. Vegetables of all kinds, especially the root crops, mature very early and make good yields. The experiments with the sugar beet are described in another chapter.

The following table shows the texture of typical samples of the fine earth of the Fort Payne sandy loam:

Mechanical analyses of Fort Payne sandy loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
12097	Chatham	Dark fine sandy loam, 0 to 6 inches.	0.2	3.3	7.3	34.9	27.0	20.9	6.2
11244	3½ miles W. of Munising.	Sandy loam, 0 to 18 inches.	1.2	10.7	17.9	35.3	15.3	11.3	8.1
12095	2 miles E. of Chatham.	Brown sandy loam, 0 to 12 inches.	3.5	3.4	8.3	37.0	23.5	14.6	9.2
11245	Subsoil of 11244	Loamy fine sand, 18 to 36 inches.	.0	.0	Tr.	47.0	34.2	14.7	3.9
12098	Subsoil of 12097	Sandy loam, 6 to 36 inches.	1.3	4.3	7.6	38.5	24.0	16.1	8.1
12096	Subsoil of 12095	Sandy loam, 12 to 36 inches.	3.4	20.5	7.2	21.7	21.8	15.1	10.3

MUCK.

There are numerous depressions throughout the area surveyed where the lack of natural drainage has permitted the accumulation of vegetable matter. These areas are locally called "cedar swamps," as they are everywhere characterized by a growth of white cedar. They are usually confined to narrow strips along the stream courses, but in a few instances they occupy considerable areas between two

streams. The material which has filled these swamps is composed of the partially decayed remains of plants, leaves, and mosses which have grown in the immediate vicinity. The value of the soil thus formed is determined by the extent of the decomposition, and this varies frequently, even in the same swamp. Over a large part of these areas, however, the soil mass has reached the condition of Muck, and is suited to agriculture. Where decay has not advanced to this stage, the plant remains form a wet, spongy mass, which is called "bog" by the lumbermen to distinguish it from the more compact Muck. It has not been found practicable to map these differences, as the bog areas are small and the almost impenetrable character of the swamp renders the work well-nigh impossible. It is also unnecessary, because it is well known that the more peaty materials undergo rapid decomposition when exposed to the air, and it is not likely that any considerable areas will be found worthless when the swamps have been drained. The Muck varies in depth from a few inches to more than 10 feet, and in some places it is underlain by a thin bed of impure marl.

The Muck areas are invariably covered by a heavy growth of water-loving trees, including the white cedar, ash, maple, and tamarack. The tamarack is rarely found in the southwestern part of the area. It is more common in the swamp areas bordering the northward-flowing streams. It is claimed by some that celery can not be successfully grown on areas that have supported tamarack. This may be due to the greater acidity of such areas, but, if so, the acid condition should disappear when the soil is thoroughly drained.

Small patches of Muck sometimes occur in cultivated fields, but no attempt has been made to cultivate the Muck as a type with crops adapted to it, except at the experiment farm at Chatham, where good celery, cabbage, and turnips have been grown. No doubt when the country is cleared and drained the Muck will be one of the most desirable soils. Onions, cabbage, radishes, and potatoes could be produced on nearly all the areas, while celery and peppermint are possibilities over a large portion of the Muck.

MARSH.

The small Marsh in the southeastern part of the Munising area is not in itself of any agricultural importance, but as it is representative of the larger tracts of Marsh farther east, it presents the most important soil problem of the upper peninsula of Michigan. The soil is a black mass of partially decayed vegetable matter, having an average depth of about 2 feet, but in some places reaching a depth of 6 feet or more. This material consists of plant remains evidently washed in from higher ground, as layers of well-rotted Muck alternate with layers of less decomposed peaty accumulations.

The top soil is everywhere sufficiently decomposed to be of agricultural value. Below this mucky soil is a more peaty, stringy mass composed of the remains of plants and mosses mixed with a fine sand which seems to increase in quantity with depth.

The Marsh is confined to one locality in the area, occupying a narrow strip within a swamp and bordering a small stream. The soil itself is not greatly different from that of the neighboring swamps, but the heavy timber growth of the latter is entirely lacking. Coarse grasses and moss form the vegetation of the water-soaked soil. The treeless condition of the areas may be accounted for by the imperfect drainage. Water stands everywhere within a few inches of the surface, and over a large part of the Marsh the surface is partially covered with standing water. In seasons of heavy rainfall all of it is covered with water for several weeks at a time.

Only one attempt has been made to cultivate this Marsh, and it was not successful owing to the lack of drainage. Small surface ditches were dug, but they were not sufficient to remove the excess of water in the soil. The adequate drainage of large areas of this type of Marsh land can only be accomplished by corporations or individuals able to invest large sums of money in general drainage systems. The possibility of draining these areas is demonstrated by the local effect of ditches constructed along the railroads, and the elevation and slope of the land should render feasible the establishment of general drainage channels. Capitalists are now ready to take up this reclamation work whenever they are assured that the soil itself would justify the expenditures. We can judge the capabilities of this soil only by the character of the vegetation already taking hold under the present adverse conditions. The grasses growing on the wet land are of some feeding value and are sometimes cut for hay. It is certain that when these areas are drained the proportion of valuable forage grasses will greatly increase and the areas will be converted into good pasture lands. Better drained areas along the railroad support a fine growth of timothy, indicating that the soil is adapted to the cultivated grasses.

The value of the Marsh for purposes of general farming can only be determined by actual experiment. The character of the soil would indicate that when drained the crops that flourish on a muck soil should do well.

ADAPTATION OF SOILS AND CLIMATE TO SUGAR BEETS.

Sugar beets have been grown only in an experimental way in Alger County, but the results, in connection with those obtained in the other counties of the upper peninsula, indicate that this may be a part of one of the best sugar-producing sections of Michigan. As

late as 1896 maps of the supposed sugar-beet belt included only the southern part of the State, with Lansing as the most northern point, and it was thought that the beet had reached the northern limit of production. This supposition was based on the belief that beet culture would not be a success outside of a climatic belt extending 100 miles on each side of the isothermal line of 70° for the months of June, July, and August.

Later investigations show that the economical production of beets is not confined to these limits, and that other conditions besides temperature influence the quality of the beet. In a bulletin issued by the U. S. Department of Agriculture in 1899, Dr. H. W. Wiley sums up the facts, as follows:

> North of the limit of the belt, however, the extension of the culture of the beet can be pushed just as far as the climate will permit the ripening of the crop and the harvesting and the care of the crop before the freezing of winter sets in. Our experience in this country has shown that the farther north, other things being equal, beet culture is practiced the better the quality of the beets produced. This is due to the fact that by reason of the longer days which are secured by going farther north the activity of the chlorophyll cells of the beet leaves, in which, under the influence of light and heat, the sugar is elaborated, is increased and extended, so that more sugar can be made for a given leaf surface than farther south. In addition the lower temperature seems to favor the elaboration and accumulation of the sugar.

In Bulletin 64, Bureau of Chemistry, this statement is made:

> It is evident that the elements of sunlight, which are active in promoting the action of the chlorophyll cells in the formation of sugar, do not depend upon the direct rays of the sun. The diffused light coming through the clouds is apparently quite as effective as the direct sunlight.

A comparison of the amount of time in which the sun is above the horizon in different parts of the State, during the six months from April 15 to October 15, shows that Houghton, slightly above latitude 47°, receives 56.33 hours more of sunshine than Grand Rapids, in latitude 43°, and 69.13 hours more than Coldwater and Adrian, in latitude 42°. The favorable effect of the different climatic conditions of the northern latitudes is proved beyond doubt by the experiments made by the State Agricultural College Experiment Station.[a] From 1897 to 1902, inclusive, samples of beets were obtained for analysis from 74 out of the 83 counties of the State, the total number of samples being 1,114. The results show a range in the sugar content from 13.4 per cent in the samples from the southern tier of counties to 15.4 per cent for the beets grown in the latitude of Alger County.[b] With few irregularities there was a gradual increase in the richness of the beets toward the north. The beets grown at the experiment station in Alger County during several years have varied in sugar content from

[a] Special Bulletin No. 18, Michigan State Agricultural College.

[b] Bulletin No. 207, Michigan Experiment Station.

14.2 per cent to 17.6 per cent. A safe average from year to year could perhaps be placed between 15 and 16 per cent, with a purity coefficient of about 84.

The fact that the ground never freezes to any extent in the Munising area suggested the experiment of leaving the beets in the ground during the winter, to determine whether they could be kept in this manner and what the effect would be on the composition. The results for the winter of 1903–4 show that the beets have been perfectly preserved, and that there has been neither loss of weight nor decrease in the amount of sugar. The one experiment can hardly be said to show the wisdom of this plan, but if such a method should prove to be practicable, it will have great influence on the future development of the beet industry in the upper peninsula, as the disadvantages of a short season for harvesting and manufacturing will be eliminated.

Even if this plan is not practicable, the beet will no doubt be extensively grown on the more loamy soils of the upper peninsula, and the profits derived from the industry will be as large here as in the southern part of the State. In Alger County the crop will probably be confined to the Miami sandy loam and the Fort Payne sandy loam, as it has been the history of the industry elsewhere that the tonnage is greater and the quality better on the loamy or heavy soils.

AGRICULTURAL CONDITIONS.

As already noted, the Munising area is still new in an agricultural sense, and the small population engaged in farming is yet undergoing the hardships that fall to the lot of pioneers. As a rule only the bare necessities of life have been accumulated about the farms. The dwellings and barns are hastily constructed log buildings. The fields are mostly irregular, stump-covered patches of cleared land inclosed by brush fences. These conditions will be rapidly improved when the farmers produce a surplus above the needs of the family. All the settlers have had to make a start in the wilderness without capital, and, many of them being foreigners, have been handicapped by an ignorance of the country and its language. With these facts in view, it can be said that the progress of the community has been exceptionally rapid, and much can justly be expected of it along agricultural lines in the future.

With only a few exceptions the farmers own the land which they cultivate. Many are still in debt for their land, but in most cases it was contracted for under such easy conditions that the payments will be made without difficulty. The average size of farms, as given by the Twelfth Census, is 117 acres, but the average amount of cleared land on each farm is less than 20 acres. The greater part of the land has not been divided into farms, but is owned or controlled by large

mining or lumbering companies. It is not the intention of these corporations to hold this land indefinitely, but to dispose of it as soon as the more valuable timber has been removed. To this end they are making every effort to attract immigration and offer land under easy conditions of payment. The largest owner among these corporations holds more than one-half the arable land of the area.

The price of land varies with location, quantity and kind of timber, and state of improvement. Few, if any, homesteads of any value are now to be had. Land values are rapidly increasing, and especially is this the case with the timbered lands. Cleared and improved farms are worth from $20 an acre up. The average price of good farming land where the better class of timber has been removed is about $8 an an acre.

The farmers have not found it necessary to employ much labor in cultivating their small farms. It is only in haying time that the average farmer hires help. The available laborers are the spare hands from the lumber camps, and are chiefly of Swedish or Finnish nationality. Wages are high, owing to the demand for laborers in the various industries of the region. The laborers are hardy and accustomed to hard work. The price of labor for short periods is from $1.25 to $2 a day.

The largest and most valuable crop of the area is potatoes, and about 30,000 bushels were produced in the present year. Of the other crops not enough is grown to supply the needs of the area. Hay ranks next to potatoes in value. Timothy is a sure crop and is grown to the exclusion of other grasses wherever the land is cleared, much of the hay produced being of no expense to the farmer aside from the cost of cutting and storing. A considerable acreage is devoted to oats, and the average yield is about 32 bushels per acre. Wheat is not widely grown, but the yields are fairly good. No corn is produced, as the seasons are too short and the nights too cool for it to mature. A wide variety of fruits and vegetables may be grown, and the farmers can not be too earnestly urged to take up the cultivation of these profitable crops. The peach tree invariably winter-kills, but other fruit trees do well and the fruit is of excellent quality. The difference in the time of ripening puts many kinds of fruit grown here out of competition with that of other localities. The cherry, for instance, ripens in the fall, and should bring a fancy price on the market. Among the small fruits strawberries make heavy yields, and the fruit is large and of fine flavor. Gooseberries, raspberries, blackberries, and blueberries grow wild, and large quantities, especially of the blueberries, are picked and shipped to the Chicago market. The price ranges from $1 to $2 a half-bushel crate.

The area is well provided with railroads. The Duluth, South Shore

and Atlantic Railroad and the Munising Railway traverse the area from east to west and furnish rapid communication with Chicago, Milwaukee, Grand Rapids, and the copper and iron mining regions. Munising has an excellent harbor, and while the shipping by water is very light at present, it will doubtless be of much importance in the future.

The most urgent need of the farming communities is good country roads. The few roads that traverse the area are, as a rule, not well located and are seldom in good condition. Main roads were once built through the area, but were not planned to suit present needs, and have fallen into disuse. Many of the farmers have the railroad as their only means of transportation. The roads cut by the lumbermen are generally useless to the public, as they are mere clearings through the woods, designed for moving logs over the heavy snows. No great prosperity can come to the farmers until better means of communication are established between different parts of the region. Under present conditions the farmers can not supply the local markets with their products. It is to be hoped that the county will rapidly push the work of constructing good roads.

There are few regions where the farmers have less competition in the sale of their produce. Besides the local markets, which have never been supplied, the proximity of the area to the iron and copper mining regions, with a population of more than 100,000 engaged in other pursuits than agriculture, insures a ready market for all farm produce that can be furnished by this area. The products that could be most profitably grown to supply this market are vegetables, fruits, and dairy products. At present these commodities are reshipped from the Chicago markets to the mining regions.

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