

EXPERIMENT DESIGNED TO SHOW THE RELATIONSHIP
BETWEEN SOIL AND CHANGES IN THE VEGETATIONAL
COVER.

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INTRODUCTION

"During the summer of 1938 a long time study was inaugurated designed to show the relationship between the soil and the vegetational cover in the region of Douglas and Burt Lakes in the western part of Cheboygan County, Michigan." (1) During the summer of 1939 this project was continued with the collection of soil samples from each soil horizon in the various plots, and these samples are to be analyzed during the coming year for the quantity of organic matter present, the minerals present, the wilting point, and for their physical composition including the colloidal content of the soil. pH tests were made at the Biological Station using the quinhydrone electrometric method of determining the pH on each soil sample. The distilled water used for these tests had a pH of 6.2 and the pH as recorded in this report is subject to this correction, the exact amount of which has not yet been agreed upon. Descriptions of the present soil profiles were written up when the soil samples were taken. Also 42 inch soil monoliths were taken for each soil type and these are being preserved at the Biological Station. These present studies are aimed to show the nature of the soil in these sample plots now and will be used in the future for comparisons with the soil then in order to show the changes which took place in the soil during this period, if any. Also the

influence of the various soils on the rate of forest growth can be determined in the future.

For the purpose of comparison with the forest soils, a sample and a monolith of the farm soil in this region was taken from a road cut $1 \frac{1}{3}$ miles north of Riggsville Corners. At this date (August 18, 1939) an extension of 24 quadrats has been taken on one of the plots to see if any other plants are found in the region of the plot and not on the plot itself. This work will be continued on the other plots later this season, and the data taken will be filed with the cover data for each of the plots.

The location of these plots will be found in the report of the first years work (1).

Acknowledgements are made to L. R. Schoenmann of the Michigan State College of Agriculture for the geology of the plots and for his aid in the writing of the soil descriptions.

METHODS

For writing descriptions of the soil and for obtaining the soil samples, a hole about 4 feet by 4 feet by 2 feet each of was dug near the sample plots. A clean vertical face was then cut on one side and the description written up. The samples were taken in $3\frac{1}{2}$ inch diameter "Sealright" cardboard containers and two of these were filled for each layer of soil. In the Granby Sand and in the Rifle Peat mason jars were used to collect the samples in because of the water in these samples. The depth rod used consisted of 4 four foot iron rods which screwed together. These were forced into the soil one at a time and then the next one was screwed on to it. There was no point on these rods. The method used in the pH determination has already been discussed in the introduction.

For the taking of the monoliths, a hole was dug about 4 feet in all directions. The a vertical face was made on one wall with a flat spade. In these sandy soils it was found that the removal of the monolith was greatly aided if the soil was wet, so this face was then sprayed with the fine spray of an Indian fire pump. Care was taken not to allow any erroison to take place and to let the water soak well into the soil. Then the metal monolith box was placed up against the face and gently pushed against the soil. When there were roots of other obstructions blocking the way of the monolith box, they were cut away by running a long bladed knife along the side of the box. Then the box was pushed in until the box was full of soil and the ground could be seen through the air holes in the back of the box. In doing this great care had to be taken to see that the loose,

incoherent B horizon would not fall away from the box. Then to remove the box from the surrounding soil, the soil on each side of the box was dug away and then the knife was run down in front of the monolith box to cut all of the roots and thoroughly loosen the box with care being taken to be sure to have plenty of extra dirt on the front of the box. These are to be preserved by ^{spraying} pouring over the sample a "colorless Dupont laquer such as is used in the preparation of laboratory aluminum paint" (3).

PLOT 1

GRAYLING SAND. SOIL NUMBER 56.

This plot is located on the bed of a bay of old Lake Algonquin and therefore has level surface features. This flat, sandy plain is thoroughly drained because of the substrata which is open and porous. The original cover on this area was an open stand of Norway or red (*Pinus resinosa*), white (*P. strobus*), and Jack (*P. banksiana*) pines (2). Now the area is covered with Jack pine and red oak (*Quercus borealis maxima*).

A profile of this soil* shows a top layer $\frac{1}{2}$ inch thick of pine needles, oak leaves, reindeer moss, and scattered twigs of Jack pine and Blueberry (*Vaccinium pennsylvanicum* and *V. p. nigra*) with a pH of 5.2. Below this is a layer of grayish black, medium sand and partially decayed organic matter which varies from 1 to $1\frac{1}{2}$ inches thick and has a pH of 5.4. This overlies a layer of very slightly loamy, yellow gray, medium sand which varies from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches in width and has a pH of 5.0. This layer contains many fine feeding roots of the plants on the area. Below this is from $15\frac{1}{2}$ to 16 inches of the B horizon which is composed of a very slightly loamy, buff yellow, medium sand with some fine gravel and small stones. The sand in this layer is incoherent and has a pH of 5.4. Some roots are also found in this layer. The C horizon begins about 21 inches below the surface of the ground and consists of a very slightly loamy, light straw colored, medium fine sand which has a pH of 5.2. A few roots are found in the upper part of this layer. At the depth of 45 inches the sand was slightly moist and a little consolidated.

*Profile taken south of the west side of the plot on Aug. 3, 1939

RUBICON SAND. SOIL NUMBER 46 (FLAT-TOPPED HILLS).

This plot is located on a thoroughly drained, flat, high table land of sandy glacial outwash from the block of glacial ice left in the depression of Douglas Lake by the last Wisconsin glacier. This glacial outwash deposit is underlain by undulating glacial drift. The various gullies and depressions in this table land have been eroded out since the time of the glacier. The original cover on this area was red and white pines, and now it is covered with large toothed aspen (*Populus grandidentata*), red oak, and some young red and white pine trees.

The surface of the ground is covered with a layer of recently dropped forest litter* (leaves, twigs, acorns, and the remains of broken fern) with occasional patches of moss or bare spots from 1½ to 2½ feet across. This layer has a pH of 5.7. Below this is ½ to 1 inch of dark brown to black disintegrating and humified organic material in a felty mat in a dull grayish, salt and pepper colored, medium sand which has a pH of 5.2. The last layer in the A horizon consists of from 4 to 7 inches of light gray, medium sand which has a pH of 5.2. This layer also contains many fine rootlets to which the sand grains adhere when the roots are shaken. This overlies 18 to 21 inches of the B horizon which consists of a slightly loamy, light yellowish brown, medium sand with some coarse gravel and which has a pH of 5.4. The upper part of this horizon is weakly cemented in places. The transition from the A to the B horizons is not noticeably sharp and the transition of the B to C horizons extends through a 10 to 12 inch zone. Lateral and feeding roots are found

*Field work done on July 20, 1939.

in the upper part of this horizon. The C horizon which begins about 26 inches below the surface consists of a yellowish, loose, incoherent, medium sand with a noticeable proportion of coarse sand and also some fine sand and gravel. This layer has a pH of 6.2 and also shows some particles composed of dark redish colored minerals. At the depth of 38 inches this grades into a light straw colored, loose, incoherent, medium and coarse sand with some fine gravel, and it has a pH of 6.2. This also shows a noticeable proportion of particles composed of dark and redish colored minerals.

PLOT 3

ROSELAWN SAND. SOIL NUMBER 16.

This plot is located on a sandy, somewhat stoney, glacial moraine. The soil is porous and therefore there is a rapid surface and underground drainage. The original cover on this area consisted of red and white pines and also of small quantities of oak, and the present cover consists of large toothed aspen, red maple (*Acer rubrum*), and some red and white pine trees. This plot has a slope of 3.4 degrees from the horizontal along its northwest - southeast axis with a northwest aspect. Standing on this axis at the center of the plot, the plot also has a slope of 6.1 degrees with a northeast aspect and a slope of 5.4 degrees with a southwest aspect.

The soil in this area* consists of from $\frac{1}{2}$ to $\frac{1}{4}$ inch of recently dropped litter of leaves, twigs, dead bracken, etc. which has a pH of 5.1. Below this is from $\frac{1}{2}$ to 1 inch of dark brown to black disintegrating and humified organic matter in a felty mat over a dull gray salt and pepper colored sand with a pH of 5.2. The lower layer of the A horizon consists of from $4\frac{1}{2}$ to 5 inches of pale gray, loose, incoherent, sharp, medium sand with a pH of 5.3. This grades down into the B horizon which is about 20 inches thick. The B horizon consists of light brown, medium sand with some gravel. It is slightly darker colored and faintly loamy in the upper part and grades downward through the more yellowish colored transition into the C horizon. The B horizon has a pH of 5.3. The C horizon which begins approximately 26 inches below the surface is light straw colored and consists of loose, incoher-

*Field work done on July 11, 1939.

ent, medium sand with a sprinkling of fine gravel. This horizon has a pH of 5.6 and contains a noticeable quantity of sand grains composed of dark colored minerals.

This plot is located on sandy clay moranic material with a surface veneer of a more sandy drift of a variable depth. The surface layer of sandy material is porous and permits a rapid infiltration down at least to the more clayish sandy drift which is more retentive of moisture. This is within reach of the tree roots and serves as a reservoir. Thus beech (*Fagus grandifolia*), hemlock (*Tsuga canadensis*), and pine (2) were found in the original forest (probably some maple also) where as this area might have been pure pine if it were not for this reservoir of water in the sandy clay layer. The beech was found here because of the high lime content of the soil. The present stand is composed of large toothed aspen, red maple, and seedlings of such species as hard maple (*Acer saccharum*) and beech. This plot has a slope of 8.8 degrees with the horizontal and a northeasterly aspect. The surface drainage is free, that is, unobstructed.

The soil on this area* consists of about $\frac{1}{2}$ inch of recently fallen forest litter with a pH of 5.4. This rests on top of $\frac{1}{2}$ to 2 inches of disintegrating and partially humified organic matter and mineral soil which is dull to dark gray or salt and pepper like in color. It has a pH of 5.0. The lower layer of the A horizon is from 4 to 5 inches thick and consists of pale gray, slightly loamy sand with a pH of 5.3. The B horizon consists of dark brown, loamy, medium sand to a ^{light} sandy loam 6 to 10 inches thick with a pH of 5.7 and grading downward through a lighter yellowish brown material of a similar texture into the underlying C horizon at a depth of 32 inches

*Field work done on July 6, 1939.

below the surface. The C horizon consists of clayey sand glacial drift which is strawcolored with lenses and pockets of redish brown, sandy clay. The pH of this horizon is 5.9. Gravel, cobbles, and larger stones of a wide variety in composition are present in moderate numbers throughout the profile.

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PLOT 5

SAUGATUCK SAND, SOIL NUMBER 36.

This plot is located on a bench (sandy floor) of a higher stage of Douglas Lake. The land has flat surface features and the soil is porous and permeable down to the water table. The original stand consisted of white pine and a few yellow birch (*Betula lutea*), and the present stand consists of trembling aspen (*Populus tremuloides*) and paper birch (*Betula papyrifera*).

This soil consists* of about $\frac{1}{2}$ inch of recently fallen forest litter with a pH of 5.3. Below this is $\frac{1}{2}$ to $1\frac{1}{2}$ inches of humified organic matter and sand which is of a salt and pepper color and which has a pH of 4.9. The main part of the A horizon consists of from 10 to 11 inches of pale gray, incoherent, medium sand which has a pH of 4.9. The B horizon consists of a chocolate brown, moderately indurated, medium sand of variable thickness (1 to 3 inches), grading down into a lighter colored, yellowish, rusty sand of the same general texture with the most pronounced induration in the central part of the B horizon where the brown and yellow color appear in a mottled effect. The principle part of the main root development is in the upper part of this horizon which extends from 12 to 32 inches below the surface. The pH of this layer is 5.1. The C horizon consists of a pale straw colored, moist, incoherent, medium sand with a pH of 5.2. The water table stood at the depth of 47 inches on July 6, 1939.

*field work done on July 6, 1939.

PLOT 6

GRANBY SAND. SOIL NUMBER 89.

This plot is located on a sandy floor of a higher stage of Burt Lake, and it is now a flat, moist plain in which the ground water table fluctuates from a few inches above the surface in early spring to a depth of at least 30 inches below the surface during the dry part of the summer and fall. The original stand consisted of cedar (*Thuja occidentalis*), and black spruce (*Picea mariana*). Now the stand is made up of trembling aspen, large toothed aspen, balsam poplar (*Populus balsamifera*), and *Salix bebbiana* with seedlings of cedar, black spruce, and balsam fir (*Abies balsamea*).

This soil* is covered with a layer $3\frac{1}{2}$ inches thick of a mat of roots and partially decomposed organic matter which is slightly consolidated near the bottom of the layer. This layer is reddish brown in color and has a fine texture, containing very little sand. It has a pH of 6.3. This overlies a 5 to 7 inch layer of salt and pepper colored mixture of decomposed organic matter and medium sand with a preponderance of the organic matter. Its pH is 6.7. All root activity is in or above this layer. The B horizon consists of a moist, brown gray, medium sand with a pH of 7.2. This varies from $13\frac{1}{2}$ to $15\frac{1}{2}$ inches in thickness. The C horizon begins 24 inches below the surface of the ground and consists of a yellow gray, medium fine sand with a pH of 7.2. This layer was moist to wet with the water table standing 30 inches below the surface on July 29, 1939.

*Field work done on July 29, 1939

PLOT 7

RIFLE PEAT. SOIL NUMBER 70.

This plot is located on a bog mat which is grounded on a moist sandy floor of a higher stage of Burt Lake. This sand floor varies from 1 to about 2½ feet in thickness and rest on another layer of decomposed organic matter, probably peaty in nature. Below this there are other layers of sand alternating with peat or/and marl which shows other levels of Burt Lake. These layers seemed to slope upwards the farther away they got from Burt Lake. The distance from the surface to the various layers of sand encountered near the north end of the plot are as follows:

first layer	3feet 5inches
second layer	8feet 0inches
third layer	10feet 6inches
fourth layer	12feet 0inches

no bottom struck at 16 feet, the length of the rod used.

These layers seem to have a more rapid rise toward the surface north of the plot than in the plot itself. The water level here does not vary as much as it does in the Granby Sand (Plot 6). This water comes from seepage from higher levels and it is flowing toward Burt Lake. Its temperature was degrees on August , 1939. This area originally was a cedar swamp and at present it is covered with cedar, balsam fir, black spruce, and tamarack (*Larix laricina*).

The top 2 to 3 inches of the ground* is covered with a mat of green sphagnum whose pH is 7.0. Below this is about 11 to 12 inches of a brownish, partially decayed layer of organic material with some partially decayed logs. The roots are found in this layer giving it an ununiform texture. The pH of this layer is 7.1. This grades downward into a layer

*Field work done on July 29, 1939.

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of brownish black, fine, decomposed organic matter which contains a few sand particles. This layer is consolidated into large peaty chunks, and its pH is 6.7. A few roots are found in this layer. This ran down to 24 inches below the surface where a layer of medium course, yellow brown sand was found. More water flowed into the pit from this sand layer than did from the organic layers above it. The pH of this sand was 6.7 and the pH of the water was 7.5*. The profile was taken about $\frac{1}{2}$ of a chain north of the west boundary of the plot and here the sand layer continued to about 5 feet 1 inch from the surface where a softer layer was found, and at 7 feet a layer of marl was struck which was not penetrated. On July 29, 1939 the water table stood at 10.5 inches beneath the surface.

*The pH of the water needs no correction as no distilled water was added to the sample.

FARM SOIL

ONAYAY SANDY LOAM. SOIL NUMBER 26.²⁴

The sample of farm soil was taken 1 1/3 miles north of Riggsville Corners in a cut on the east side of the road. On the west side of the road there is a dense stand of young hardwoods.

The top 1 to 1 1/2 inches of the soil* consists of a sod with roots, decaying organic matter, and fine sand scattered in. The layer was black in color and had a pH of 7.4. Below this was 1 1/2 to 2 inches of redish brown, fine and medium sand with some clay in it which has a pH of 5.9. This layer occurs in pockets and is very spotty in nature, therefore varying in depth. Stones and fine roots are present in this layer. This overlies 2 inches of gray black, fine sand with decayed organic material, clay, stones, and fine roots present. The black color may be do to charring in some fire. The pH of this layer is 6.0. Below this is 3 to 5 inches of the last layer of the A horizon which is light gray in color and consists of fine and medium sand with clay, stones, and roots present. Its pH is 5.7. The first layer of the B horizon which is from 4 to 6 inches ~~thick~~ thick consists of brownish yellow, fine and medium sand with clay and stones. The roots are concentrated in this layer which has a pH of 6.0. This grades down into a gray brown, loosely consolidated, fine and medium sand with clay and stones of varying sizes present. Its pH is 6.3, and it extends down to 20 inches below the surface. The C horizon consists of red consolidated clay with some coarse and medium sand and stones in it. Its pH is 6.9. This clay contains pockets and lenses of redish

*Field work done on August 5, 1939.

17.
brown, medium, unconsolidated sand containing a few stones
and some fine gravel. The pH of one of these pockets was
6.4. The stones which are scattered throughout this
glacial drift material are made of limestone, sandstone,
and granite.

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SUMMARY

1. This is the report of the 1939 continuation of the long time study designed to show the relationship between the soil and the vegetational cover in the region of Douglas and Burt Lakes, Cheboygan County, Michigan.
2. Soil descriptions were written for the following soils; Grayling Sand, Rubicon Sand, Roselawn Sand, Emmet Loamy Sand, Saugatuck Sand, Granby Sand, Rifle Peat, and Cnaway Sandy Loam.
3. Monoliths were taken of these soils, and these are being preserved at the University of Michigan's Biological Station on Douglas Lake, Michigan.
4. Samples of the soils in each horizon of the various soil types were taken and these are to be analyzed during the coming winter. These samples were tested for pH.
5. A 24 quadrat extension was made on the Grayling sand plot.

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REFERENCES

1. Duncan, D.P. and Varner, R.W. Experiment Designed to show the Relationship Between Soil and Changes in the Vegetational Cover. 1938
2. Mellon, Harvey On map made of this region by the General Land Office Survey. 1855
3. Baldwin, Mark In letter to W. F. Ramsdell Aug.1, 1939