SOIL SURVEY

OF

ONEIDA COUNTY, WISCONSIN

THE UNIVERSITY OF WISCONSIN
WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY
SOIL SURVEY DIVISION

G. F. HANSON,
State Geologist

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Soil Survey Division

IN COOPERATION WITH
THE SOILS DEPARTMENT, COLLEGE OF AGRICULTURE
AND
THE SOIL CONSERVATION SERVICE, U.S.D.A.

Bulletin No. 82 **Soil Series No. 57**

Madison, Wisconsin—Published by the State, 1959

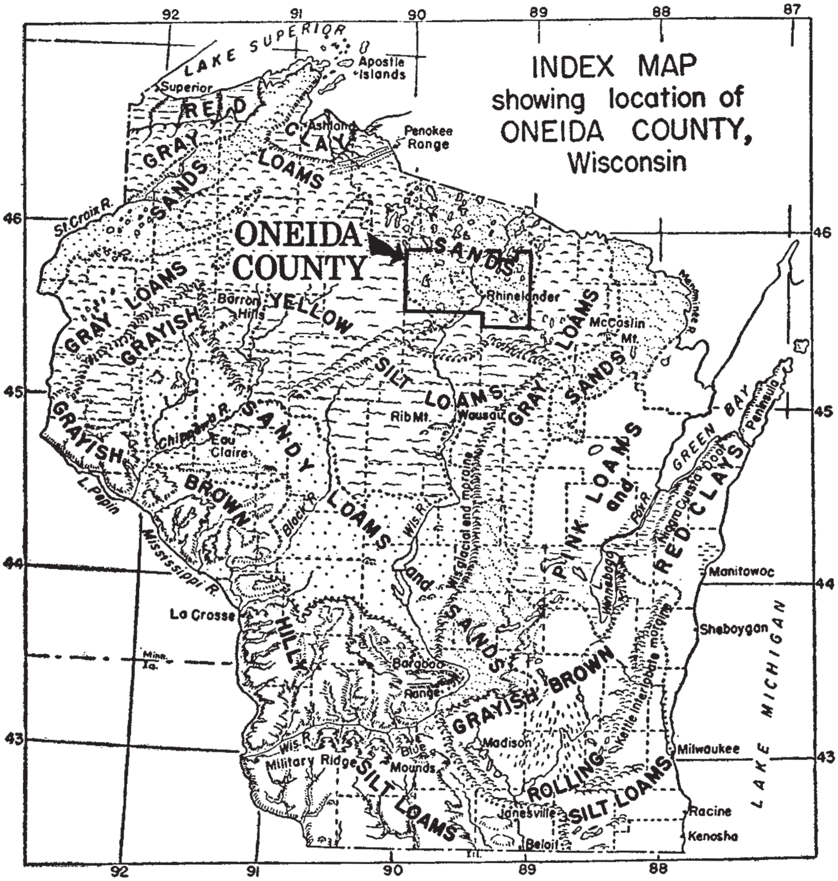

Figure 1. Each kind of soil in Oneida County has a characteristic profile (cross-section) showing definite horizons (soil layers), and a characteristic landscape. This is illustrated by the two examples on page 2, representing two very different soils of the county.

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by

FRANCIS D. HOLE AND KEITH O. SCHMUDE

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MADISON, WISCONSIN
PUBLISHED BY THE STATE
1959

Copies available at 204
Soils Building, University
of Wisconsin, Madison,
Wisconsin, and County
Extension Office, Courthouse,
Rhinelander, Wisconsin
Price, $1.25

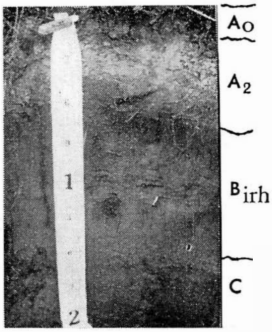

Figure 2. This is a Hiawatha sand, found in extensive sandy areas of Oneida County. There are four distinct layers or "horizons" in this soil (see page 41): an organic mat (A_0), a bleached sand horizon (A_2), a strong brown sand horizon (B_{irh}) slightly cemented with iron (ir) and humus (h), and deep brown sand (C). This is a droughty soil, much used for forestry, wildlife and recreation. This is classified as a medial Podzol. (See unit No. 11 on the colored soil map.)

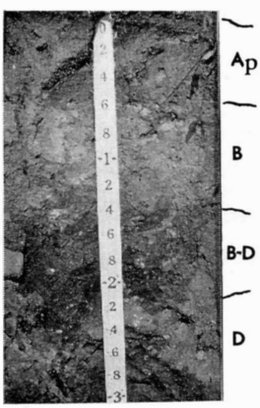

Figure 3. This is a Stambaugh silt loam (see page 47), a productive soil found on outwash flats. The plow layer (A_p) is underlain by a brown silt loam (B_{irh}) horizon, a transitional sandy loam (B–D) horizon, and coarse sand and gravel (D) substratum. The B horizon appears light in the picture because it was dry, whereas the B–D horizon was moist and therefore appears dark. This is classified as a medial Podzol. (See units nos. 1, 2, and 10 on the colored soil map.)

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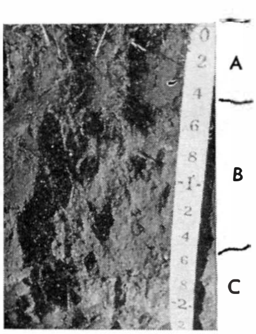


Figure 4. Pence sandy loam on an undulating outwash plain. The sandy loam plow layer (A_p) is underlain by a sandy loam horizon (B) which has been colored brown by iron and humus deposits made long ago under forest cover. The lower four inches of the B horizon constitute a brittle "pan" when dry, but is soft when moist. The substratum (C) is loose acid sand and gravel. This is classified as a medial Podzol. (See units Nos. 5, 6, 12, 17 on the colored soil map.)

REPORT ON THE SOIL SURVEY OF ONEIDA COUNTY, WISCONSIN

By FRANCIS D. HOLE and KEITH O. SCHMUDE

Soil Survey Division, Wisconsin Geological and Natural History Survey
203 Soils Building, University of Wisconsin

I. THE SOIL MAP AND REPORT

The present soil map shows soil associations, sometimes called soil communities (p. 49), which consist of several members. For example, soil unit number "1" on the map is "Stambaugh-Pence soils, nearly level to undulating", and consists of three soils, Stambaugh silt loam, Stambaugh loam, and Pence loam which occur side by side in a level to undulating field or forested landscape. The soil key on page 11 can be used along with the map to good advantage in the field. By means of the soil map, the user may locate himself on a body numbered "1". With a spade he can clear off a road bank or can dig a pit in a field or woods to a depth of about 3 feet, to expose the soil layers or "horizons" (see Fig. 16, p. 34). By reading from left to right on the soil key, using his observations of the soil layers as a guide, he can find the proper name of the soil on the right side of the key. The soil map tells what soils occur together at a given place, and the soil key tells how to distinguish these several soils, one from another. Detailed soil descriptions and various interpretive soil ratings are given in this report.

The map has a scale of ¾-inch equals one mile, and was compiled from field observations made in the summers of 1957 and 1958, from the 1916 reconnaissance soil map of Oneida, Vilas, Iron and Price Counties (28),[1] from several scattered farm soil maps by Mr. Harvey V. Strelow of the Soil Conservation Service, and from data on relief taken by stereoscopic examination of aerial photographs of Oneida County, on file in the office of the U. S. Agricultural, Stabilization and Conservation agency in Madison. Planimetric quadrangle maps published by the U. S. Geological Survey were used as a base. K. O. Schmude served as Party Chief, R. D. Melville as his assistant and F. D. Hole as soil correlator in the field. A. J. Klingelhoets spent a week with the field party in September, 1957. Final correlation in August, 1958 was conducted by A. H. Paschall, Senior Soil Correlator, Soil Conservation Service, St. Paul. William DeYoung, State Soil Scientist, Mr. J. Kenneth Ableiter, Principal Soil Correlator, and R. W. Simonson, Director of soil classification and correlation, Soil Conservation Service, re-

[1] Numbers in parentheses refer to items in the bibliography.

SOIL PHOTO-MAP

Parts of Sections 10 and 11, Town of Sugar Camp, Oneida County, Wisconsin

Adapted by permission from a field sheet of the Soil Conservation Service, prepared by Harvey V. Strelow, Soil Scientist.

Figure 5

LEGEND

Sample symbol: 104—4—1
Soil—Slope—Erosion
Stambaugh loam—4% slope—slightly eroded

Soil Numbers

7	Coarse woody peat
9	Moss peat
21	Iron River loam
28	Emmert gravelly loam
101	Stambaugh silt loam
103	Stambaugh silt loam, imperfectly drained
104	Stambaugh loam
110	Pence loam
111	Pence sandy loam

A = 0 to 2% slope gradient
3,4,5,6, etc. = slope gradient in per cent (feet of fall per 100 ft. of horizontal distance)

Erosion symbols on the Map
1 = Slight erosion
2 = Moderate erosion
3 = Severe erosion

Other symbols

Black square = farmstead
Diamond = natural pit or "kettle"

viewed the correlation. The final map was drawn by R. D. Sale, Cartographer of the Wisconsin Geological and Natural History Survey, using the scribing and dye-strip methods. Frank S. Kelland and Victor P. Healey and the authors prepared the illustrations for the report.

How to use detailed soil maps. A number of detailed soil maps, like the one in Figure 5, page 6, have been made at the request of farmers, and can be consulted in the office of the Soil Conservation Service. The soil map in Fig. 5 shows individual soil bodies and labels them by means of symbols which are explained in the legend below the map. Figure 6 is a sketch of the same area showing several soil associations or soil communities. Immediately southwest of Walters Lake on the sketch (Fig. 6) is a high outwash plain on which the photo-map (Fig. 5) shows nearly level Stambaugh silt loam. This soil body is bounded by steep escarpments which lead down to areas of peat. Southeast of Walters Lake is a rather extensive area of pitted, rolling Stambaugh loam. Along the north boundary of this soil body runs a narrow ridge of Emmert gravelly loam. Rolling Stambaugh loam is the most extensive soil shown. Abrupt pits in this soil mark the former location of large blocks of ice which were buried in the sand and gravel and which melted away slowly after burial (19).

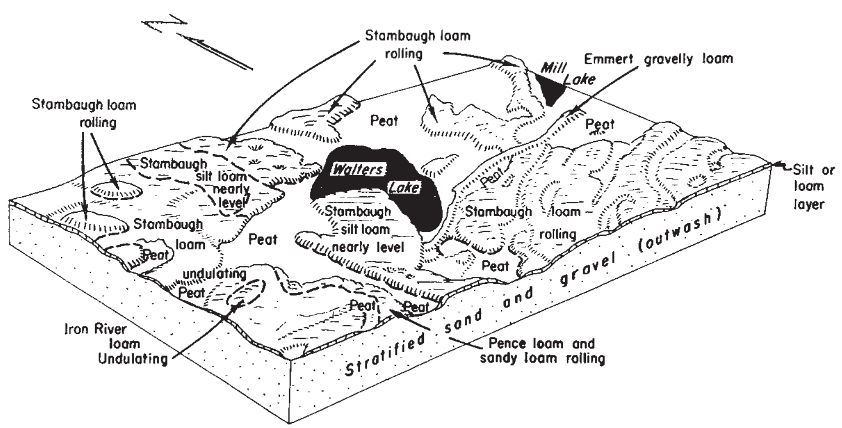


Figure 6. Block diagram of the same area as is shown in the map of Figure 5. The view is from the southwestern corner of the map.

II. ONEIDA COUNTY AGRICULTURE AND FORESTRY

Oneida County was named for a tribe of American Indians who moved from New York state to Wisconsin in the early 1800's. The city of Rhinelander, founded in 1882, was named in honor of the president, in New York City, of the Milwaukee, Lake Shore and Western Railroad, which transported lumber east to Monico and thence to larger centers. Lumbering began in the county in 1857, and by 1890, through the enterprise of men like Abner Conro and the Brown Brothers, eight sawmills were operating day and night in Rhinelander. In 1882 a field newly cleared near the court house in that city yielded an excellent crop of potatoes. In 1905 the present boundaries of the county were established. In 1922 the first Boys' and Girls' Agricultural Club was organized by the new County Agent, A. J. Brann.

The population was about one-fifth of German extraction, somewhat less of Canadian origin, with smaller proportions of Swedes, Norwegians, and Finns. The development of dairy farming meant the return to the soil of plant nutrients and organic matter in the form of manure. The increased use of lime and commercial fertilizers, and the adoption by farmers of erosion control practices, have improved both soil conditions and crop production. It still cannot be said, however, that man-induced soil erosion has been brought under control in Oneida County.

In 1950, 9.2 per cent of the labor force of Oneida County was employed in agriculture, as compared with about 20 per cent of the labor force for the state as a whole. In 1954 there were 416 farms, with an average acreage each of 228.3 acres and a total combined area of 94,962 acres, or 13.0 per cent of the land area of the county. The land use map in Figure 7, page 9, shows the distribution of this farm land. The recent trend has been for farms to increase in size with a consequent reduction in total number of farms. Only 1.4 per cent of the farms were tenant-operated. Farmland in Oneida County was utilized as follows: 34.1 per cent of the area in unpastured woodland, 14.5 per cent in pastured woodland, 20.5 per cent in harvested cropland, 6.7 per cent in pastured cropland. The total cropland amounted to 34 per cent of the area of farmland.

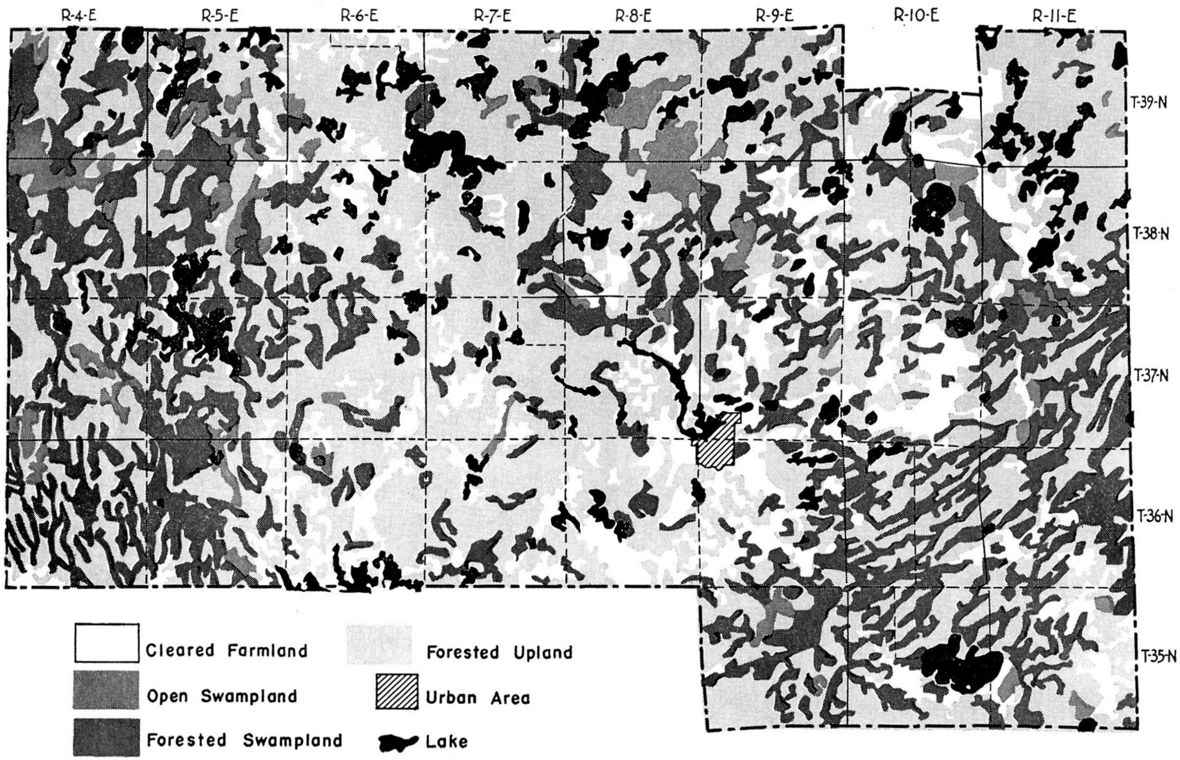
In 1956, 73.2 per cent of the total Oneida County cash farm income of $2,557,000 was from the sale of crops, 26.8 per cent from the sale of livestock and livestock products, including 13.4 per cent from the sale of milk. Clover-timothy hay, oats, and potatoes ranked in the order named as the most extensive crops. Some rye, barley, corn, buckwheat, cranberries, beans and peas were grown. The numbers of dairy cattle and herds are declining, but the acreage of cranberries is increasing. The potato and cranberry industries account for a large proportion of income from the sale of crops.

In 1952, forest land occupied about 80 per cent of the area of the county. One-fourth of this was publicly owned, including 85,000 acres of county-owned forest, 60,000 acres of the American Legion State Forest, and 10,000 acres of the Nicolet National Forest. The remaining forest lands were owned by farmers (62,400 acres) and other individuals and companies

MAP SHOWING FORESTED AND OPEN AREAS

ONEIDA COUNTY, WISCONSIN

After U.S.G.S. Quadrangle Advance Sheets, 1928-1941



Soil Survey Division, Wis. Geol. and Nat. Hist. Survey, Univ. of Wisconsin

Figure 7.

(364,190 acres). Fir-spruce forest occupied 53,920 acres; black spruce, 47,230 acres; jack pine, 23,890 acres; and cedar, 4,530 acres; tamarack, 16,700 acres; Norway (red) pine, 14,400; white pine, 5,300 acres. Woodland products included fence posts, pulpwood, firewood, sawlogs and veneer logs, maple syrup. The value of forest products sold from Oneida County farms in 1954 totaled almost $50,000 (3).

The large acreage of forest land, just referred to, more than 800 lakes and 45 trout streams, the coolness of the summers, and the abundance of snow and ice in the winter account for the importance of the tourist industry in Oneida County. Pike, bass, and muskelunge are among the species of fish found in the lakes, and brook trout are found in the streams. Hunters find deer, bear, wild fowl and other game in the county.

III. A CLASSIFICATION OF SOILS OF ONEIDA COUNTY

Introduction to the Soil Keys

Oneida County has a total of 757,210 acres (15) of which the Soil Map shows about 66,240 acres covered by water, leaving 690,880 acres of land.

Twenty-one soil units are listed in the legend of the Soil Map. Complete lists of the soils, with acreages, are given in Table II, page 16, and Table V, page 50.

Two types of soil keys are included in this report: a graphic key, Fig. 8 and a tabular key, Table 1. The graphic key can be taken to the field by an observer, who stands on a soil body, and reads across the upper half of the key from left to right to find the soil name which best fits the characteristics of the soil as seen in a pit or in soil samples pulled up with a soil auger (9). The tabular soil key on page 12 is divided into four parts for 1) soils formed from silty materials overlying glacial drift, 2) soils formed from loam materials on glacial drift, 3) soils formed from deep sand, and 4) soils formed from organic materials. These materials are listed on the left side of the table. The remaining columns, from left to right, arrange the soils in order from the most droughty to the wettest. In this table, natural drainage or aeration relationships are assumed, which means that the soils are classified by the natural condition before tiling or ditching or irrigation have been introduced. Because most soils do not change color noticeably, even after drainage or irrigation, the tabular key is useful in classifying soils according to their original characteristics.

It can be seen from the soil keys that Oneida County has a variety of soils, from gravelly and sandy droughty soils to deep, wet peats. The well- to excessively-drained soils are grouped in the tabular key under four headings, which are defined in foot-notes, as are a number of other terms used in the table.

GENERALIZED SOIL KEY FOR USE IN LANDSCAPES OF ONEIDA COUNTY, WISCONSIN

(Note: A soil key for your farm will be simpler. Your agricultural leader can help you prepare a soil key for your vicinity.)

LAY OF THE LAND — SOIL PROFILE — SOIL NAME

ALL SOILS IN THE LANDSCAPE

- Soils above bogs and streams and therefore not flooded with water nor wet permanently. Soils nearly level to hilly.
  - Sandy soils over loose sand with little gravel
    - Deep sand or loamy sand surface soil overlying sand at 6 inches
      - "B" horizon is brown (7.5YR4/4) underlying very dark "A_p" or "A_1" .... OMEGA
      - "B" horizon is reddish brown (5YR4/4) 2-4 inches thick underlying "A_p" or 1-3 inch "A_2" (5YR6/2) .... VILAS
      - "B" is reddish brown, 4-10 inches thick and slightly cemented, underlying "A_p" or 3-7 inch "A_2" .... HIAWATHA
      - "B" is dark reddish brown (5YR3/3), 10-20 inches thick and cemented, underlying 7-15 inch "A_2" .... AU TRAIN
    - Loamy sand surface soil overlies sand at 18 to 42 inch depths
      - "B" is brown to reddish brown (7.5YR3/4 to 5YR4/4) underlying "A_p" or 1-3 inch "A_2" .... CRIVITZ
  - Loams and silt loams over loose sand and gravel
    - Silt loam is 18 to 42 inches deep .... STAMBAUGH
    - Sandy loam or loam is 12 to 24 inches deep .... PENCE
  - Silt loams and loams 18-42 inches thick over brown (7.5YR) to reddish brown (5YR) stony sandy loam
    - Surface silt loam is 18-42 inches deep .... GOODMAN
    - Surface silt loam is 18-24 inches deep
      - No gray and rusty spots present .... IRON RIVER
      - Gray and rusty spots present below 3 inch depth .... MONICO
    - Surface loam is less than 20 inches deep
      - Gray and rusty spots present below 12 inch depth .... LYNNE
      - Gray and rusty spots present below 3 inch depth .... CLIFFORD
  - Silt loams, loams, and sandy loams less than 18 inches thick over brown, stony, sandy loams .... ELDERON
  - Gravelly, stony soils .... EMMERT
- Soils on low ground where water stands after rains or where soils are permanently wet.
  - Sandy soils on loose sand with little gravel
    - Gray and rusty spots present below 3 inch depth .... AU GRES
    - Whitish "A_2" 6 to 12 inches thick, over dark brown, rusty spotted "B" .... SAUGATUCK
  - Silt loams and loams over stony sandy loams
    - Surface silt loam and loam is 12-18 inches thick
      - Nearly black "A_1" is less than 5 inches thick overlying mottled "A_3" & "C" .... CABLE
      - Nearly black "A_1" is more than 6 inches thick overlying mottled "A_3" & "C" .... ADOLPH
    - Surface silt loam and silty clay loam (B)- 18-24 inches
      - Dark brown "A_1" is less than 5 inches thick overlying 5-inch mottled pale "A_2" over a mottled slightly finer textured "B" .... AUBURNDALE
  - Organic soils of bogs; soil is greater than 12 inches thick over sand, silt, or loam .... PEATS
  - Overwash material from slopes onto one or more of the above low-lying soils .... LOCAL ALLUVIAL SOILS

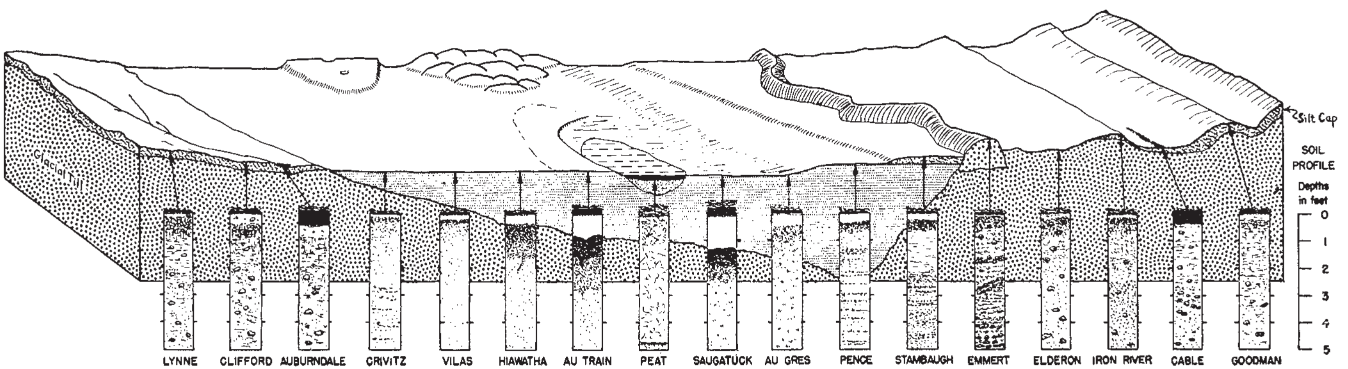


Figure 8.

TABLE 1.—TABULAR KEY TO THE SOILS OF ONEIDA COUNTY, WISCONSIN

Parent Materials[1] from which the soils formed		SOILS										
		Podzol[7]								Humic-Gley[18]		
		Regosolic[4]	Well drained to excessively drained[8]				Moderately well drained[13]	Imperfectly[14] drained	Ground-water Podzol[15]	Low Humic Gley[17]	Humic Gley[18]	Bog
			Disturbed minimal[9]	Minimal[10]	Medial[11]	Maximal[12]						
Silty surface layer present	18–42″ of silty material over acid sand and gravel outwash[2]				Stambaugh silt loam and loam							
	24–42″ of silty material over brown (7.5 YR) sandy loam till[3]				Goodman silt loam						Adolph silt loam	
	12–24″ of silty material over reddish (5 YR) loam till						Lynne silt loam and stony silt loam	Clifford silt loam and stony silt loam		Auburndale silt loam	Adolph silt loam	
Loam surface layer present	12–24″ loam to heavy sandy loam layer over acid sand and gravel outwash				Pence loam sandy loam							
	Less than 24″ of loam to silt loam layer over brown (7.5 YR) sandy till				Iron River sandy loam and silt loam			Monico silt loam and loam		Cable silt loam and loam	Adolph silt loam	
	Less than 18″ of gravelly sandy loam to silt loam layer over cobbly, stony till	Emmert[5] gravelly sandy loam		Eldcron sandy loam, silt loam								
Deep sand present	Deep (more than 5 feet) reddish-yellow acid sand outwash	Omega[6] sand and loamy sand	Vilas sand and loamy sand		Hiawatha sand and loamy sand	Au Train sand and loamy sand		Au Gres and lomay sand	Saugatuck sand and loamy sand			
	Reddish-yellow acid loamy fine sand 18–42″ deep over deep acid sand outwash		Crivitz loamy fine sand									
Organic material: wood, moss, grasses and sedges												Peat

Notes on Table 1:

[1]Parent materials are inorganic or organic materials from which soils are forming or have formed. In Oneida County these materials are acid.

[2]Outwash is sorted and stratified coarse material (sand, gravel) deposited by meltwaters from glaciers.

[3]Till is stony unsorted, unstratified material deposited by glaciers.

[4]Regosolic means nearly a Regosol, a very young soil in which A and C horizons alone are present.

[5]Emmert soils are intergrades from Regosol toward minimal Podzol.

[6]Omega soils are intergrades from Regosol toward minimal Brown Podzolic.

[7]Podzol is the name of a great soil group of soils of northern cool humid climatic zones. These soils are characterized by a forest humus layer underlain by a nearly white horizon over a coffee-brown B horizon.

[8]Well drained soils are medium textured soils (silt loams, loams, and fine sandy loams) which show little or no mottling in the A and B and upper C horizons. Excessively drained soils show no mottling in the profile, and include deep sands and coarse sandy loams, medium textured soils overlying sand or gravel.

[9]Disturbed minimal Podzols are those without a distinct nearly white (A_2) horizon. Apparently the humus layer has been mixed with the A_2, producing a dark grey horizon overlying the coffee-brown B horizon.

[10]A minimal Podzol is a slightly developed Podzol. In Oneida County, this Podzol in sand usually has an A_2 ½ to 3 inches thick, and an orterde (5YR ¾) 5 to 7 inches thick. In silty material, this Podzol shows an A_2 about 1 inch thick and a B horizon (5YR ¾) 3–5 inches thick, with medium platy to weak subangular blocky structure. Reference is to colors of moist soil.

[11]A medial Podzol is a moderately well developed Podzol. In Oneida County, this Podzol shows an A_2 horizon 3 to 7 inches thick and a strongly developed orterde 7 to 14 inches thick in sandy material. In silty material, this Podzol has an A_2 2–6 inches thick and a B horizon (5YR ¾) 8 to 15 inches thick, with medium platy to weak subangular blocky structure.

[12]A maximal Podzol is well developed. In Oneida County, this Podzol is found in sandy material and has an A_2 horizon 7 to 15 inches thick and an ortstein 6 to 20 inches thick.

[13]Moderately well drained soils are those which under natural drainage conditions show some yellow and grey mottling in the B and C horizons, and somewhat duller colors in the lower A horizon than is characteristic of the well drained associated soils.

[14]Imperfectly drained soils are those which under natural conditions show mottling in the B, C, and lower A horizons, more strongly than do moderately drained soils.

[15]Ground-water Podzols are Podzols showing maximal development and found associated with peat. These soils are believed to be formed under wet conditions.

[16]Humic-Gley Soils are mineral soils which occupy wet positions near peat bogs, and have black surface soils overlying bluish-grey subsoils which are mottled.

[17]Low Humic-Gley Soils have dark A horizons which are shallower than plow-depth (about 7 inches).

[18]These Humic-Gley soils have black A horizons which are deeper than plow-depth.

IV. SOIL PRODUCTIVITY RATING ESTIMATES FOR ONEIDA COUNTY

Introduction to the Soil Productivity Rating Table

Crop yields vary from soil to soil. The best soils may be regarded as "blue-ribbon" soils, which, like stock-show animals, excel in productivity. Like a superior animal, a superior soil has a fine heritage and has received good care from its owner. A poor soil, like the Emmert gravelly sandy loam, cannot be eliminated from a farm, as a poor stock animal can, except as it is excavated and hauled off the farm by sand and gravel trucks. In this case, the remaining substrata of sand and gravel or the exposed water table are even less productive of agricultural crops. But such a soil may be eliminated from cultivation. It can be put to the best use suited to it and to the economy of the farm. In this sense, no soil on the farm is an entirely unproductive soil. The Emmert gravelly sandy loam is better suited to woodland and wildlife than to any other uses. Some soils, which are not well suited to agricultural crops, respond remarkably to improved or intensive management. Crivitz loamy fine sand, of low natural productivity can, with fertilization and other good management practices, be improved from an eighth to a fifth rate soil, according to Table II. This shows a greater response than in the case of Pence loam, a more productive soil, which can be improved with good management from a sixth to a fourth rate soil for hay and oats. With proper irrigation, the highest levels of crop production can be maintained year after year on droughty soils like the Pence. Shelter belts of conifers, as noted in Sections 24 and 25, T. 39 N., R. 10 E., help control wind erosion of the sandy soils, reduce consequent damage to crops, increase snow cover to protect legumes and winter grains during the cold months.

Soil tests, made by the Soils Department, College of Agriculture, indicate that the plow layers of newly cleared fields are acid, and low in content of available phosphorous and potassium. Professor R. B. Corey and others, reporting on soil samples collected by K. O. Schmude for a cooperative subsoil fertility project, give the following fertility information for an uncultivated Pence sandy loam in the SE¼, SE¼, Sec. 19, T. 36 N., R. 10 E.:

Depth	*Texture*	*pH*	*Available P*	*Available K*
0–6″	sandy loam	4.8	11 lb./acre	98 lb./acre
6–12″	sandy loam	5.0	11 lb./acre	24 lb./acre
12–18″	sandy loam	5.0	4 lb./acre	18 lb./acre
18–24″	sand and gravel	5.2	3 lb./acre	14 lb./acre
42–48″	sand and gravel	5.6	36 lb./acre	18 lb./acre

(Available phosphorous was determined by the State Soil Testing Laboratory method. Available potassium was determined from undried soil samples.)

In older fields, fertilizer application may have raised the phosphorous content to adequate levels, but the available potassium supply is likely to be inadequate still. The soils are allowed to remain acid in reaction on potato fields to help keep the crop free of infection, but alfalfa fields of dairy farms should be limed. With changes in fertilizer applications and management practices, the fertility levels of the soils change. Therefore, the general productivity ratings in Table II, page 16, are estimated on the basis of a scale of one to ten, with "1" for the soil most productive of hay and oats in the county. Soils differ as to reserves of moisture and plant nutrients which they carry in the subsoils. These differences are taken into account. The reader will need to consult the County Agricultural Agent and the Soils Department of the University of Wisconsin to determine current crop yields for crops and management levels not shown, or after current recommendations have gone out of date. Detailed management recommendations can be obtained from the College of Agriculture, the Soil Conservation Service, and the County Agricultural Agent.

For best results with oats, with a legume-grass seeding, the following steps should be taken: lime and fertilize the soil according to soil test recommendations; plant, clean, viable seed of adapted varieties at recommended rate; plant oats early and at the right depth. Recommendations for the production of legume-grass hay are: use recommended seeding mixtures; plant only clean, viable seed of recommended varieties; if seeding is threatened by lodged oats or by drought, remove oats for silage or hay; cut hay early when it is of best quality, and cut no more than twice in one growing season in Oneida County; topdress the stand each year with a maintenance application of phosphate and potash fertilizer, adding boron if needed; protect the stand from grazing and cutting from early September to mid-October (13).

Farm woodlands should be fenced to prevent damage by livestock. Lumber, pulp wood, Christmas trees, fence posts, and fire wood can be taken from forests according to approved methods. Trees protect soil from erosion. Care must be taken to avoid soil erosion along access roads into woodlands (21).

Wildlife is an important element in the economy of Oneida County. Game management advice can be obtained from wildlife conservation specialists of the Wisconsin Conservation Department and the College of Agriculture in Madison.

General land types and land use in Oneida County are outlined in Fig. 7, which is a map showing forested and open areas.

TABLE II.—SOIL PRODUCTIVITY RATING ESTIMATES, ONEIDA COUNTY, WISCONSIN

Map Symbol[1]	Soils listed in order[2] as given in the legend of the soil map	Approximate area (and proportionate extent) Acres (Percent)	General Productivity Ratings[3]	Crop Productivity Ratings[4]: Timothy and Clover Hay (Tons)	Crop Productivity Ratings[4]: Alfalfa-Brome Hay (Tons)	Crop Productivity Ratings[4]: Oats (bu.)	Crop Productivity Ratings[4]: Potatoes[5] (bu.)	Crop Productivity Ratings[4]: Corn[6] silage (tons)	Crop Productivity Ratings[4]: Native Bluegrass Pasture[7]	Woodland Productivity Ratings[8] — Board Feet (BF) (Scrib. Dec. C) or Standard Cords (Cd) Per Acre Per Year: Hardwoods	Woodland Productivity Ratings[8] — Board Feet (BF) (Scrib. Dec. C) or Standard Cords (Cd) Per Acre Per Year: Conifers
1, 2, 10, 13 (5, 6)	Stambaugh silt loam and loam	15,990 (2.3)	6(1)	1.3 (2.75)	1.5(3.0)	35(65)	150(300)	5(6–9)	0.75(1.5)	250 BF	325 BF
1, 2, 5, 6, 10, 12, 13, 17 (8, 11, 14)	Pence loam and sandy loam	86,940 (12.6)	6(4)	1.1 (1.75)	1.3(2.0)	30(50)	110(200)	4(6–9)	0.5 (1.0)	175 BF	300 BF
3, 7 (16)	Goodman silt loam	12,290 (1.8)	6(1)	1.4 (3.0)	1.8(3.5)	35(70)	140(285)	4(9–12)	1.0 (2.0)	300 BF	325 BF
3, 7, 8, 14 (10, 13, 17, 18, 19)	Iron River silt loam, loam, sandy loam and stony phases	50,349 (7.3)	6(2)	1.2 (2.75)	1.6(3.5)	28(65)	110(200)	4(9–12)	0.75(1.5)	200 BF	300 BF
4, 9	Lynne silt loam and stony silt loam	2,930 (0.4)	6(1)	1.6 (3.25)	1.6(4.0)	30(65)	--------	4.6(12–15)	1.25(2.5)	225 BF	275 BF
4, 9, 15	Clifford silt loam and stony silt loam	10,479 (1.5)	7(1)	1.6 (3.0)	---(4.0)	25(65)	--------	4.5(9–12)	1.5 (3.0)	200 BF	250 BF
5, 6, 11, 12, 17, 18, (2, 19)	Vilas sand and loamy sand	189,453 (27.6)	9(6)	----(1.25)	0.6(1.5)	14(35)	---(175)	2(3–6)	0.25(0.5)	0.4 Cd	250 BF
8, 14, 19 (18)	Elderon sandy loam and stony sandy loam	28,661 (4.1)	7(3)	0.8 (2.25)	1.2(3.0)	25(55)	90(175)	3(9–12)	0.5 (1.0)	150 BF	275 BF
(1, 5, 6, 11, 12, 17, 18	Crivitz loamy fine sand	47,331 (6.9)	8(5)	0.7 (1.25)	0.8(1.5)	18(40)	95(190)	2.2(6–9)	0.25(0.5)	150 BF	250 BF
(11, 18)	Hiawatha sand and loamy sand	12,000 (1.7)	8(6)	----(1.25)	0.8(1.5)	18(35)	95(190)	---(4–5)	0.25(0.5)	0.4 Cd	250 BF
(11, 18)	Omega loamy sand	12,000 (1.7)	9(6)	----(1.25)	0.6(1.5)	14(35)	---(175)	2(6–9)	0.25(0.5)	0.4 Cd	250 BF
15 (4, 9)	Auburndale silt loam and stony silt loam[9]	2,188 (0.3)	8(2)	1.75(2.75)	---(3.5)	20(60)	--------	---(9–12)	0.75(1.5)	150 BF	175 BF
16 (3, 7)	Monico silt loam and loam and stony phases[9]	6,569 (1.0)	7(1)	2.25(3.0)	---(4.0)	22(65)	--------	---(9–12)	1.5 (3.0)	200 BF	250 BF
16, 20	Cable silt loam, loam and stony phases[9]	5,870 (0.8)	10(2)	----(3.0)	---(2.75)	--(60)	--------	---(9–12)	-------	125 BF	150 BF
19	Emmert gravelly sandy loam	2,308 (0.3)	10(10)	0.5 (1.6)	1.0(2.2)	------	--------	----------	----------	0.4 Cd	250 BF
20, 21 (16)	Peat	158,383 (23.0)	10(10)	----------	--------	------	--------	----------	----------	0.2 Cd	0.3 Cd
21	Saugatuck sand	16,013 (2.3)	10(10)	----------	--------	------	--------	----------	----------	0.3 Cd	100 BF
(2, 5, 6, 8, 11, 21)	Au Gres loamy fine sand[9]	26,442 (3.8)	10(4)	1.0 (1.5)	---(2.0)	(45)	--------	---(9–12)	0.5 (1.0)	0.3 Cd	150 BF
(15, 16, 20)	Local Alluvium	2,258 (0.3)	10(10)	----(2.5)	--------	------	--------	----------	0.25(0.50)	150 BF	175 BF
(20)	Adolph silt loam and stony silt loam[9]	1,503 (0.2)	10(2)	----(3.5)	---(2.75)	--(60)	--------	---(9–12)	----------	125 BF	150 BF
(1, 4, 9)	Imperfectly drained soils, undifferentiated	943 (0.1)	7(5)	1.5 (2.8)	--------	23(42)	--------	----------	0.5 (1.0)	200 BF	250 BF
		690,880(100.0)									

Notes on Table 2:

[1] Each map symbol number stands for a soil association listed in the legend of the soil map. In the first column on the left, in the table above, a number without parentheses represents a soil association which specifically cites the soil names in the second column of the table. A number within parentheses represents a soil association which does not cite the soil in question, but which actually includes small areas of it, as mapped.

[2] Those soils which appear more than once in the soil map legend are named only once here. For example, the Clifford soil is named in soil associations numbered 4, 9, and 15, but is listed only once in the table.

[3] Soils having the highest productivity of hay and oats in the country are rated grade "1", on a scale of 1 to 10. Ratings without parentheses are for the soils under the common management now followed by most farmers in the area. Ratings in parentheses indicate the productivities of the same soils under "high management", which includes liming and fertilizing according to soil test, maintaining optimum conditions of drainage and tilth, proper planting of good seed of most productive crop varieties, controlling diseases and harmful weeds and insects. It is apparent from the table that no soil in Oneida County ranks higher than sixth under common management. Five soils rank first for hay and oats under a high level of management.

[4] Dashes (—) indicate that the crop is usually not grown on the soil due to unfavorable conditions. Yields in parentheses are those resulting from high management, as contrasted with the preceding yield figures, which represent results under common management. High yield estimates are taken from tables prepared by A. J. Klingelhoets and M. T. Beatty in July, 1958, and represent long time averages under best management. Crop yield estimates are given for all soils on slopes less than 6% in gradient.

[5] The high-level management yields for potatoes, as given in parentheses in this column, can be approximately doubled with irrigation.

[6] Corn for grain will not mature in Oneida County in most years because of the short frost-free season and low summer temperatures. In years with a favorable growing season, productivity ranges from about 45 bushels under common, and 60 bushels under high management on Stambaugh silt loam to 25 bushles under common, and 45 bushels under high management on Omega sand.

[7] Bluegrass pastures are usually found on steeper, stonier, droughtier or wetter soils than are cultivated crops. As indicated above, production of total dry matter is approximately doubled with proper fertilization. Grazing management determines how much dry matter is recovered. For this reason pasture yield is expressed in tons per acre per year, rather than in cow-days per acre.

[8] The above provisional yields for woodland are for the most part quoted from tables of estimated long-time average yields of crops and timber in Wisconsin, as compiled by A. J. Klingelhoets of the Soil Conservation Service, U.S.D.A., and M. T. Beatty of the Soils Department, College of Agriculture, and Wis. Geological and Nat. Hist. Survey, University of Wisconsin in July, 1958. Woodland yields are given for soils on all slopes.

[9] Yields under high management (figures in parentheses) are for soils with adequate drainage.

TABLE III.—GENERAL RATINGS OF SOILS OF ONEIDA COUNTY, WISCONSIN WITH REGARD To SOME ENGINEERING PROPERTIES

Soil Name	Soil Horizon	Drainage or aeration index[1]	Estimated infiltration rate[2], natural soil (inches)	Highway Research Board Classification estimates[3]	Estimated frost susceptibility rating[4]	Estimated pumping susceptibility rating[5]
Emmert gravelly sandy loam	C horizon (below 6 in.)	-10	15.0	(A-2)	(F-0)	(N)
Vilas sand and loamy sand	B, C horizons (below 12 in.)	-10	10.0	(A-3)	(F-0)	(N)
Omega sand and loamy sand	B, C horizons (below 12 in.)	-10	10.0	(A-3)	(F-0)	(N)
Hiawatha sand and loamy sand	B, C horizons (below 12 in.)	-9	10.0	A-2-4	F-2	N
Crivitz loamy fine sand	B, C horizons (below 12 in.)	-8	10.0	(A-3)	(F-2)	(N)
Pence sandy loam and loam	A, B horizons (0–15 in.)	-5	8.0	(A-4) to (A-2)	(F-2) to (F-3)	(N)
	C horizon (below 24 in.)			(A-2)	(F-2) to (F-3)	(N)
Elderon sandy loam and stony loam	A, B horizons (0–15 in.)	2	8.0	A-4	F-2	Y
	C horizon (below 24 in.)			A-2-4	F-2	N
Iron River loam	A, B horizons (0–15 in.)	-1	6.0	(A-4)	(F-2)	(N)
	C horizon (below 24 in.)			(A-2)	(F-2)	(N)
Stambaugh silt loam and loam	A, B horizons (0–15 in.)	0	2.0	(A-4)	(F-4)	(Y)
	D horizon (below 48 in.)			(A-1)	(F-0)	(N)
Goodman silt loam and stony silt loam	A, B horizons (0–15 in.)	+1	1.0	(A-4)	(F-4)	(Y)
	D horizon (below 36 in.)			(A-2)	(F-2)	(N)
Lynne silt loam and stony silt loam	A, B horizons (0–15 in.)	+2.5	0.3	(A-4)	(F-4)	(Y)
	D horizon (below 24 in.)			(A-2)	(F-2)	(N)
Clifford silt loam and stony silt loam	A, B horizons (0–15 in.)	+4	0.08	(A-4)	(F-4)	(Y)
	D horizon (below 24 in.)			(A-2)	(F-2)	(N)
Monico silt loam and loam, and stony phases	A, B horizons (0–15 in.)	+4	0.08	(A-4)	(F-4)	(Y)
	D horizon (below 24 in.)			(A-2)	(F-2)	(N)

TABLE III.—GENERAL RATINGS OF SOILS OF ONEIDA COUNTY, WISCONSIN WITH REGARD TO SOME ENGINEERING PROPERTIES—Continued

Soil Name	Soil Horizon	Drainage or aeration index[1]	Estimated infiltration rate[2], natural soil (inches)	Highway Research Board Classification estimates[3]	Estimated frost susceptibility rating[4]	Estimated pumping susceptibility rating[5]
Au Gres loamy sand	B, C horizons (below 12 in.)	+ 4	0.10	(A-3)	(F-0)7	(N)
Saugatuck sand	B, C horizons (0–12 in.)	+ 5.5	0.05	(A-3)	(F-0)	(N)
Auburndale silt loam	A, B horizons (0–10 in.)	+ 7	0.05	(A-4)	(F-4)	(Y)
	D horizon (below 48 in.)			(A-4)	(F-4)	(Y)
Cable silt loam and loam, and stony phases	A, C_1 horizons (0–15 in.)	+ 7	0.05	(A-4)	(F-4)	(Y)
	C_2, D horizons (below 24 in.)			(A-4)	(F-4)	(Y)
Adolph silt loam and stony silt loam	A, C_1 horizons (0–15 in.)	+8.5	0.05	(A-4)	(F-4)	(Y)
	C_2, D horizons (below 24 in.)			(A-4)	(F-4)	(Y)
Peat	All organic horizons	+10	0.05	(A-8)	(F-4)	(Y)

Note: (4) In the above table, in columns 5, 6, and 7 counting from left to right, actual laboratory determinations made by W. M. Haas are given without parantheses, but figures in parentheses are estimates only, made by F. D. Hole.

[1]Natural aeration or drainage index (6) refers to the general or average degree of wetness (symbols preceded by "+") or dryness (symbols preceded by "—") of a soil in the field. Natural aeration is controlled, among other things, by texture of material, position of the soil with respect to water table, and influence of various layers or horizons conducive to seepage. Artificially drained soils are not considered in the table. Artificial drainage changes the aeration index of a soil from a natural one to an artificial one.

[2]Estimated infiltration rates of water in inches per hour through saturated, undisturbed soil under a ¼-inch head of water. Estimates based on unpublished report of James A. Pomerening, "Relative Infiltration Rates of Several Soil Types in Wisconsin", Soil Survey Division, Wisc. Geological and Nat. Hist. Survey, University of Wisconsin.

[3]The Highway Research Board Classification of materials for subgrade purposes includes group and subgroup classes. These are based on laboratory tests of soil samples. Examples from the table: A-2 is a Group designation; A-2-4 is a Subgroup designation. The various groups may be characterized very briefly as follows: A-1, well graded materials; A-2 poorly graded materials; A-3, sandy materials in which internal friction is a significant factor; A-4, cohesionless silts and friable clays; A-5, silts and sands; A-6, cohesive clays; A-7, flocculated clays; A-8, peats and mucks.

[4]Frost susceptibility ratings may be characterized briefly as follows: F-0, generally not frost-susceptible; F-2, moderately frost-susceptible; F-3, severely frost-susceptible; F-4, very severely frost-susceptible. Note that the above ratings are based on soil texture alone, and not on availability of moisture. The natural soil drainage or aeration index does take availability of moisture into account. A combination of soil texture and moisture availability gives a measure of the frost susceptibility of a soil in the field.

[5]Pumping is a process of ejection of water and soil from beneath a pavement under pressure from wheel loads. The soil and water may be pumped by traffic up through cracks or laterally from beneath pavement. The net result is damaging to the pavement because of the local removal of supporting subgrade. In this table, two classes of soils with regard to pumping (Ohio criteria) are indicated as follows: N—no pumping; Y—yes, pumping occurs.

V. SOIL RATINGS FOR ENGINEERING USES: GENERALIZED TABLE

Introduction

Although soils are used chiefly as media for plant growth, increasing acreages of soils are being used to support roads and buildings. This chapter is introduced here to call attention to some differences which exist between soils in performance as supporting materials for pavements and other structures (4).

Soil bodies, like lakes, are of various sizes and shapes. But all bodies of a given kind of soil behave about the same when subjected to pressure, as under a highway. The rate of movement of water through a soil is one of the characteristics of the soil. Highways remain in good condition for relatively long periods of time on well-drained, permeable soils like Vilas sand. Roads deteriorate rapidly wherever they are improperly laid on imperfectly drained soils like Clifford silt loam. Bodies of naturally moist or wet soils can be quickly located by means of the soil map, in conjunction with Table 1 and Figure 8. Road construction on these sites can be handled in such a way as to minimize the effects of the instability inherent in these soils. It is recommended that a more detailed soil map be made especially for engineering uses along any major highway right-of-way before road construction begins.

The general groupings of soils in the Soil Keys, presented on preceding pages of this bulletin, can be given general interpretations with respect to engineering structures. Bodies of colluvial or local alluvial soils (see Fig. 8) indicate sites where engineering structures need protection from flood and ice damage. All silty soils such as Lynne, Clifford, Monico, Auburndale, Cable, and Adolph, are likely to exhibit frost heaving wherever moisture is present during a freezing period. Au Gres and Saugatuck sands, formed from stratified deposits of lake flats and now saturated with water at shallow depths, are also subject to frost action, because of high water table.

Table III presents some data and estimated indexes for soils of Oneida County, with respect to engineering properties. The data for the Hiawatha and Elderon soils were furnished by Professor Wilbur M. Haas, of Michigan College of Mining and Technology, Houghton, Michigan (4). Infiltration rates are estimated, and serve to indicate the relative rates at which water can be expected to move downward through the soils in place in the field.

It should be noted that the natural drainage or aeration index (6) has a range from a minum value (— 10, extremely dry) through an optimum condition (+ 1) to a maximum positive index (+ 10, exteremely wet). This differs from, but can be related to the engineers' concept of positive values ranging from dry to wet.

Because bodies of representative soil series occur in repeating patterns up and down hills in a landscape, the highway engineer is confronted with a succession of soil situations which is fairly orderly. Table 1 shows that soil series are related to each other in dry-to-wet sequences, such as the Iron River–Monico–Cable–Adolph sequence.

VI. HOW THE SOILS OF ONEIDA COUNTY FORMED

The climate and vegetation of Oneida County have caused the soils to develop very differently from soils in other climatic and vegetational zones, as in southwestern Wisconsin, for example. Differences between soils within the county may be traced, in many instances, to differences in parent materials or in topography. The maps in this section of the report help explain the formation of soils of Oneida County, Wisconsin.

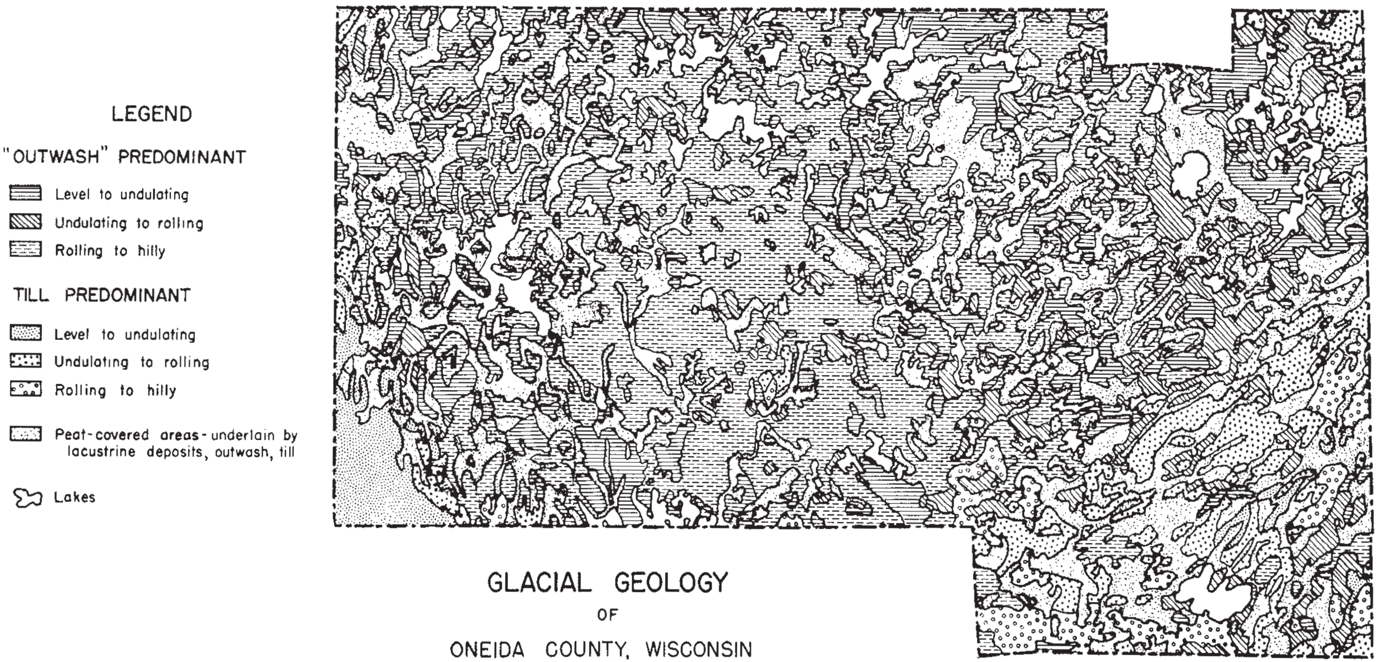
BEDROCK FORMATIONS. Geologic maps of Oneida County (8,14) list the bedrock as undifferentiated crystalline rocks of pre-Cambrian age, outcrops of which are indicated on the soil map. Oneida County lies within the southern extension of the Canadian Shield, which in Wisconsin is referred to approximately as the Northern Highland (15). The great variety of minerals in the sandy soils of the county are derived from crystalline rocks.

SURFICIAL DEPOSITS. Thousands of years ago continental glaciers or ice-sheets moved across the area now called Oneida County. About 14,000 years ago the ice advance, during the Cary substage of the Wisconsin stage of Pleistocene glaciation, undoubtedly covered deposits and ice blocks left by previous ice advances. The general flow of ice was from northeast to southwest, as indicated by drumlins and other molded forms, and by eskers and other stagnation features.

The ice left several kinds of deposits, as follows: 1) unsorted debris called "till", deposited directly from the ice with little or no reworking by water; 2) sorted and stratified water-laid glacial drift (glacio-fluvial deposits: inwash and outwash) including a) sand and gravel deposits from rapidly flowing melt-waters, and b) fine sand, silt and clay deposits in quiet waters. The glacio-fluvial deposits (labeled "outwash" in Figure 9) may be subdivided on the basis of topography into unpitted and pitted. The pitted deposits at one time contained buried ice blocks (19), which eventually melted, leaving the pits. These are called kettles, or kettle lakes if occupied by water.

Most till in the county is sandy and is not easily distinguished from glacio-fluvial deposits. In places these two kinds of drift occur in complex association as in the S.W. 1/4 S.E., 1/4 Sec. 23, T. 35 N., R. 11 E., and in the S.E. 1/4 S.E. 1/4 Sec. 20, T. 38 N., R. 4 E., where small islands of till were found in stratified drift. In the S.W. 1/4 S.E. 1/4 Sec. 33, T. 37 N. R. 7 E., about 20 feet of sandy loam till overlie sand. Lenses of clay and silt occur at a depth of 6 to 8 feet in the till at this place. In the southeastern part of the county, in T. 35 N., R. 11 E., a number of parallel ridges appear to constitute an extension of the drumlin field mapped by Thwaites (20) in adjacent Langlade and Forest counties. These ridges are partly till and partly glacio-fluvial materials. Till also occurs in extensive, irregular sheets, called moraines, in the southwest and southeast corners of the county.

Although bedrock outcrops are numerous near Monico in southeastern Oneida County, glacial drift is thick over most of the area. Well records show 233 feet of drift at Woodruff, 215 feet at Minocqua, and 70 to 90 feet at Rhinelander. A well record from Minocqua lists alternating beds



GLACIAL GEOLOGY
OF
ONEIDA COUNTY, WISCONSIN

Figure 9.

STEEP SOILS ON SANDY AND GRAVELLY GLACIAL DRIFT

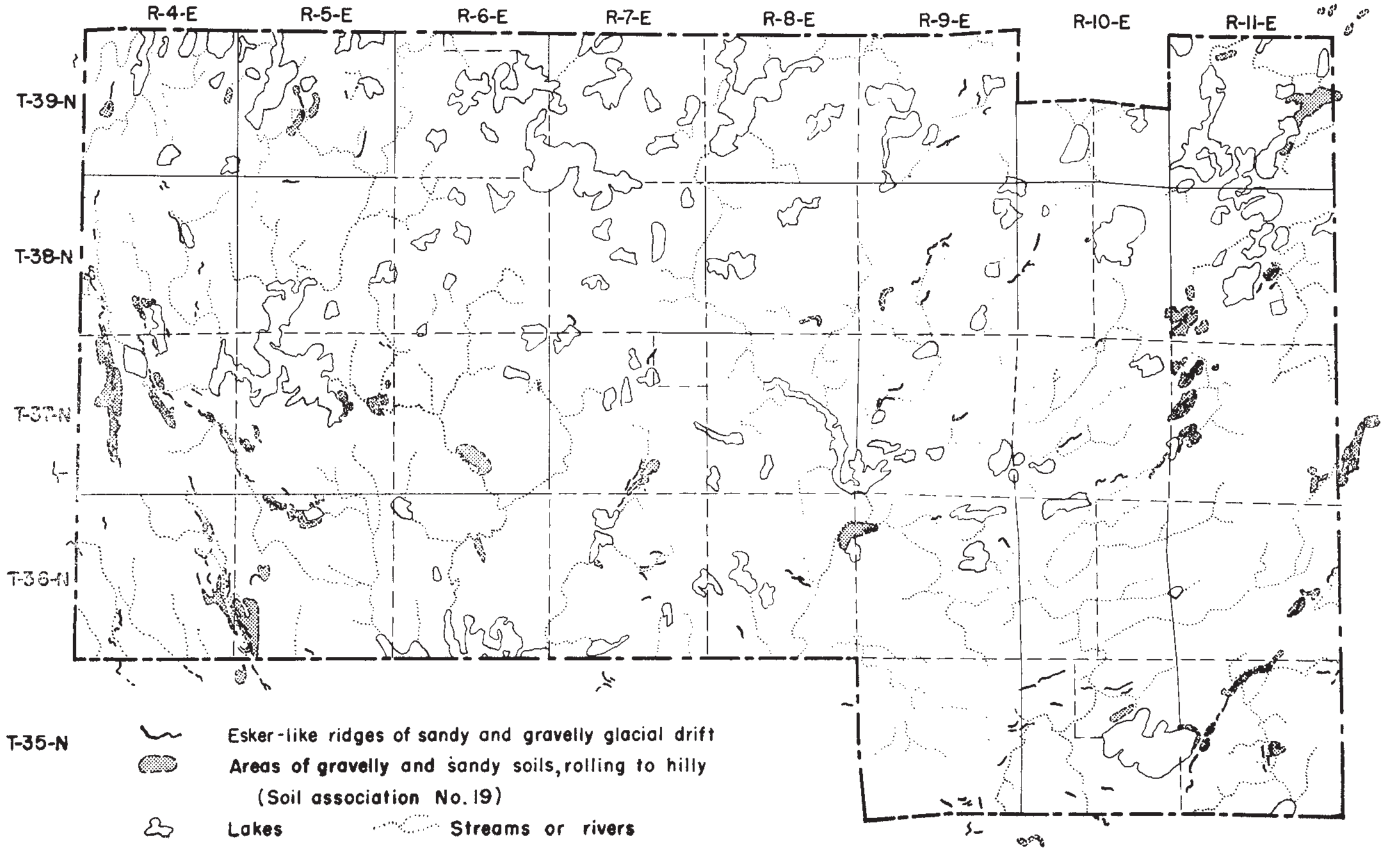


Figure 10.

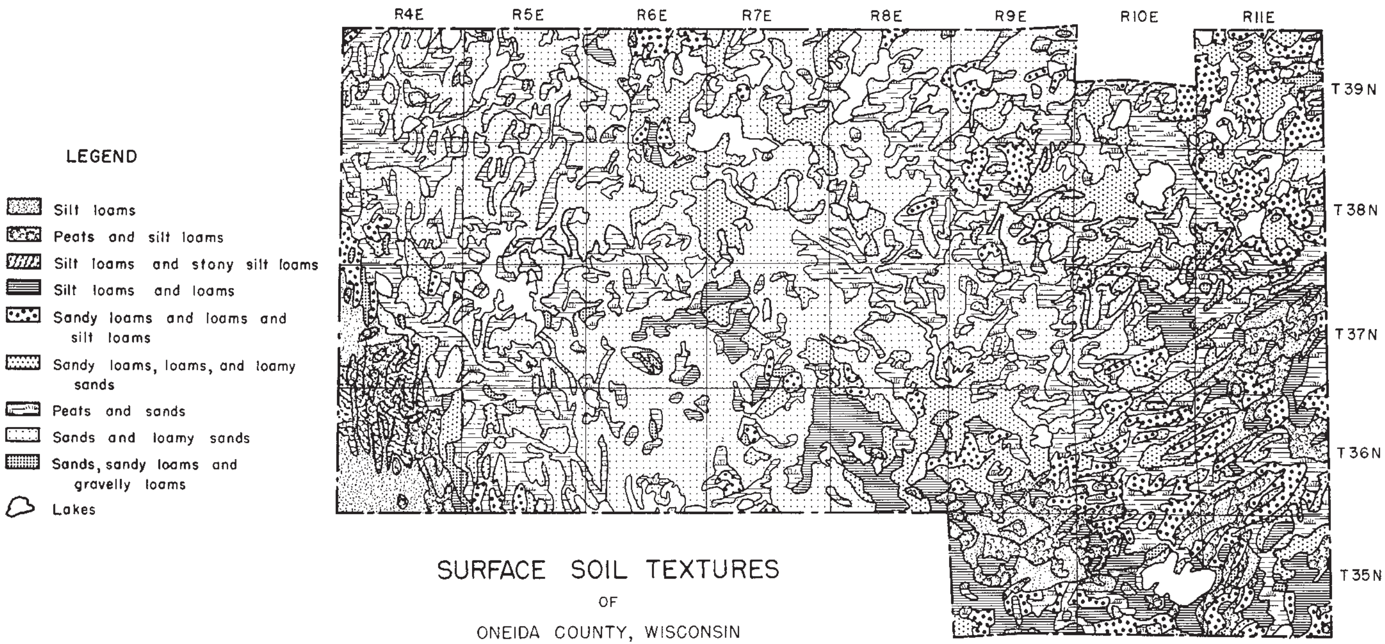

LEGEND
Silt loams
Peats and silt loams
Silt loams and stony silt loams
Silt loams and loams
Sandy loams and loams and silt loams
Sandy loams, loams, and loamy sands
Peats and sands
Sands and loamy sands
Sands, sandy loams and gravelly loams
Lakes
R4E
R5E
R6E
R7E
R8E
R9E
R10E
R11E
T39N
T38N
T37N
T36N
T35N
SURFACE SOIL TEXTURES
OF
ONEIDA COUNTY, WISCONSIN

Figure 11.

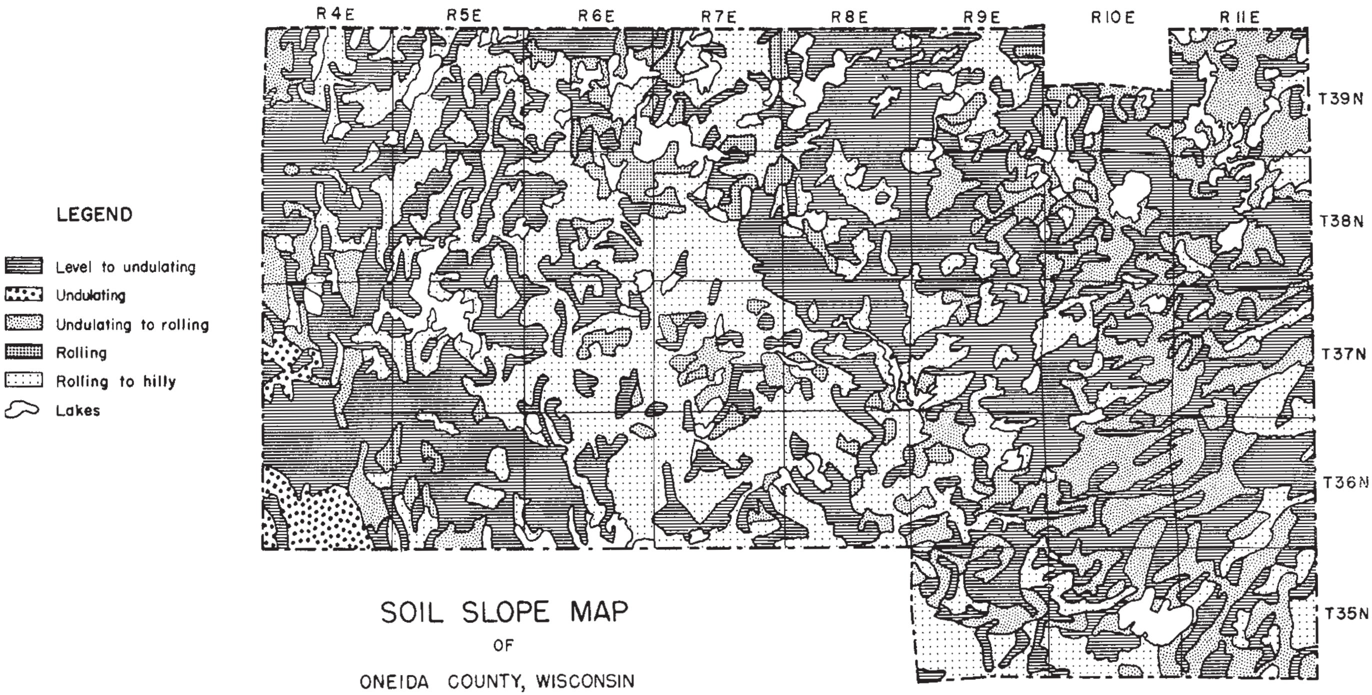

R4E
R5E
R6E
R7E
R8E
R9E
R10E
R11E
T39N
T38N
T37N
T36N
T35N
LEGEND
Level to undulating
Undulating
Undulating to rolling
Rolling
Rolling to hilly
Lakes
SOIL SLOPE MAP
OF
ONEIDA COUNTY, WISCONSIN

Figure 12.

TABLE IV.—CLIMATIC DATA FOR ONEIDA COUNTY, WISCONSIN

Month	Average Temperature °F		Average Precipitation Inches		Number of degree-days[2]	
December	17		1.2		1,428	
January	11		1.3		1,618	
February	13		1.3		1,342	
WINTER		14		3.8		4,388
March	25		1.6		1,265	
April	40		2.2		689	
May	53		3.4		343	
SPRING		39		7.2		2,297
June	63		4.8		96	
July	68		3.8		43	
August	65		3.8		76	
SUMMER		65		12.4		215
September	57		3.5		289	
October	45		2.3		560	
November	30		2.0		1,018	
AUTUMN		44		7.8		1,867
YEAR		41		31.2		8,767

[1] Ebling, W. H., et al, Wisconsin Rural Resources, Oneida County, 1957. Wisconsin State Department of Agriculture, Crop and Livestock Reporting Service.

[2] 65-degree base. Average for six years, 1951–1956, of the heating degree days. A heating degree day measures the departure in degrees per day below 65 degrees. For example, if the average temperature out-of-doors for a 24-hour period is 40 degrees, then the heating degree days for that period is 25. The colder the weather, the larger the resulting figure. At Rhinelander there are four months with less than 300 degree days. These are the best months for crop growth as far as temperature is concerned. During months with more than 600 degree days, crops are dormant.

LEGEND FOR FIGURE 13

Symbol	Explanation
	I. ALLUVIAL FLATS
A	Alluvial flats, largely occupied by muck and peat.
	II. EXTINCT LAKE PLAINS
L	Extinct lake plains, now largely covered with peat.
	III. GLACIO-FLUVIAL PLAINS, PITTED AND UNPITTED
P	Pits in glacio-fluvial deposits.
W1	Level plains, low-lying, extensive.
W2	Undulating to level plains, low-lying, extensive.
W3	Undulating plains, high-lying, extensive.
W4	Undulating plains, high-lying, inextensive.
W5	Irregular, clustered mound-like hills.
W6	Steep pointed hills separated by abrupt pits.
W7	Hills exhibiting relatively sharp crests and spur lines.
W8	Long esker-like ridges, occurring singly or in parallel or intertwining patterns.
	IV. UPLANDS, LARGELY UNDERLAIN BY TILL
T1	Undulating plains.
T2	Macro-fluted upland.
T3	Rolling, irregular upland.
T4	Hilly, irregular upland.

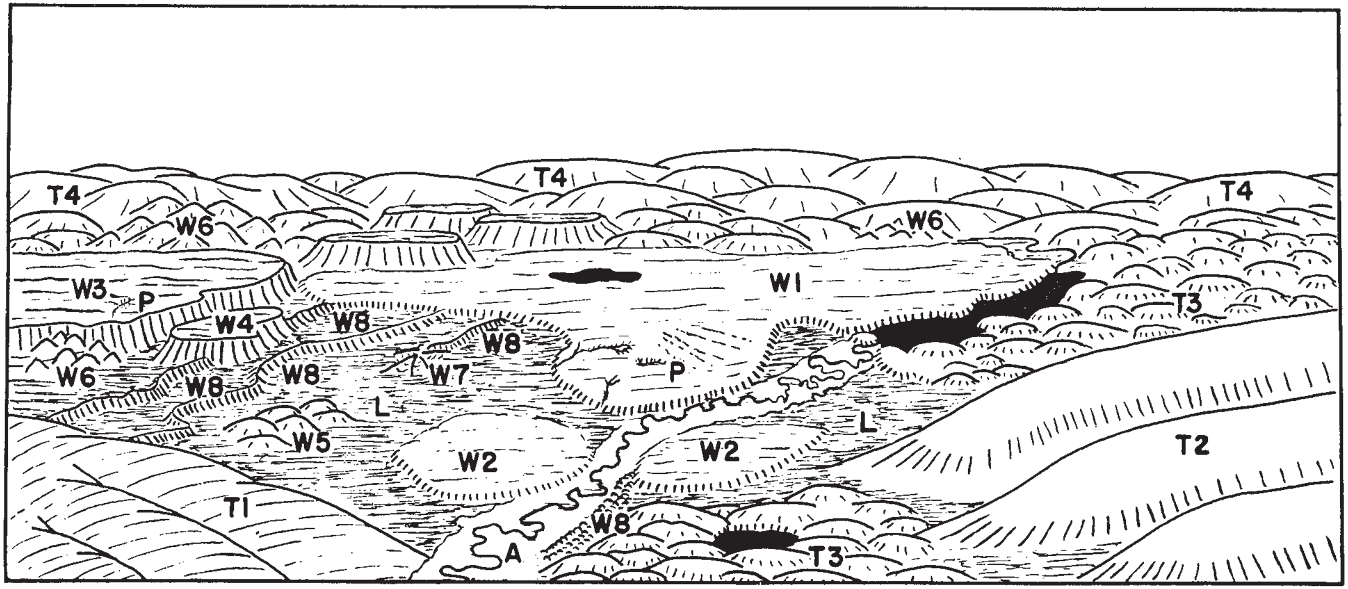


Figure 13. Some land forms of Oneida County, Wisconsin. See page 26 for the legend for symbols.

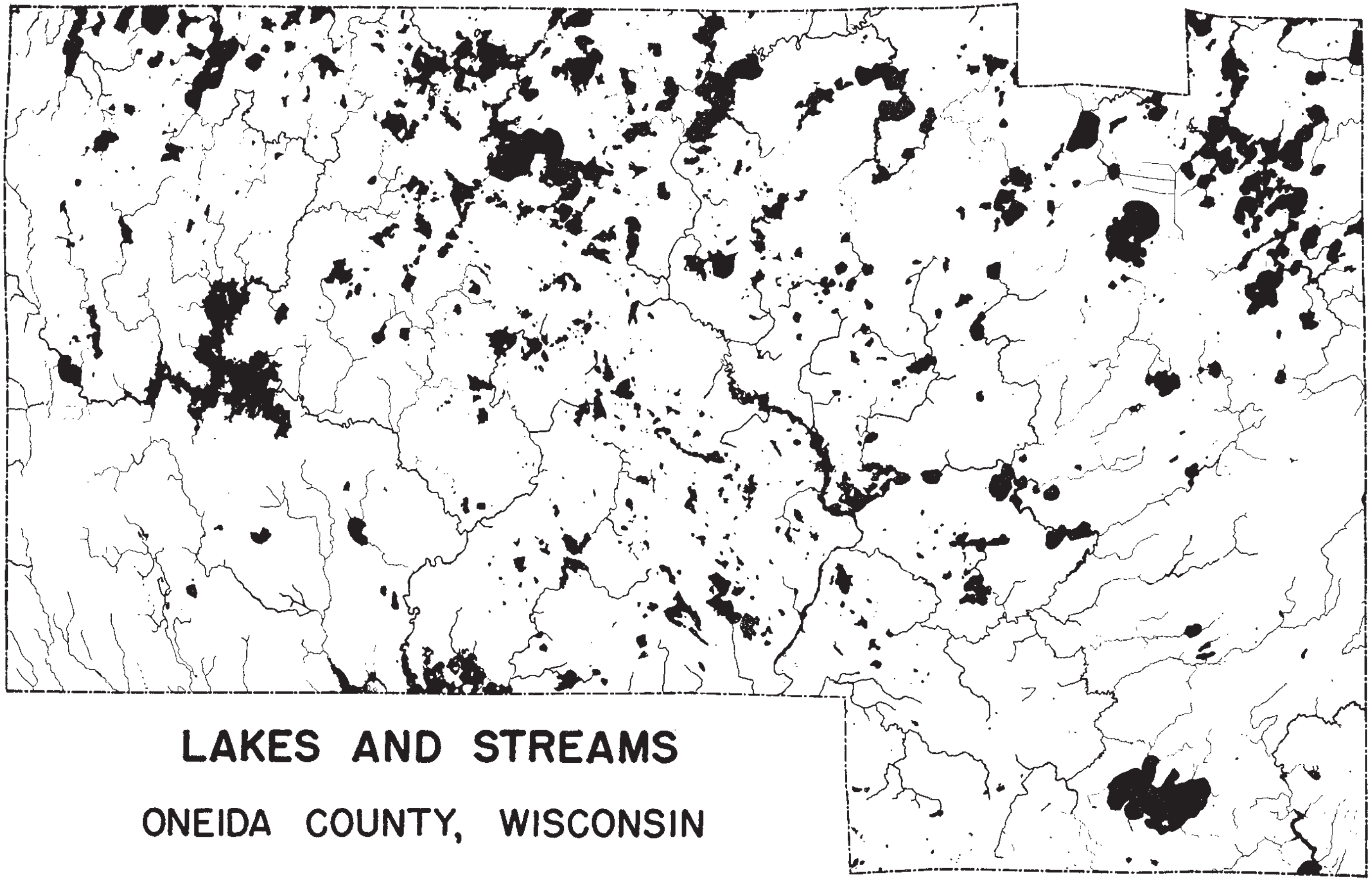


Figure 14.

of sand, silt and clay, indicating alternations between moving and quiet waters. Rolling to hilly country in the western part of the county, is interpreted on the glacial geology map, Figure 9, based on the soil map, as pitted glacio-fluvial deposits. There are some eskers, which lie parallel to present-day drainage ways (Figure 10).

The glacier brought some crystalline boulders from Canada, the northern peninsula of Michigan and northern Wisconsin. However, the bulk of the material in the glacial drift is probably of local origin. Hendrix (5) reports that the sands of representative soils contain minerals indicative of predominantly metamorphic source rocks.

Across the hills and plains left by the glacier, winds deposited locally a silty material, probably originally non-calcareous, in a blanket as thick as two feet. This silt deposit is found in southern, eastern, and western extremities of the county. Where silt covers sandy drift or stony till, soil resources for agricultural crops and hardwood forests are improved.

TOPOGRAPHY. Elevations listed by Martin (15) shows a range from 1,493 feet above sea level at McCord in southwestern Oneida County to 1,658 feet at Three Lakes in the northeastern part of the county, a difference of 165 feet. The soil slope map, Figure 12, gives a general picture of the county. The drainage pattern shown in Figure 14 is irregular, as a typical for a glaciated area. More than 800 lakes are represented on the soil map, and there are numerous peat bogs. Surface water flows from Oneida County for the most part south into the Wisconsin River drainage basin, and to lesser extents southeast into the Wolf River basin, and northeast into the Menominee drainage system.

Most land forms in Oneida County are glacial in origin. The great variety of shapes, sizes and arrangements of land forms can be related to their genesis. The classification of land forms shown in Figure 13 gives particular attention to slope characteristics. These land forms were observed in the field, and in a stereoscopic inspection of aerial photographs of the county.

CLIMATE. Oneida County, lying near the northwestern limit of the humid climatic zone of eastern North America, has a humid, continental, cool-summer climate. It is situated about equidistant (100–150 miles) from three other climatic regions: 1) a cool-summer subarctic region to the north; 2) a warm-summer humid region to the south; and 3) a subhumid climatic zone to the southwest. A line drawn from Ashland to Green Bay roughly divides the zone of Podzol soils from the zone of Gray–Brown Podzolic soils to the southwest. The average snow-fall is about 55 inches and snow covers the landscape approximately 120 days out of the year.

The average frost-free season ranges from 87 to 117 days. Bogs and marshes have summer night frosts. Average frost penetration in open fields is about 40 inches, but in a popple stand with an insulating layer of forest litter on Vilas sand is only about 6 inches. The last killing frost in the spring in Rhinelander, Wisconsin occurs on the average about May 13 (8), although ten times out of a hundred it is as late as May 28. The first fall frost comes September 11, on the average, but 10 per cent of the time it may come as early as August 21. According to Climate and Man (22), temperatures as high as 108° F. and as low as — 51° F. have been recorded in the county. There are about 32 days each year with thunderstorms, some of which produce rainfall intensities as high as 2 inches per hour. There is hail on the average of 2 days annually. There are on the average 105 clear days each year, and 12 days with dense fog. On a winter day there are on the average four hours of sunshine, 40 per cent of the possible sunshine. In summer, there are on the average about 9.5 hours of sunshine daily, or 65 per cent of the possible sunshine (8,22,26).

VEGETATION. Before the arrival of European settlers there were apparently three predominant kinds of forest cover in Oneida County (Figure 15): white and red pine forest, sugar maple-birch-pine forest with and without hemlock, black spruce-tamarack forest with and without white cedar. Brown and Curtis describe the forest communities in considerable detail elsewhere (2). Present land use is reported in Figure 7.

Following the departure of the glacier, fir and spruce forests appeared, followed by pine and hemlock forests. Indian legend reports a great fire about 1550, after which the largest white pine trees now known may have sprouted. Flash fires started by sparks from locomotives on logging railroads during lumbering operations from 1860 to 1920 destroyed thousands of acres of both logged and virgin timber (2).

After each disturbance of vegetation, whether by logging, burning or cultivation followed by abandonment of fields, plant successions have been in progress, possibly in these sequences: on sandy soils, from reindeer moss to jack pine to red and white pine to hemlock and hardwoods; on well drained silt loams and loams, from bracken fern and grasses to white and red pine to hemlock and hardwoods. Small lakes converted to peat bogs with invasion by pond lilies, then sphagnum and leather leaf, then tamarack and black spruce. The germination of jack pine seeds is said to be favored by fire, which fact helps explain the large acreages of jack pine forest.

A comparison of Figure 15 with the soil map shows the following general correlation between original vegetation and soils:

SOILS	VEGETATION
1. Droughty sands, loamy sands, gravelly loams (Vilas, Crivitz, Hiawatha, Omega, Emmert)	Jack pine forest (including "barrens"), red and white pine forest, and sugar maple forest.
2. Well-drained sandy loams, loams and loamy sands and shallow silt loams (Pence, Crivitz, Elderon)	Jack pine forest, red and white pine forest, sugar maple forest.
3. Well-drained and imperfectly drained silt loams and loams (Lynne, Clifford, Goodman)	Sugar maple forest.
4. Peats and associated wet sands and silt loams (peat, Au Gres, Saugatuck, Cable, Auburndale, Adolph)	Tamarack forest.

White birch-aspen and "upland brush" of Figure 15 occur on all mineral soils. The jack pine "barren" of T. 36 N., R. 8 E. crosses an unusually wide variety of soils, from sands to silt loams. The bodies of swamp forest shown on Figure 15 are quite generalized, and appear more extensive in many instances than the swamp soils shown on the soil map.

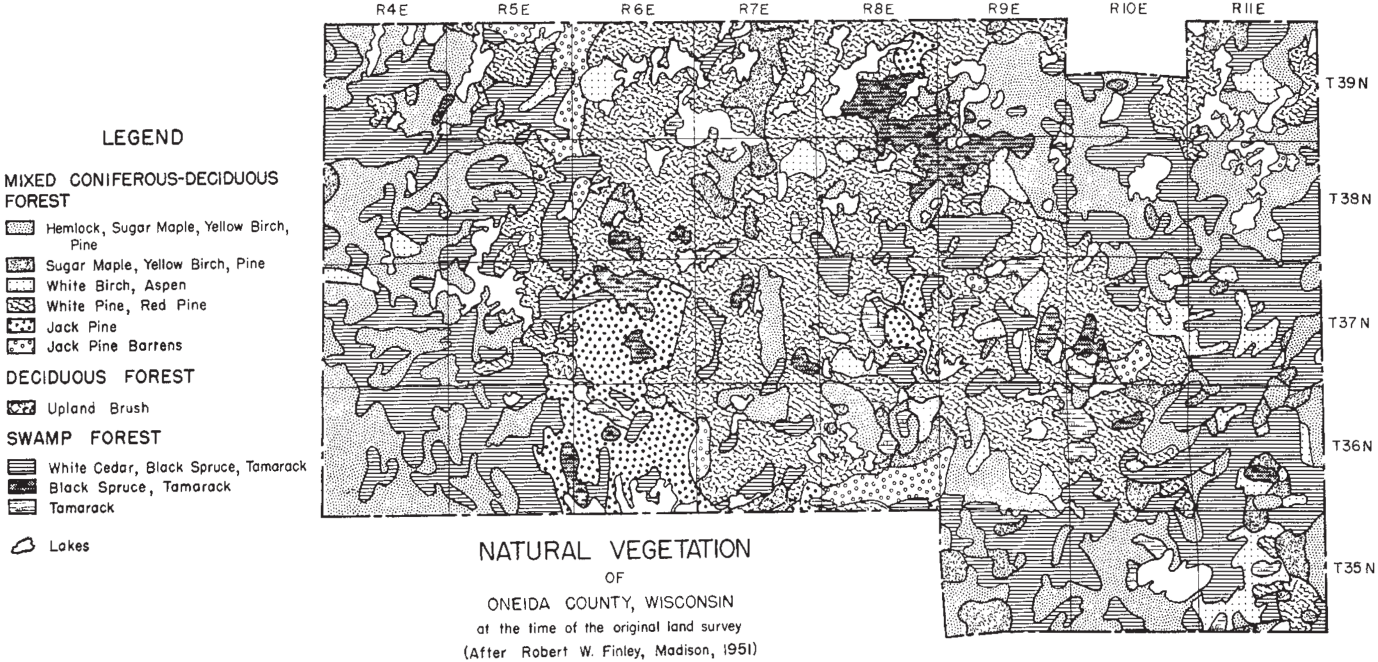

LEGEND
MIXED CONIFEROUS-DECIDUOUS FOREST
Hemlock, Sugar Maple, Yellow Birch, Pine
Sugar Maple, Yellow Birch, Pine
White Birch, Aspen
White Pine, Red Pine
Jack Pine
Jack Pine Barrens
DECIDUOUS FOREST
Upland Brush
SWAMP FOREST
White Cedar, Black Spruce, Tamarack
Black Spruce, Tamarack
Tamarack
Lakes
R4E
R5E
R6E
R7E
R8E
R9E
R10E
R11E
T39N
T38N
T37N
T36N
T35N
NATURAL VEGETATION
OF
ONEIDA COUNTY, WISCONSIN
at the time of the original land survey
(After Robert W. Finley, Madison, 1951)

Figure 15.

The pine and hardwood forests produce a forest litter which becomes fungus-infested, and through which water apparently percolates, carrying organic compounds which help to move iron and clay down to the coffee-brown B horizon, leaving a bleached A_2 horizon (see Figure 2). Disturbance of the soil by fire, wind and water erosion, tree throw, and activity of small and large animals (including man) can destroy or can prevent the formation of the whitish A_2 horizon and can weaken B horizon development.

MAN AS A FACTOR OF SOIL FORMATION. Man has changed the soils of Oneida County by changing the vegetation, by burning forests and forest residues, by earthmoving operations connected with logging, construction and agriculture, by raising and lowering of soil fertility levels, and by protecting the soils or exposing them to frost, direct sunlight, and to erosion by wind and water. The bits of charcoal which occur in the surface soil over most of Oneida County form perhaps the most enduring record in the soil of changes made by man during the period, 1850–1920. The agricultural activities of man have so disturbed the upper seven inches of the soil in cultivated areas, that the classification of soils in Figure 8 emphasizes the B horizon. In plowed fields, soils must be classified on the basis of horizons below the plow-layer. Of the 20 soils described in detail in this report, the horizon just below the plow layer is the B_{irh} in 10 soils, B_{irhg} in 3, A_2 in 3, A_{o2}, A_1, B_{cr} and C_g in one soil each. In the N. E. 1/4 S.W. 1/2 Sec. 35, T.37 N, R.7 E. it was observed that cultivated soils had lost some of the characteristics of Podzols, even below the plow layer. Drifts of fine sand several inches thick are blown from unpaved roads onto adjacent areas in much of the county.

VII. SOIL DESCRIPTIONS

Introduction

Table II lists the soil separations shown on the colored soil map. Each soil is defined in the following pages by its cross-section to a depth of about three feet or so, as shown in Figure 16. This cross-section is called the soil profile (8, 9), and shows the various soil layers, called soil horizons, in which plant roots develop and feed. A soil body of which the three-to four-foot profile is a narrow, representative vertical cross-section, is a large sheet, irregular in shape, measuring 300 to 3,000 or more feet across. Soil bodies of each kind of soil have a typical range in profile characteristics, slope, susceptibility to erosion under various conditions, native fertility, and response to amendments. It may be said that soil management is simplest on fields which consist of one soil. In such a case the same treatment can be applied to the entire field with uniform results. However, many soil bodies are irregular ribbons in shape and even a strip in a strip-cropped field may cross two or more bodies of different soils. Where two soils in a field have extremely different management requirements, the operator may handle each portion of the field differently, or may treat the whole field in accordance with the requirements of the least productive part.

Individual soil profile descriptions are arranged in alphabetical order in the following pages. In some cases, exact locations are given for the sites at which descriptions were made in the field. For most of the soils, however, descriptions have been based on observations made at several sites.

A soil profile description provides important information, because our scientific classification of soils (12, 24), as well as our agriculture and silviculture (29, 30), is based on these definite soils units. Great soil groups, such as "Podzol" and "Humic-Gley", are technical terms used by soil scientists in classifying soils throughout the world. They are briefly defined in foot-notes to Table I. As more research is done on the soils, both in the laboratory and in the field, more complete descriptions and data become available. Present data have been compiled by workers of the Wisconsin Geological and Natural History Survey, the College of Agriculture, and by workers of the Soil Conservation Service.

Some technical terms (24, 25) used in the soil descriptions are defined briefly below. Each soil description consists of two parts: an introductory paragraph, and a description of soil horizons. The first paragraph gives information about the parent material from which the soil formed; the thickness and approximate clay content of the subsoil or B horizon, and of the overlying and underlying horizons; the common types and phases mapped; and names of associated soils. The silt from which the silty upland and glacio-fluvial plain soils formed was deposited in post-glacial time, and is probably of local origin. It was very likely acid from the beginning. The description of soil horizons gives moist soil colors and corresponding scientific Munsell notations, such as 10YR 2/1, taken from the color chart book (16, 25) used by soil surveyors; the texture (loamy sand, sandy loam, loam, silt loam, and so on; see Figure 11); structure (granular, platy, blocky); degree of acidity (pH) and sometimes organic matter content (see Table VI). The type location and date and place of establishment of series are given. The Cable, Clifford, Crivitz, Elderon, Goodman, Lynne, and Monico soil series are at present considered as tentative. All depth measurements given in the descriptions are made from the surface of the mineral soil. Therefore the depth of a 5-inch layer of humus is reported as "A_0, 5″—0″, but the underlying sandy layer is reported as "A_2, 0—10". A whitish A_2 horizon is called a"Bleicherde", meaning bleached earth. A soft coffee-brown B horizon is called an "Orterde," meaning soil formed in place. But a cemented, stone-like dark brown B is called an "Ortstein", which means stone formed in place. The symbol "ir" refers to "free iron" or iron oxide. The symbol "h" refers to humus organic matter. "B_f" stands for a fragile or brittle horizon called the fragipan. Elsewhere in current literature, this is usually labeled "B_m".

INDIVIDUAL SOIL PROFILE DESCRIPTIONS

ADOLPH SERIES (No. 20 on the soil map)

The Adolph series includes naturally wet soils formed from a silty deposit about 20 inches thick over acid glacial till of a sandy loam to loam texture. Natural drainage and aeration conditions have been very poor and the original vegetation includes tagalder and willow. These soils are classified in the Humic–Gley great soil group. The subsoil (C_g or B_g horizon) begins at a depth of about a foot and continues downward about 7 inches, with a maximum clay content of about 12 to 20 per cent. Above the subsoil are silt loam or loam layers (A horizon) containing about 10 to 20 per cent clay. Slope gradients are usually less than 2 per cent. Associated soils are peat, Cable, Auburndale, and Spirit. There are some stony areas. A profile description follows:

5″–4″	A_{00}	Leaf litter
4″–0″	A_0	Peat layer
0″–5″	A_{11}	Black (10YR 2/0 above to 3/1 below) silt loam; moderately developed medium granular to subangular blocky structure; firm; pH 4.7; about 20% organic matter.
5″–11″	A_{12g}	Black (10YR 2/1–3/1) silt loam; moderately developed medium subangular blocky structure; firm; pH 5.0; about 2% organic matter.

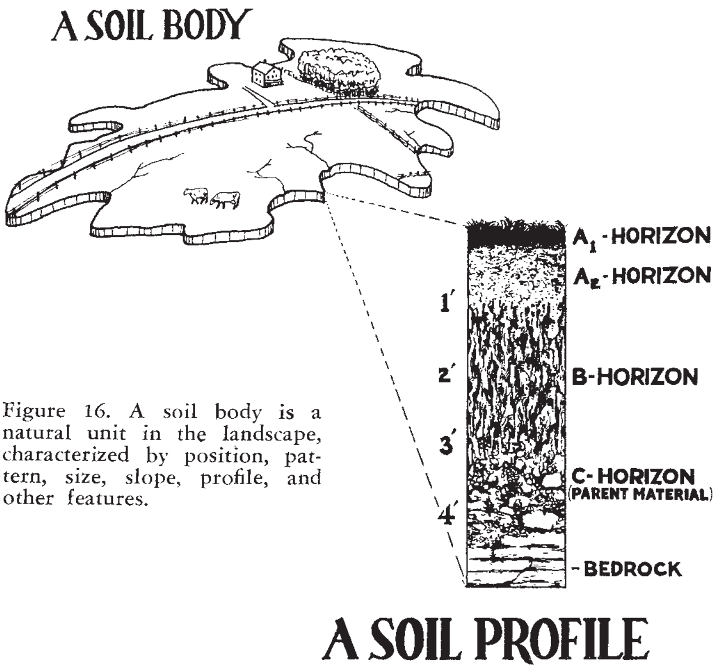


Figure 16. A soil body is a natural unit in the landscape, characterized by position, pattern, size, slope, profile, and other features.

11″–13″	A_1–C_{1g}	Gray (10YR 5/2) mottled brown (10YR 5/3) silt loam; weakly developed medium platy structure; friable; pH 5.0; about 1% organic matter.
13″–20″	C_{1g}	Gray to olive gray (10YR 6/1–5YR 5/2) gritty, stony silt loam with strong brown mottles (7.5YR 5/6); friable; massive to weakly developed fine angular blocky structure; pH 4.3; 0.5% organic matter.
20″–30″	D_{1g}	Gray (10YR 5/1) mottled with yellowish brown (10YR 5/8) stony loam; massive to weak coarse platy and medium angular blocky structure; slightly cemented; pH 4.0; about 0.2% organic matter.

Type location: S.W. ¼ S.W. ¼ Sec. 21, T.38 N., R.26 W., Mille Lacs County, Minn. Series established in 1927, Mille Lacs County, Minn.

Source of name: Village in St. Louis County, Minn.

ALLUVIAL SOILS, LOCAL (Nos. 15, 16, 20 on the soil map)

This includes a variety of soils derived from overwash of soil materials brought into depressions and to the edges of marshes and bogs by run-off waters from adjacent slopes. Some deposits are along river and stream courses. There are dark gray and dark grayish brown sands, sandy loams, loams, gritty silt loams, silts and mucky loams of moderately good to poor drainage.

AUBURNDALE SERIES (Nos. 4, 9, 15, on the soil map)

The Auburndale series includes naturally poorly drained silt loams developed in depressions in ground moraine plains. A silty deposit 24 to 42 inches thick overlies acid reddish brown sandy loam to sandy clay loam glacial till. Original vegetation includes tagalder and willow. The soils are assigned to the poorly drained Low

Humic-Gley great soil group. The subsoil (C_{1g} or B_g) begins at a depth of about 10 inches and continues downward about 18 inches, with a maximum clay content of 14 to 26 per cent. Above the subsoil are silt loam layers (A horizon) containing about 12 to 25 per cent of clay. Slope gradients are usually less than 2 per cent. Associated soils are Lynne, Clifford, Adolph and peat. There are stony silt loam areas. A profile description follows:

3″–2″	A_{00}	Leaf litter.
2″–0″	A_0	Humus.
0″–5″	A_1	Very dark gray (10YR 3/1) silt loam; weak fine granular to weak medium platy structure; friable; pH 5.0; about 8% organic matter.
5″–10″	A_{2g}	Gray (10YR 6/1) mottled brown (7.5YR 5/4) silt loam; weak medium platy structure; friable; pH 5.0; about 3% organic matter.
10″–15″	B_{g1}	Gray (10YR 5/2) and brown (7.5YR 5/4) silt loam; weak medium platy to medium subangular blocky structure; friable; pH 5.3; about 1% organic matter.
15″–24″	B_{g2}	Gray (10YR 4/2) mottled with yellowish brown (10YR 5/6) silt loam; weak coarse platy structure; friable; pH 5.3; about 0.4% organic matter.
24″–30″	D_{1g}	Reddish gray and brown (5YR 5/2, 5/4) loam; massive; friable; pH 5.5; about 0.1% organic matter.

Type location: Clark County, Wisconsin. Series established: Langlade County, Wisconsin.

Source of name: Village in Wood County, Wisconsin.

AU GRES SERIES (Nos. 2, 5, 6, 8, 11, 21, on the soil map)

The Au Gres series includes soils developed from loose acid sands under naturally restricted drainage and aeration conditions. Natural vegetation includes: tagalder, willow, spiraea, tamarack, black spruce. These soils are classified as imperfectly drained Podzols. The subsoil (B_{irh}) begins at a depth of about 5 inches, and continues downward about 2 feet, with maximum contents of about 5% clay, 1.5% organic matter, and 0.5% free iron. Above the subsoil is a sand layer (A_2 horizon) containing about 3% clay, 1.7% or less of organic matter, 0.2% free iron. Slope gradients are less than 2%. Associated soils are the poorly drained Kinross, the imperfectly drained Saugatuck which has an Ortstein or cemented B, and peat. In Michigan the well drained Kalkaska and moderately well drained Croswell are catenal associates. A profile description follows:

3″–2″	A_{00}	Leaf and needle litter.
2″–0″	A_0	Humus layer or peat.
0″–½″	A_1	Very dark grey (5YR 3/1) loamy sand, with white quartz grains evident; weak medium granular to single grain; very friable; pH 4.8; about 15% organic matter.
½″–5″	A_2	Pinkish gray (7.5YR 7/2) sand; single grain; loose; pH 5.0; about 2% organic matter.
5″–15″	$B_{irh_{1g}}$	Dark brown (7.5YR 4/2–4/4) sand, mottled in lower part with strong brown (7.5YR 5/6); single grain, slightly cemented in places so that the loosened soil contains some rounded fragments; loose; pH 4.5; about 1% organic matter.
15″–30″	$B_{irh_{2g}}$	Brown (7.5YR 5/4) sand mottled with spots of strong brown (7.5YR 5/8); single grain; loose; pH about 5.0; about 0.2% organic matter.

30″–40″	C_{3g}	Light brown (7.5YR 6/4) sand mottled with reddish yellow (7.5YR 6/6); single grain; loose; pH about 5.5; about 0.1% organic matter.

Type location: N.E. ¼ S.W. ¼ Sec. 16, T.37 N., R.2 W., Sheboygan County, Mich. Series established in 1955, Franklin County, N. Y.

Source of name: Town of Arenac County, Michigan.

AU TRAIN SERIES (Nos. 5, 6, 11, 17, 18)

This series includes soils developed from acid glacio-fluvial sands. Natural drainage or aeration is good to excessive. The original vegetation included white and red pine, hemlock and hardwoods. These soils are classified as maximal Podzols. The subsoil (B_{irh}) begins at a depth of about 10 inches, with maximum contents of 5% clay, 2% organic matter (h), and 0.5% of free iron (ir), and continues downward for about 2 feet. This horizon is variable in thickness and exhibits tongues which extend three feet or more into the substratum. Above the B_{irh} horizon are sand layers (A horizon) containing about 3% clay, 1.5% organic matter, and 0.2% free iron. The A_2 horizon thins and thickens irregularly, with tongues projecting downward just over the tongues of the B_{irh}. Slope gradients are usually less than 2%. Excellent samples of an Orstein horizon were obtained in the N.W. ¼ N.E. ¼ Sec. 30, T. 38 N., R.4 E. A profile description follows:

4″–3″	A_{00}	Leaf and needle litter.
3″–0″	A_0	Humus layer.
0″–¼″	A_1	Black (5YR 2/1) loamy sand, with white quartz grains evident; weak medium granular to single grain; very friable; pH 5.0; about 15% organic matter.
¼″–10″	A_2	Pinkish gray (5YR 7/2) loamy fine sand; single grain to very weak platy structure; loose; pH 4.7; about 1.5% organic matter.
10″–18″	B_{irh_1}	Dark reddish brown above to dark brown below (5YR 3/3, 7.5YR 4/4) loamy fine sand; solidly cemented into an Ortstein in places, irregularly cemented elsewhere; pH 5.0; about 2% organic matter.
18″–34″	B_{irh_2}	Strong brown (7.5YR 5/6) loamy fine sand; weakly cemented; pH about 5.3; about 0.5% organic matter.
34″–42″	C_1	Reddish brown above to light reddish brown below (7.5YR 4/4, 6/3) loamy sand; single grain; loose; pH 5.0; about 0.1% organic matter.

Type location: Ontonagon County, Michigan. Series established: Alger County, Michigan, 1939.

Source of name: Village in Alger County, Michigan.

CABLE SERIES (Nos. 16, 20 on the soil map)

This series includes naturally wet soils in depressions in moraines of acid till. Original vegetation included tagalder, willow, balsam fir, tamarack, and black spruce. These soils are classified as Low Humic–Gley soils which "plow up white" in contrast to the Humic–Gley soils which are said to "plow up black" because of the greater depth of the A_1 horizon. The subsoil (C_g horizon) begins at a depth of about 7 inches, and continues downward about 20 inches with a maximum clay content of about 12 per cent. Above the C_g horizon are silty layers (A horizon) containing about 10% clay. Slope gradients are usually less than 3%. Associated soils are Monico, Iron River, Adolph, Auburndale, peat. A profile description taken at the type location follows:

3″–2″	A_{00}	Leaf litter.
2″–0″	A_0	Humus or peat layer.

0″–5″	A_1	Very dark gray (10YR 3/1) stony silt loam; massive; moderately developed medium subangular blocky structure; firm; pH 5.0; about 18% organic matter.
5″–7″	A_3	Gray (10YR 5/1–5/2) mottled brown (10YR 5/3) stony silt loam; weakly developed medium platy structure; firm; pH 5.0; about 3% organic matter.
7″–15″	C_{1g}	Light gray (10YR 6/1) mottled with brown and yellowish brown (10YR 5/3, 5/8) stony silt loam; moderately developed fine platy structure; friable; pH 5.0; about 1% organic matter.
15″–28″	C_{2g}	Light brownish gray (10YR 6/2) mottled with yellowish brown (10YR 5/6) stony silt loam; moderately developed coarse platy structure; friable; pH 4.5; about 0.5% organic matter.
28″–35″	D	Light gray (10YR 6/1) mottled yellowish brown (10YR 5/8) loam till; massive; friable; pH 4.0; about 0.1% organic matter.

Type location: N.E. ¼ Sec. 24, T.35 N., R.11 E., Oneida County, Wisconsin.

Series proposed: Clark County, Wisconsin, 1942. Series is tentative.

Source of name: Village in Bayfield, Wisconsin.

CLIFFORD SERIES (Nos. 4, 9, 15 on the soil map)

This series (see figure 17) includes naturally imperfectly drained soils formed on broad undulating upland from an acid silty layer one or two feet thick over acid reddish brown glacial till of loam to sandy loam texture. The original vegetation included white and red pine, hemlock, yellow birch, maple. The soils are classified as imperfectly drained Podzols. The Subsoil (B_{irh}) begins at a depth of about 7 inches and continues downward through a weak incipient fragipan (B_f) or fragile pan about 20 inches with maximum contents of 12% clay, 1% free iron (ir) and 1.6% organic matter (h). Above the B_{irh} horizon is a silt loam layer (A_2 horizon) containing 14% clay, 0.7% free iron and 2.5% organic matter. Slope gradients are less than 2%. Associated soils are Lynne, Auburndale, Adolph, and peat. A profile description

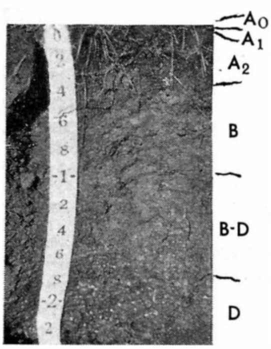


Figure 17. Clifford silt loam on a nearly level till plain in southwestern Oneida County. The shallow litter (A_0) and dark silt loam (A_1) horizons overlie a mottled lavender-brown silt loam (A_2) which is underlain by a mottled brown (B) silt loam horizon, and a strong brown (B–D) loam. The substratum (D) is a reddish brown stony loam. With surface drainage and fertilization, this soil is agriculturally productive. However, drainage is difficult, and most of the Clifford soil is left in woodland at present. This is classified as an imperfectly drained medial Podzol. (See unit nos. 4, 9, and 15 on the colored soil map.)

follows which was taken in the N.W. 1/4 of the S.W. 1/4 of Section 22, T.36 N., R.4 E., Oneida County, Wisconsin. Stones occur on the surface.

0″–1/2″	A_1	Leaf litter.
2″–1″	A_{oo}	Humus layer.
1″–0″	A_o	Very dark grayish brown (10YR 3/2) silt loam; very weakly developed medium granular to platy structure; friable; pH about 4.7; about 15% organic matter.
1/2″–5″	A_{2g}	Brown (7.5YR 5/2) silt loam with 5% exposed surface of horizon occupied by brighter brown mottles (7.5YR 5/4); very weak thin platy structure; friable; pH 4.68; 2.5% organic matter.
5″–12″	B_{irhg}	Brown (7.5YR 5/4) silt loam, 30% mottled with grayer brown (7.5YR 5/2); moderately developed medium platy to weakly developed fine subangular blocky structure; friable; pH 4.35; 1.6% organic matter.
12″–22″	B_{fg}	Strong brown (7.5YR 5/6) heavy loam, 50% mottled with brown (7.5YR 5/2); weakly developed coarse platy srtucture and moderatly developed fine subangular blocky structure; firm; pH 4.65; 0.47% organic matter.
22″–30″	D	Reddish brown (5YR 4/4) loam glacial till; massive; firm; pH 4.88; 0.18% organic matter.

Type location: S.E. 1/4 of the S.E. 1/4 of Sec, 28, T.36 N., R.4 E., Oneida County, Wisconsin.

Series proposed: Oneida County, Wisconsin, 1958. Series is tentative.

Source of name: Village in Oneida County, Wisconsin.

CRIVITZ SERIES (Nos. 1, 5, 6, 11, 12, 17, 18 on the soil map)

This series includes fine sands and loamy fine sands formed from acid glacio-fluvial deposits. The parent material appears to have consisted originally of 18 to 42 inches of loamy fine sand overlying sand containing some gravel. Natural drainage or aeration is excessive. The original vegetation included jack pine and hardwoods. These soils are classified as weak Podzols. The subsoil (B_{irh}) begins at a depth of about 2 inches and continues downward through a very weak incipient "fragipan" (B_f) about 18 inches, with maximum contents of about 7% clay, 0.5% free iron, and 1.8% organic matter. The B horizons show a slight coherence. Above the B horizons is a thin loamy sand layer (A_2 horizon) containing about 6% clay, 0.2% free iron and 1.7% organic matter. Slopes are usually less than 5% in gradient. Associated soils are Vilas, Hiawatha, Omega, Pence. A profile description follows:

1 1/2″–1/2″	A_{oo}	Leaf and needle litter.
1/2″–0″	A_o	Humus layer. Very dark brown (10YR 2/2).
0″–1/4″	A_l	Black (5YR 2/1) loamy fine sand, with numerous white or nearly clear quartz grains in evidence; single grain; very friable; pH about 4.5; about 15% organic matter.
1/4″–2″	A_2	Dark reddish gray (5YR–7.5YR 4/2–5/2) loamy fine sand; single grain to very weak coarse platy structure; very friable; pH about 4.0; about 1.7% organic matter.
2″–10″	B_{irh}	Dark reddish brown (5YR 3/4) loamy fine sand to light fine sandy loam; slightly coherent; very weak medium subangular blocky structure; friable; pH 5.0; about 1.8% organic matter.
10″–22″	Bf	Brown (7.5YR 4/4–5/4) loamy fine sand; weak coarse platy structure; slightly coherent; very friable; pH about 5.5; about 0.2% organic matter.

22″–30″	C_1	Brown to strong brown (7.5YR 4/4–5/6) fine sand with little gravel; single grain; loose; pH about 5.5; about 0.1% organic matter.
30″–36″	C_2	Light brown (7.5YR 6/4–6/6) fine sand with gravel; single grain; loose; pH 5.5; about 0.05% organic matter.

Type location: West ¼ corner, Sec. 21, T. 32 N, R. 20 E., Marinette County, Wisconsin.

Series proposed: Marinette County, Wisconsin, 1955, Series is tentative.

Source of name: Small villlage in Marinette County, Wisconsin.

ELDERON SERIES (Nos. 8, 14, 18, 19 on the soil map)

This series includes well- to excessively-drained soils formed on rolling upland from acid sandy, stony till or poorly sorted glacio-fluvial deposits. The original vegetation included balsam fir, hard maple, hemlock, yellow birch, ironwood. These soils are classified as weak Podzols. The subsoil (B_{irh}) begins at a depth of about 4 inches and continues downward through a weak incipient fragipan (B_f) about 20 inches, with maximum contents of 10.5% clay, 0.58% free iron and 1.81% organic matter. Above the B horizons is a sandy layer (A_2 horizon) containing about 6% clay, 0.37% free iron and 2.68% organic matter. Slope gradients between 3 and 10% are common. Sandy loam, loam, and silt loam types and stony phases are recognized. The heavier ones of the aforementioned textures persist to a depth of not more than 20 inches. Associated soils are Emmert, Iron River, Monico, Au Gres, peat. A detailed soil profile description follows, as observed in the N.E. ¼, S.E. ¼, Sec. 5, T. 38 N., R. 5. E., Oneida County, Wisconsin.

1″–½″	A_{00}	Leaf litter.
½″–0″	A_0	Humus layer.
0″–½″	A_1	Very dark grey (7.5YR 3/0) heavy loamy sand to light fine sandy loam, with numerous white quartz grains visible; weak medium granular structure; friable; pH 5.6; about 15% organic matter.
½″–3″	A_2	Brown (7.5YR 5/2) loamy sand to light fine sandy loam; weak medium granular to medium platy structure; friable; pH 5.7; 2.68% organic matter.
3″–12″	B_{irh}	Brown to reddish brown (7.5YR–5YR 4/4) sandy loam; weak medium granular, to subangular blocky structure; pH 5.7; 1.81% organic matter.
12″–22″	B_f	Reddish brown (5YR 4/4–4/6) sandy loam, with pebbles present up to ¼″ in diameter; weak coarse platy and weak medium subangular blocky structure; slightly indurated when dry; pH 5.8; 0.60% organic matter.
22″–30″	C	Dark reddish brown to brown (5YR 3/4–7.5YR 4/4) cobbly loamy sand; massive to single grain; loose; pH 5.8; 0.25% organic matter.

Type location: N.E. ¼ N.E. ¼ Sec. 13, T. 37 N., 2 W., Price County, Wisconsin.

Series proposed: Marathon County, Wisconsin, 1934. Series is tentative.

Source of name: Village in Marathon County, Wisconsin.

EMMERT SERIES (No. 19 on the soil map)

This series (see figure 18) includes droughty soils on hilly and rolling relief and stony, coarse, acid inwash and outwash, kames, eskers and esker-like ridges (See map, Fig. 10). Original vegetation included red and white pine, balsam fir, hemlock, yellow birch, maple. These soils are classified as Regosols and weak Podzols and transitions between the two. The soil consists of 20% to 80% of stones by volume.

Slope gradients usually lie between 15% and 40%. Associated soils are Vilas, Pence, Omega, Crivitz, Elderon, Iron River, Au Gres, peat. The following description was made in the S.W. ¼ Sec. 4, T. 36 N., R. 5 E., Oneida County, Wisconsin.

1½"–½"	A_{00}	Leaf and needle litter.
½"–0"	A_0	Humus layer, black (5YR 2/1).
0"–½"	A_1	Black (5YR 2/1) stony gravelly sandy loam, with numerous white (5YR 8/1) quartz grains present; single grain; loose; pH about 4.5; about 20% stones by volume.
½"–¾"	A_2	Brown (7.5YR 5/2–4/2) stony, gravelly sandy loam; single grain; loose; pH about 4.5; about 20% stones by volume.
¾"–8"	B_{irh}	Dark brown (7.5YR 4/4–4/2) stony, gravelly sandy loam; loose; pH about 5.0; about 35% stones by volume.
8"–12"	C	Dark brown (7.5YR 3/4) stony, gravelly sandy loam to loamy sand; loose; pH about 5.5; about 55% stones by volume.

Type location: Mille Lacs County, Minnesota, or S.W. ¼ Sec. 4, T. 36. N., R. 5 E., Oneida County, Wisconsin.

Series established: Mille Lacs County, Minnesota, 1927.

Source of name: Emmert Tower in St. Louis County, Minn.

GOODMAN SERIES (Nos. 3, 7, 16 on the soil map)

This series includes soils formed under forest vegetation from two to 3½ feet of silty material overlying sandy loam to heavy loam acid glacial till on nearly level to rolling uplands. Natural drainage or aeration has been good. The original vegetation included hemlock, balsam fir, yellow birch, hard maple. These soils are classified as medium Podzols. The subsoil (B_{irh}) begins at a depth of about four inches and continues downward through a weak fragipan two or three feet, with maximum contents of 10.5% clay, 1.05% free iron and 4.4% organic matter. Above the B horizons is a silty layer (A_2 horizon) containing 8% clay, 0.46% free iron and 3.2% organic matter. Slope gradients range from 2 to about 12%. Associated soils are the moderately well drained Kaiser, the imperfectly drained Spirit and Monico, and

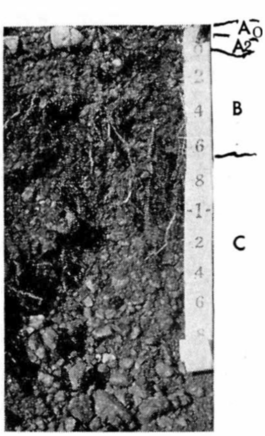


Figure 18. Emmert gravelly loam (see page 39) is found on many of the eskers and esker-like ridges in Oneida County. Beneath the forest litter horizon (A_0), the thin lavender-brown horizon (A_2) and thicker brown horizon (B) are so weakly developed that they scarcely appear in the photograph. This may be considered as an intergrade between a Regosol (A–C soil) and a minimal Podzol (A_0–A_2–B–C soil).

poorly drained Adolph, and peat. The following profile description was made in the S.E. ¼, N.E. ¼ Sec. 30, T. 35 N., R. 9 E., Oneida County, Wisconsin.

2"–1"	A_{00}	Leaf litter, hardwood leaves.
1"–0"	A_0	Black to very dark brown (10YR 2/0–2/2) humus layer.
0"–½"	A_1	Very dark grey (7.5YR 3/0) silt loam; well developed fine to medium granular structure; friable; pH about 4.5; about 15% organic matter.
½"–4"	A_2	Brown (7.5YR 5/2) silt loam; weak medium granular and coarse platy structures; friable; pH 4.16; 3.2% organic matter.
4"–13"	B_{irh}	Dark reddish brown (5YR 3/4) above to dark brown (7.5YR 4/4) below, silt loam; weak medium subangular blocky structure, and weak coarse platy structure; friable to firm; pH 4.60 above to 4.70 below; 4.4% organic matter above to 3.4% below.
13"–27"	B_f	Brown (7.5YR 5/4) coarse silt loam grading to fine sandy loam below; massive and slightly indurated when dry, breaking into moderately developed medium platy structure and to weak medium angular blocky structure; some reddish brown (5YR 4/4) coatings on peds; pH 4.55; 0.67% organic matter.
27"–36"	D	Yellowish red (5YR 5/6) sandy loam till; massive; firm; pH 5.3; 0.34% organic matter.

Type location: N.E. ¼, N.W. ¼ Sec. 26, T. 37 N., R. 19 E., Marinette County, Wisconsin.

Series proposed: Marinette County, Wisconsin, 1954. Series is tentative.

Source of name: Village in northwestern Marinette County, Wisconsin.

HIAWATHA SERIES (Nos. 11, 18 on the soil map)

This series (see figure 2) includes sand and loamy soils developed from deep acid sand, presumably glacio-fluvial deposits. Natural drainage or aeration conditions have been excessive, and the original vegetation includes jack, white and red pine. These soils are classified as medium Podzols, with horizonation that is more distinct than in the Vilas series, but less distinct than in the Au Train series. The subsoil (B_{irh}) begins at a depth of about 7 inches and continues downward through a weak, incipient fragipan about 50 inches, with maximum contents of about 2 to 6% clay, 0.49% free iron (ir) and 1.5 to 2% organic matter (h). The B_{irh} horizon is wavy, with tongues extending downward as much as a foot or two in the substratum, and with some corresponding invasions from above of the A_2 horizon, apparently along old root channels. The latter horizon is a bleached sand layer containing 2 to 3% clay, 0.16% free iron, and 1 to 1.8% organic matter. Analyses of Hiawatha profiles are given in U.S.D.A. Lab Memo No. 1 (23) and on page 53 of this report. Slope gradients usually range between 2 and 25%. Associated soils are Omega, Vilas, Au Train, Elderon, Emmert, Au Gres, peat. These soils occupy large tracts in northern Wisconsin, and also occur as depressional soils in large bodies of Vilas soils, as at the site in the N.E. ¼ N.W. ¼ Sec. 21, T. 39 N., R. 6 E., Oneida County, Wisconsin, where the following description was made, on August 22, 1957. Another profile located 15 miles west of Rhinelander had 5YR colors in the A and B horizons, and 7.5YR colors in the C.

2"–1½"	A_{001}	Fresh needle litter.
1½"–½"	A_{002}	Fresh and somewhat decomposed white and red pine needle litter.
½"–0"	A_0	Very dark brown (10YR 2/2) humus layer, pH about 4.0.

0″–½″	A_1	Very dark grey (5YR 3/1) loamy sand, having a "salt and pepper" appearance, the light particles being uncoated quartz grains, single grain; loose; pH about 4.0; about 15% organic matter.
½″–4″	A_2	Brown (7.5YR 5/2) sand; single grain, with occasional slightly coherent lumps; very friable; pH 3.8; 1.84% organic matter.
4″–5″	A_2–B_{irh}	Interpenetrating tongues of these two horizons.
5″–15″	B_{irh_1}	Dark brown (7.5YR 4/2) loamy sand; slightly coherent, exhibiting ½ inch soft aggregates of a weak very coarse granular structure; very friable; pH 5.40; 1.91% organic matter.
15″–20″	B_{irh_2}	Brown (7.5YR 4/4) loamy sand; very weakly coherent, very weak medium granular structure to single grain condition; very friable; pH 5.40; 0.67% organic matter.
20″–30″	$B_{f_{11}}$	Strong brown (7.5YR 5/6) loamy sand, with some mottles of yellowish red (5YR 5/6); somewhat coherent, incipient fragipan; friable; pH 5.58; 0.37% organic matter. Few roots penetrate this horizon.
30″–42″	$B_{f_{12}}$	Brown (7.5YR 5/4) coherent bands of loamy sand ¼ to ⅛ inch thick; some horizontal, some oblique, some branching, in a less coherent matrix of strong brown to yellowish brown (7.5YR–10YR 5/6) sand; friable pH 5.45; 0.30% organic matter.
42″–60″	B_{f_2}	Brown (7.5YR 5/4) sand; somewhat coherent; very friable; pH 5.4 above to 5.1 below; organic matter content 0.22% above and 0.03% below.
60″–70″	C_1	Brown (7.5YR 5/4) sand; loose; pH 5.4; 0.22% organic matter.
70″–75″	C_2	Brown (7.5YR 5/2–5/4) wet sand; loose; pH 5.4; 0.15% organic matter.

Type location: N.E. ¼ Sec. 3, T. 50 N., R. 37 W., Ontonagon County, Michigan.

Series established: Alger County, Michigan, 1929.

Source of name: Village in Schoolcraft County, Michigan.

IRON RIVER SERIES (Nos. 3, 7, 8, 10, 12, 13, 14, 17, 18, 19)

This includes well-drained soils formed under forest vegetation on undulating to rolling acid sandy glacial till, which may have a silty covering as much as 2 feet thick. The original vegetation included hemlock, white and red pine, balsam fir, yellow birch, hard maple, iron wood. These soils are classified as medial Podzols. The subsoil (B_{irh} horizon) begins at a depth of about 3 inches and continues downward through a weak incipient fragipan about 27 inches, with maximum contents of 8 to 12% clay, 0.5 to 1% free iron (ir) and 2 to 6% organic matter (h). Above the B_{irh} horizon is a bleached sandy layer (A_2 horizon) with 5 to 10% clay, about 0.5% free iron and 2 to 3% of organic matter. Additional analytical data are given on page 58 of this report. Slopes range from 2 to 15%, usually. Associated soils are the Goodman, Elderon, Emmert, Vilas, Au Gres and peat. There are silt loams, loams, sandy loams. The following description was made on a 6% slope in the N.W. ¼, N.W. ¼ Sec. 24, T. 36 N., R. 9 E., Oneida County, Wisconsin.

1½″–½″	A_{oo}	Hardwood leaf litter.
½″–0″	A_o	Dark brown humus.
0″–¼″	A_1	Black (5YR 2/1) heavy loamy sand to light sandy loam; single grain to weak fine granular structure; very friable; pH about 4.5; about 15% organic matter.

¼″–2″	A_2	Brown (7.5YR 5/2) sandy loam; weak fine granular to fine platy structure; friable; slightly vesicular; pH 4.35; 0.30% organic matter.
2″–6″	B_{irh_1}	Dark reddish brown (5YR 3/4) sandy loam; weak medium granular structure; friable; pH 5.05; 2.3% organic matter.
6″–10″	B_{irh_2}	Strong brown (7.5YR 5/6) sandy loam; weak medium subangular blocky structure; firm; pH 5.20; 1.5% organic matter.
10″–20″	B_{f1}	Brown (7.5YR 5/4) sandy loam; weak medium subangular blocky structure; firm; pH 5.35; 0.64% organic matter.
20″–30″	B_{f2}	Yellowish brown (10YR 5/4) sandy loam; weak coarse platy structure; firm; pH 5.21; 0.47% organic matter.
30″–40″	C	Brown (7.5YR 5/4) sandy loam; massive; firm to friable; pH 5.40; 0.37% organic matter.

Type location: S.W. Corner, Sec. 28, T. 36 N., R. 13 E., Forest County, Wisconsin.

Series established: Town of Iron River, Iron County, Michigan, 1930.

Source of name: Town of Iron River, Iron County, Michigan.

LYNNE SERIES (Nos. 4, 9, 14 on the soil map)

The Lynne series includes moderately well drained soils developed on gently undulating till plains which carry a silty covering 18 to 24 inches thick over acid loam glacial till. Original vegetation probably included hemlock, white and red pine, hard maple, ironwood, yellow birch. These soils are classified as moderately well drained Podzols. The subsoil (B_{irh} horizon) begins at a depth of about 2 inches and continues downward through a weak fragipan (B_f) about 2 feet, with maximum contents of 21% clay, 1.10% free iron (ir) and 6.5% organic matter (h). Other analytical data are given on page 54 of this report. Slope gradients range from 2 to 5%. Associated soils include Clifford, Auburndale, Adolph, peat. The following profile description was made on a 1.5% slope under a young hard maple stand in the N.E. ¼, S.E. ¼, Sec. 21, T. 36 N., R. 4 E.

1½″–½″	A_{00}	Leaf litter.
½″–0″	A_0	Dark humus layer.
0″–1″	A_1	Black (10YR 2/1–2/2) silt loam with 5% by volume of stones; weak medium granular structure; friable; pH about 5.8; about 10% organic matter.
1″–2″	A_2	Reddish grey (5YR 5/2) silt loam, with 5% by volume of stones; moderately developed medium platy structure; friable; pH 4.4; 3.75% organic matter.
2″–7″	B_{irh_1}	Dark reddish brown (5YR 3/3) silt loam with 5% by volume of stones; very weak medium to fine subangular blocky structure and weak medium platy structure; friable; pH 4.5; 6.5% organic matter.
7″–13″	B_{irh_2}	Brown (7.5YR 4/4) silt loam with 5% by volume of stones; weak coarse platy and weak medium subangular blocky structure; pH 4.7; 0.94% organic matter.
13″–24″	B_{f_g}	Pinkish grey (7.5YR 6/2) gritty silt loam mottled with brown and strong brown (7.5YR 5/4, 5/8); about 10% by volume of stones; slightly cemented; well developed medium platy and weak angular blocky structures; firm; pH 4.9; 0.57% organic matter.

24″–30″ D_{1g} Reddish brown (5YR 3/3) loam mottled with yellowish red (5YR 4/6); about 15% by volume of stones; coarse platy structure well developed; firm; pH 4.9; 0.40% organic matter.

30″–36″ D_{2g} Reddish brown (5YR 4/4) loam, mottled reddish grey and yellowish red (5YR 5/2, 4/6); about 15% by volume of stones; massive; firm; pH 5.75; 0.17% organic matter.

Type location: N.E. ¼ N.E. ¼ Sec. 21, T. 36 N., R. 4 E., Oneida County, Wisconsin.

Series proposed: Oneida County, Wisconsin, 1958. Series is tentative.

Source of Name: Town in Oneida County, Wisconsin.

MONICO SERIES (Nos. 3, 7, 16 on the soil map)

This series includes imperfectly drained soils developed on lower slopes and depressions in a rolling till plain on which less than 20 inches of silty or loam material overlies acid, sandy glacial till. Original vegetation included hard maple, yellow birch, hemlock. These soils are classified as imperfectly drained, very weakly developed Podzols. The subsoil (B_{irh} horizon) begins at a depth of about 2 inches and continues downward about 20 inches with maximum contents of about 8% clay, 1% free iron (ir) and 3% organic matter (h). Above the B_{irh} horizon is a thin silty layer containing about 6% clay, 0.3% free iron and 4% organic matter. Slopes are usually less than 3% but may go as high as 6% where seepage is sufficiently active. Associated soils are Iron River, Cable, Adolph, peat. There are gritty silt loam and loam types. The following description was made in the S.E. ¼, S.E. ¼ Sec. 28, T. 35 N., R. 11 E., Oneida County, Wisconsin.

1½″–½″ A_{00} Leaf litter.

½″–0″ A_0 Dark humus layer.

0″–2″ A_1 and A_2 mixed. Very dark grey (10YR 4/1–3/1) gritty silt loam, with numerous bleached sand grains visible; 10% by volume of stones; weak fine to medium granular structure; friable; pH 4.5; about 4% organic matter.

2″–6″ B_{irh_1} Brown (10YR–7.5YR 4/3) gritty silt loam; stones as above; weak medium subangular blocky and platy structures; stones as above; friable; pH 4.5; about 3% organic matter.

6″–14″ $B_{irh_{2g}}$ Brown (10YR 5/3) loam mottled with brown and strong brown (7.5YR 5/4 and 5/8); stones as above; massive to weak medium platy; friable; pH 4.5; about 0.5% organic matter.

14″–24″ B_{3g} Brown (7.5YR 5/2) heavy sandy loam mottled with strong brown and pinkish gray (7.5YR 6/2 and 5/8); stones as above; massive to weak medium platy structure; friable; pH 4.7; about 0.2% organic matter.

24″–42″ B_{3g}–C_g Brown (7.5YR 4/4) heavy sandy loam, mottled with strong brown; (7.5YR 5/8); stones as above; massive to very weak medium platy structure; very friable; pH about 5.0; about 0.1% organic matter.

42″–48″ C_g Brown (7.5YR 5/4) light sandy loam, mottled with gray and strong brown as above; stones as above; massive; loose; pH about 5.0; about 0.1% organic matter.

Type location: S.E. ¼ S.E. ¼ Sec. 28 T. 35 N., R. 11 E., Oneida County, Wisconsin.

Series proposed: Oneida County, Wisconsin, 1958. Series is tentative.

Source of name: Village in Oneida County, Wisconsin.

OMEGA SERIES (Nos. 11, 18 on the soil map)

This series includes droughty soils developed from acid glacio-fluvial sands, both level and rolling. Original vegetation was largely jack pine. In Oneida County, these soils appear to the authors of this report to include very weak, disturbed and undisturbed Podzols. They are classified in the soil kep (page 12) as "Regosolic", meaning transitional between Regosols, or very young soils forming on sand, to some kind of podzolic soil. Until a year or two ago, Omega soils were called Brown Podzolic (23), but now it is conventional to put them in the Sol Brun Acide (Acid Brown Soils) great soil group. The complexity and instability of the great soil group designations for these soils indicates that they actually have little profile development at all. The subsoil is a "color B" (B_{cr}), rather than a definite zone of accumulation of iron, clay and organic matter. This horizon begins at a depth of about 4 inches and continues down about 2 feet, with maximum contents of about 4% clay, 0.4% free iron, and 0.5% organic matter. Above the B_{cr} horizon are darker sandy layers (A_1 or mixed A_1–A_2, and A_3) with about 4% clay, 0.2% free iron, and 10% organic matter. Slope gradients are dominantly 2% but may range up to 20%. Associated soils are Vilas and Crivitz. A profile description follows:

1″–¼″	A_{00}	Needle litter.
¼″–0″	A_0	Dark humus layer.
0″–2″	A_1–A_2	Very dark brown (10YR 2/2) loamy fine sand with numerous nearly white (10YR 7/2) quartz grains evident, giving this horizon a "salt and pepper" appearance; charcoal fragments common; single grain to weak fine granular structure; very friable to loose; pH about 4.5; about 10% organic matter.
3″–4″	A_3	Brown to dark brown (10YR 4/4–7.5YR 4/4) loamy fine sand; single grain to very weak fine granular structure; loose; pH about 5.0; about 1.5% organic matter.
4″–18″	B_{cr}	Dark brown to reddish brown (7.5YR 4/4–5/4) loamy fine sand; single grain to very weak irregular medium blocky and coarse granular structure; loose; pH about 5.5; about 0.5% organic matter.
18″–24″	B_3	Brown (7.5YR 5/4) fine sand; single grain; loose; pH about 5.8; about 0.5% organic matter.
24″–30″	C	Reddish brown (5YR 5/4) fine sand; single grain; loose; pH about 6.0; about 0.1% organic matter.

Type location: Cloquet Forest Experiment Station, Carleton County, Minnesota.

Series established: Iron County, Michigan, 1930.

Source of name: Village, St. Louis County, Minnesota.

PEAT (Nos. 20, 21 on the soil map)

The term peat is a general one for organic soils more than about one foot thick which contain recognizable plant fragments. There are numerous soil series included in peat, but in this report and map, the peats are undifferentiated. The organic matter content of peat is usually very high, ranging from about 70 per cent to nearly 100 per cent. Decomposition, such as in a plowed field on drained peat, alters peat to muck by reducing the size of particles of organic matter until they are no longer recognizable to the naked eye as organic remains. Mucks may also form without interference by man. Organic soils in Oneida County are strongly acid.

Woody peats, moss peats, sedge peats are recognized on the basis of the organic materials from which they formed. Many of the peat bogs of Oneida County are organic fillings of former lakes. It is believed that "sedimentary", "aquatic" peat forms the bottom layer on a lake as aquatic plants invade it. Sedge peat is next deposited. As sphagnum moss encroaches over the lake fill, moss peat accumulates. Finally, forest invades the bog and woody materials accumulate to form woody peat. This succession of plants and of peat layers may be interrupted or reversed. The following peats have been recognized in Oneida County: Carbondale (deep sedge peat), Rifle (deep woody peat), Greenwood and Spalding (dominantly deep moss peat, the Spalding having additions of tamarack wood peat), Tahquamenon (deep fibrous floating peat), Tawas (shallower sedge and wood peats, 12″–42″ deep over sand), and Dawson (12″–42″ of moss peat over sand). A brief description is given below of a Spalding peat under a typical cover of dwarf tamarack and black spruce with a ground cover of sphagnum moss and leatherleaf.

5″–3″	A_{001}	Forest litter.
3″–0″	A_{002}	Spongy mosses.
0″–2″	A_{01}	Brown woody peat.
2″–15″	A_{02}	Yellowish brown, slightly decomposed mixed fibrous and woody peat; pH about 5.0.
15″–100″	A_{03}	Light yellowish brown fibrous peat; pH about 4.8.
100″–110″	D_g	Gray to light brownish gray loam (2.5Y 6/0–6/2).

PENCE SERIES (Nos. 1, 2, 5, 6, 8, 10, 11, 12, 13, 14, 17)

This series (See Figure 4) includes droughty soils formed from one to two feet of loam to heavy sandy loam over acid sand and gravel glacio-fluvial deposits of level to rolling topography. Original vegetation included balsam fir, hard maple, ironwood. These soils are classified as medium Podzols. The subsoil (B_{irh} horizon) begins at a depth 3 inches and continues downward through a weak incipient fragipan for about 15 inches, with maximum contents of 10% clay, 1.3% free iron (ir) and 5.85% organic matter (h). Above the B_{irh} horizon is a shallow acid layer (A_2 horizon) containing 5% clay, 0.31% free iron, and 1.84% organic matter. Other analytical data are given on page 54 of this report. Slope gradients are usually less than 4%, but may go as high as 20%. Associated soils are the Omega, Vilas, Hiawatha, Crivitz, Stambaugh. There are loam, sandy loam, and heavy loamy sand types. The following description was made in the S.W. ¼ N.E. ¼ Sec. 10, T. 38 N., R. 9 E. on a slope of nine per cent.

1½″–1″	A_{00}	Leaf and needle litter from white pine, spruce and aspen trees.
1″–0″	A_0	Black humus layer.
0″–4″	A_2	Pinkish gray (7.5YR 6/2) light sandy loam; weak fine granular to thin platy structure; very friable; pH 4.45; 1.84% organic matter.
4″–6″	B_{irh_1}	Dark brown (7.5YR 4/4) sandy loam; weak medium granular to subangular blocky structure; very friable; pH 4.70; 5.85% organic matter.
6″–9″	B_{irh_2}	Strong brown (7.5YR 5/6) sandy loam; weak medium granular to subangular blocky structure; firm; pH 5.10; 2.10% organic matter.
9″–15″	B_f	Brown (7.5YR 5/4) sandy loam; weak coarse platy structure; slightly indurated when dry; vesicular; very firm when dry; pH 4.61; 0.50% organic matter.
15″–20″	C or D	Reddish yellow (7.5YR 6/6) sand and gravel; stratified; loose; pH 5.20; 0.22% organic matter.

Type location:	S.E.½ S.E.¼ Sec. 31, T. 40 N., R. 1 W., Price County, Wisconsin.
Series established:	Bayfield County, Wisconsin, 1958.
Source of name:	Village in Iron County, Wisconsin.

SAUGATUCK SERIES (No. 21 on the soil map)

This series includes soils formed on acid glacio-fluvial and lacustrine sands under poor drainage. "Saturated" sand lies at a depth of about 24 inches, and the water table stands at a depth of about 36 inches. The original vegetation included black spruce, tamarack, white pine, hemlock and red maple. The soils are classified as Groundwater Podzols. The subsoil (B_{irh}) begins at a depth of about 16 inches and continues downward another 16 inches with maximum contents of 6% clay, 1% free iron (ir) and 10% organic matter (h). Above the B_{irh} is a bleached sand containing about 3% clay, 0.2% free iron and 1% organic matter. The thickness and degree of cementation of the B_{irh} "Ortstein" is variable. The A_2 "Bleicherde" is also variable. Both horizons appear wavy in cross-section, as exposed in the side of a trench, and show tongues which project downward. When trees blow over, the roots disrupt the soil profile and leave mounds and pits with about 18 to 24 inches of relief. The ortstein ("pan") and the high water table force trees to develop shallow root systems. The deeper the position of the pan, the bigger the tree root system, and the larger the hole excavated by tree-fall. See page 55 for a discussion of this "cradle-knoll" topography which occurs on other Podzols, also. Disregarding the microrelief, the topography is nearly level and is low-lying. Associated soils include the Au Gres, Hiawatha and peat. A profile description follows:

6″–4″	A_{00}	Forest litter.
4″–0″	A_0	Black humus layer.
0″–2″	A_1	Black (10YR 2/1–3/1) sand with light gray (10YR 7/1) quartz grains abundant; weak medium granular to single grain; loose; pH 4.5; about 20% organic matter.
2″–16″	A_2	Light gray (10YR 7/1) sand; single grain; loose; pH 4.0; about 1% organic matter.
16″–20″	B_{irh_1}	Very dark brown (10YR 2/2) to very dark gray (5YR 3/1) sand; cemented; pH 4.3; about 8% organic matter.
20″–24″	B_{irh_2}	Dark brown (7.5YR 4/2–4/4) sand; cemented; pH 4.5; about 10% organic matter.
24″–30″	B_{irh_3}	Brown to yellowish brown (10YR 5/3–5/6) sand; slightly cemented in spots; otherwise single grain; friable; pH 5.0; about 3% organic matter.
30″–40″	C_g	Light grey (2.5YR 7/2) mottled with pale yellow (2.57Y 7/4) sand; single grain; loose; pH 5.0; about 1% organic matter.

Series established:	Allegan County, Michigan.
Type location:	Allegan County, Michigan, 1901.
Source of name:	Town in Allegan County, Michigan.

STAMBAUGH SERIES (Nos. 1, 2, 5, 6, 10, 13 on the soil map)

This series (See Figure 3) includes well drained soils developed from 18 to 42 inches of silty material over acid sand and gravel outwash. As far as is known, the silty deposit was acid from its inception. The original vegetation included balsam fir, hemlock, hard maple, iron wood, yellow birch. These soils are classified as medium Podzols. The subsoil (B_{irh} horizon) begins at a depth of about 3 inches and continues downward through an incipient fragipan (B_f) for about 20 inches, with maximum contents of 12% clay, 1.03% free iron (ir) and 5.6% organic matter (h). Above the B_{irh} horizon is a thin, bleached silt layer (A_2 horizon) containing 9% clay, 0.19% free iron and 3.2% organic matter. Other analytical data can be found on page 54 of this report. Slope gradients are usually less than 3%, but may rise to 20%. Associated soils are the Pence, Vilas, Crivitz. Stambaugh soils are thought of as the podzolized equivalents of the Antigo soils, which are found to the south and west of Oneida County. There are silt loam and loam types in the Stambaugh series. In the N.W. 1/4 N.E. 1/4 Sec. 22, T. 38 N., R. 10 E. a related, moderately-well drained silt loam was noted having a mottled fragipan at 18"–24". The following description was made in the N.W. 1/4 S.W. 1/4 Sec. 6, T 35 N., R. 10 E.

1½"–1"	A_{00}	Leaf litter.
1"–0"	A_0	Black humus layer.
0"–2½"	A_2	Brown (7.5YR 5/2) silt loam; weak medium platy structure; vesicular; firm; pH 4.35; 3.2% organic matter.
2½"–5"	B_{irh_1}	Dark brown (7.5YR 4/4) silt loam; weak medium granular structure; firm; pH 4.77; 5.6% organic matter.
5"–9"	B_{irh_2}	Brown (7.5YR 5/4) silt loam; moderately developed medium subangular blocky structure; firm; pH 4.86; 2.50% organic matter.
9"–26"	B_f	Yellowish brown (10YR 5/4) silt loam; moderately developed medium platy structure; vesicular; very firm; slightly cemented when dry; pH 4.85; 0.67% organic matter.
26"–32"	D_{1f}	Strong brown (7.5YR 5/6) sandy loam; massive; very firm; pH 4.70; 0.30% organic matter.
32"–42"	D_2	Reddish yellow (7.5YR 6/6) stratified sand and gravel; loose; pH 4.80; 0.28% organic matter.

Type location: Marquette County, Michigan.

Series established: Iron County, Michigan, 1930:

Source of name: Town of Stambaugh, southern Iron County, Michigan.

VILAS SERIES (Nos. 2, 5, 6, 11, 12, 17, 18, 19 on the soil map)

This series includes droughty soils developed from deep acid sands, presumably Cary glacio-fluvial deposits with few gravels, or ice-shoved inwash material. Original vegetation was red and white pine, hemlock, hardwoods. These soils are classified as weak Podzols. Where the upper horizon is disturbed, as by animals, the Vilas is not easily distinguished from the Omega. The subsoil (B_{irh} horizon) begins at a depth of about 3 inches and continues downward about 20 inches with maximum contents of 6% clay, 0.39% free iron (fe) and 1.71% organic matter (h). Above the B_{irh} is a bleached layer (A_2) containing 5% clay, 0.22% free iron and 1.79% organic matter. Other analytical data are given on page 54 of this report. Slope gradients range from 2 to 20%. Associated soils are Omega, Crivitz, Hiawatha, Pence, Au Gres. The following description was made under a red pine forest cover in the N.E. 1/4, N.W. 1/4 Sec. 29, T. 39 N., R. 6 E., Oneida County, Wisconsin. In the N.E. corner of Sec. 36, T. 38 N., R. 6 E. stones were abundant throughout the Vilas sand.

1½"–1"	A_{00_1}	Pine needle litter.
1"–½"	A_{00_2}	Fermenting, somewhat decomposed needle litter.
½"–0"	A_0	Black humus layer.
0"–¼"	A_1	Black (5YR 2/1) sand with numerous nearly white quartz sand grains; single grain; loose; pH 4.0; about 3% clay.

1/4″–2 3/4″	A_2	Dark reddish grey (5YR 4/2) sand; single grain; loose; pH 3.7; about 1.79% organic matter.
2 3/4″–3 1/4″	A_2–B_{irh}	Layer in which the 2 horizons interpenetrate.
3 1/4″–5 1/4″	B_{irh_1}	Dark reddish brown (5YR 3/4) sand; single grain for the most part, but with some weak medium granular peds; loose to very friable; coherent; pH 4.35; 1.71% organic matter.
5 1/4″–10 1/4″	B_{irh_2}	Brown (7.5YR 5/4) sand; single grain; slightly coherent; loose; pH 5.2; 1.17% organic matter.
10 1/4″–17″	C_{11}	Brown (7.5YR 5/4) sand; single grain; loose; pH 5.7; 0.25% organic matter.
17″–28″	C_{12}	Strong brown (7.5YR 5/6) sand; single grain; loose; pH 5.6; 0.44% organic matter.
28″–36″	C_2	Reddish yellow (7.5YR 6/6) sand; single grain; loose; pH 5.4; 0.15% organic matter.
60″–65″	C_n	Light brown (7.5YR 6/4) loose sand.

Type location: Sec. 26, T. 48 N., R. 7 W., Bayfield County, Wisconsin.

Series established: Iron County, Michigan, 1930, although the name was previously used in Wisconsin.

Source of name: County name, Vilas County, Wisconsin.

VIII. "SOIL COMMUNITY" DESCRIPTIONS

On the preceding pages, major soils of Oneida County have been described in considerable detail. However, on the soil map, soil associations or "soil communities" are shown, rather than individual soil bodies. Soil bodies are shown only on the field sheets of the Soil Conservation Service (see Figure 5). A soil community consists of soil bodies representing usually less than a dozen soil types. In certain communities, such as the Clifford–Lynne soil association, undulating (no. 4 on the soil map), bodies of Clifford, Lynne and Auburndale soils occur in a repeating sequence, from the tops of slight rises, where Clifford occurs, to the bottoms of slopes where bodies of peat begin. In soil communities composed dominantly of well drained or droughty soils, such as the Pence–Vilas soil association, nearly level to undulating (no. 5 on the soil map), soil bodies occur in rather unpredictable patterns. In the example given, Pence, Vilas, Crivitz and Stambaugh soils occur, and are differentiated by the texture. In this same Pence–Vilas soil community, however, Au Gres soils always occur in depressional positions, such as on low sandy flats near peat bogs. Most of the soil communities are given one or more of the following slope designations: level (0–2% slope gradients), undulating (2–6% slope gradients), rolling (6–15% slope gradients), and hilly (15–30% slope gradients).

The legend of the introductory soil map is set up on the basis of estimated general agricultural productivity ratings for each soil community. Within each general soil productivity class, the soil communities are arranged on the basis of physiography and parent materials. The following table lists the soil communities in the order of decreasing proportionate extents.

The composition of the soil communities is estimated as follows:

1. Stambaugh–Pence soils, nearly level to undulating: 40% Stambaugh silt loam, 40% Stambaugh loam, 10% Pence loam, 5% Crivitz loamy fine sand, 5% imperfectly drained associated soils, unnamed.

TABLE V.—PROPORTIONAL EXTENTS OF SOIL MAP UNITS, ONEIDA COUNTY, WISCONSIN

Symbol on Map	Soil Association Name	Estimated Extent	
		% of area of county	Acres
21	Peat–Saugatuck Association, nearly level and undulating	23.2	160,128
18	Vilas Association, rolling and hilly	22.2	153,984
11	Vilas Association, level and undulating	12.5	86,016
6	Pence–Vilas Association, undulating and rolling	8.6	59,520
20	Peat–Cable Association, nearly level and undulating	5.5	37,568
8	Iron River–Elderon Association, undulating and rolling	4.5	31,040
12	Pence–Vilas Association, rolling	3.6	25,024
5	Pence–Vilas Association, nearly level and undulating	3.2	21,888
7	Iron River–Goodman Association, undulating and hilly	2.6	18,368
3	Goodman–Iron River Association, undulating and rolling	2.4	16,384
14	Iron River–Elderon Association, rolling and hilly	2.0	13,952
17	Pence–Vilas Association, rolling and hilly	1.9	13,120
2	Pence–Stambaugh Association, undulating and rolling	1.4	10,112
4	Clifford–Tripoli Association, undulating	1.1	7,424
13	Pence–Stambaugh Association, rolling and hilly	1.1	7,360
19	Elderon–Emmert Association, rolling and hilly	1.0	6,592
9	Clifford–Tripoli Association, stony, nearly level and undulating	.9	6,144
1	Stambaugh–Pence Association, nearly level and undulating	.8	5,312
16	Monico–Cable Association, nearly level and undulating	.7	4,544
10	Pence–Stambaugh Association, rolling	.4	3,392
15	Clifford–Auburndale Association, nearly level and undulating	.4	3,008
		100.0	690,880
Land		91.3	690,880
Water		8.7	66,240
Total		100.0	757,120

2. Pence–Stambaugh soils, undulating to rolling: 30% Pence loam, 15% Pence sandy loam, 25% Stambaugh loam, 20% Stambaugh silt loam, 5% Vilas loamy sand and sand, 5% Au Gres loamy fine sand.

3. Goodman–Iron River silt loams and loams, undulating to rolling: 40% Goodman silt loam and stony silt loam, 23% Iron River silt loam and stony silt loam, 22% Iron River loam and stony loam, 15% Monico silt loam and stony silt loam.

4. Clifford–Lynne silt loams, undulating: 70% Clifford silt loam and stony silt loam, 20% Lynne silt loam and stony silt loam, 5% Auburndale silt loam and stony silt loam, 5% other imperfectly drained soils, unnamed.

5. Pence–Vilas soils, nearly level to undulating: 37% Pence sandy loam, 32% Pence loam, 10% Crivitz loamy fine sand, 10% Vilas sand and loamy sand, 5% Stambaugh loam, 5% Au Gres loamy sand, 1% Au Train sand.

6. Pence–Vilas soils, undulating to rolling: 52% Pence sandy loam, 15% Crivitz loamy fine sand, 24% Vilas sand and loamy sand, 5% Au Gres loamy fine sand, 3% Stambaugh loam, 1% Au Train sand.

7. Iron River–Goodman soils, hilly and rolling: 30% Iron River loam and stony loam, 30% Iron River silt loam and stony silt loam, 30% Goodman silt loam and stony silt loam, 10% Monico silt loam and stony silt loam.

8. Iron River–Elderon soils, undulating to rolling: 30% Iron River sandy loam and stony sandy loam, 15% Iron River silt loam and stony silt loam, 40% Elderon sandy loam and stony sandy loam, 10% Pence sandy loam, 5% Au Gres loamy fine sand.

9. Clifford–Lynne stony silt loams, nearly level to undulating: 65% Clifford stony silt loam, 20% Lynne stony silt loam, 10% Auburndale stony silt loam, 5% miscellaneous imperfectly drained soils, unnamed. In the N.E. 1/4 N.E. 1/4, Sec. 21, T. 36 N., R. 4 E. a few small gravel ridges occur in this soil association. In the S.E. 1/4 S.E. 1/4, Sec. 33, T. 36 N., R. 4. E. some patches of imperfectly drained silt loams over "outwash" sands were noted.

10. Pence–Stambaugh soils, rolling: 30% Pence sandy loam, 20% Pence loam, 20% Stambaugh loam, 20% Stambaugh silt loam, 10% Iron River silt loam and stony silt loam.

11. Vilas–Crivitz sands, nearly level to undulating: 64% Vilas sands and loamy sands, 15% Crivitz loamy fine sand, 5% Hiawatha sands and loamy sands, 5% Omega loamy sand, 5% Pence sandy loam, 5% Au Gres loamy fine sand, 1% Au Train sand.

12. Pence–Vilas soils, rolling: 40% Pence sandy loam, 10% Pence loam, 20% Crivitz loamy fine sand, 25% Vilas sand and loamy sand, 5% Iron River sandy loam and stony sandy loam.

13. Pence–Stambaugh soils, hilly and rolling: 25% Pence sandy loam, 25% Pence loam, 20% Stambaugh loam, 20% Stambaugh silt loam, 10% Iron River silt loam and stony silt loam.

14. Iron River–Elderon soils, rolling and hilly: 30% Iron River sandy loam and stony sandy loam, 20% Iron River silt loam and stony silt loam, 40% Elderon sandy loam and stony sandy loam, 10% Pence sandy loam.

15. Clifford–Auburndale soils, nearly level to undulating: 50% Clifford silt loam and stony silt loam, 40% Auburndale slit loam and stony silt loam, 10% local alluvial material, mostly silt loams and loams, imperfecty drained.

16. Monico–Cable soils, nearly level to undulating: 50% Monico loam and silt loam, stony loam and stony silt loam, 30% Cable loams and silt loam and stony silt loam, 5% Goodman silt loam and stony silt loam, 5% peat, 10% local alluvial sandy loams, loams, silt loams and stony loams, unnamed.

17. Pence–Vilas soils, hilly and rolling: 24% Pence sandy loam, 20% Pence loam, 20% Crivitz loamy fine sand, 30% Vilas loamy sands and sands, 5% Iron River sandy loam, 1% Au Train sand.

18. Vilas sands, rolling and hilly: 69% Vilas loamy sands and sands, 10% Crivitz loamy fine sand, 5% Hiawatha loamy sand, 5% Omega loamy sand, 5% Iron River sandy loam and stony sandy loam, 5% Elderon stony sandy loam, 1% Au Train sand.

19. Elderon–Emmert soils, rolling and hilly: 45% Elderon sandy loam and stony sandy loam, 35% Emmert gravelly sandy loam, 15% Vilas sand, 5% Iron River stony sandy loam.

20. Peat–Cable soils, nearly level: 80% peat, 12% Cable loam, silt loam, stony loam and stony silt loam, 4% Adolph silt loam and stony silt loam, 4% local alluvium, silt loam and stony silt loam.

21. Peat–Au Gres soils, nearly level: 80% peat, 17% Au Gres loamy fine sand, 3% Saugatuck sands and loamy sands.

IX. APPENDIX

A. RESULTS OF LABORATORY ANALYSES

Table VI presents results of laboratory analyses made of nine representatives soil profiles by K. O. Schmude (18), Clyde A. Applewhite, both Research Assistants, and M. Formali, Analyst, Soil Survey Division, Wisconsin Geological and Natural History Survey, University of Wisconsin.

Analyses were made by the following methods:

1. A Beckman pH meter was used in measuring the reaction of soil pastes that had stood at the saturation point for 30 minutes.
2. Bulk density was determined from soil cores taken with metal cylinders three inches tall and two inches in outside diameter. Sandy horizon samples were emptied from the cylinders into bags in the field. Silty horizon samples were left in the cyinders until after drying, paraffin coating, and weighing both in air and in water.
3. Particle size distribution analysis was made of the mineral soil fractions by using U.S.D.A. standard sieves for the sands, and an ASTM 152 H soil hydrometer with Bouyoucos scale in 1,000 M.L. graduate cylinders in a constant-temperature room for determining silt and clay contents. Each analysis totals to 100 percent since the hydrometer data were plotted on a cumulative curve.
4. Reductant-soluble or free iron was determined by reducing and complexing the iron in a neutral system (dithionite–citrate–bicarbonate method). (10, 11)
5. Organic matter was determined by the Walkley–Black method of oxidation by chromic acid with H_2SO_4 heat of dilution.
6. Exchangeable cations and cation exchange capacity were determined by leaching with ammonium acetate, and by use of the Beckman flame photometer.

The following observations have been made after a study of the laboratory data for nine soil profiles (18).

1. *Reaction (pH).* The soils are acid throughout and show an increase in pH with depth, except for a decrease in pH in the fragipan (B_f) horizon of sandy soils.
2. *Bulk Density.* Bulk density seems to be inversely related to organic matter content. In three of the soils (Pence, Goodman, Stambaugh), the B_{irh} has a lower bulk density than other horizons analyzed.
3. *Particle size distribution.* In 5 profiles the maximum clay content is in the B_{irh} horizon. In 3 profiles, the B_f horizon has the highest clay content.
4. *Iron (free or reluctant-soluble).* In most soils the iron content is greatest in the B_{irh} horizon, as is also clay content, organic matter content, and cation exchange capacity. The sandy soils formed from glacio-fluvial deposits have more free iron in the A_2 than in the C or D horizons, while the reverse is true in some soils formed over till.
5. *Organic matter.* In medium Podzols, the B_{irh} contains more organic matter than does the A_2 horizon. The reverse seems to be the case in the weak Podzols.
6. *Cation exchange capacity and base saturation percentage.* Cation exchange capacity correlates with clay content or organic matter content or both. Base saturation percentage tends to be lowest in the A_2 and highest in the C or D horizons.

TABLE VI.—ANALYTICAL DATA FOR SOME SOILS OF ONEIDA COUNTY, WISCONSIN

Horizon	Depth	pH	Bulk Density	Sand >50u	Silt 2–50u	Clay <2u	Reductant-Soluble Fe	Organic matter Walkley-Black	Exchange Capacity	Exchange metallic cation sat.	Exchangeable m.e./100 g.		
											Ca	Mg	K
	Inches		Grams per cc	%	%	%	%	%	me. per 100 g.	%			
Clifford silt loam (N.W. ¼ S.W. ¼ Sec. 22, T. 36N., R. 4 E.)													
A_2	½– 5	4.68	1.45	22.0	64.0	14.0	0.68	2.5	6.8	25.8	1.30	0.35	0.10
B_1	5–12	4.35	1.54	22.0	66.0	12.0	1.10	1.6	6.0	19.6	0.87	0.26	0.05
B_3	12–22	4.65	1.86	56.0	33.0	11.0	0.60	0.47	6.1	50.0	2.04	0.91	0.10
D	22+	4.88	1.70	68.0	24.0	8.0	0.48	0.18	7.4	53.0	2.67	1.15	0.10
Elderon sandy loam (N.E. ¼ S.E. ¼ Sec. 5, T. 38N., R. 5 E.)													
A_2	1– 3	4.90	1.37	79.0	15.0	6.0	0.37	2.68	5.2	47.0	2.10	0.27	0.07
Birh	3–12	5.15	1.43	76.0	13.5	10.5	0.58	1.81	7.0	55.0	3.60	0.18	0.07
Bf	12–22	4.75	1.87	71.3	18.7	10.0	0.56	0.60	5.7	53.7	2.60	0.89	0.14
C	22+	5.30	----	77.0	17.0	6.0	0.46	0.25	5.2	71.4	2.81	0.80	0.09
Goodman silt loam (S.E. ¼ N.E. ¼ Sec. 30, T. 35N., R. 9 E.)													
A_2	½– 4	4.16	1.17	37.0	55.0	8.0	0.46	3.2	9.4	18.3	1.77	0.18	0.09
Birh	4– 8	4.60	1.00	48.0	46.0	6.0	1.05	4.4	14.5	13.9	1.70	0.23	0.08
Bir	8–13	4.70	1.22	34.0	57.0	9.0	0.81	3.4	11.3	5.1	0.48	0.05	0.05
Bf	13–27	4.55	1.42	28.0	61.5	10.5	0.74	0.67	4.9	23.0	0.69	0.37	0.07
D	27+	5.30	1.49	75.0	17.0	8.0	0.49	0.34	4.0	32.0	0.88	0.34	0.06
Hiawatha loamy sand (N.E. ¼ N.W. ¼ Sec. 21, T. 39N., R. 6 E.)													
A_2	½– 4	3.8	1.21	80.8	16.2	3.0	0.16	1.84	3.8	6.6	0.17	0.04	0.04
A_2-Birh	4– 5	----	----	----	----	----	----	----	----	----	----	----	----
Birh	5–15	5.40	1.24	97.5	0.0	2.5	0.49	1.91	3.6	14.7	0.34	0.08	0.11
Bir	15–20	5.40	1.45	96.9	0.5	2.5	0.26	0.67	2.2	11.3	0.17	0.03	0.05
Bf_{11}	20–30	5.58	1.66	94.8	2.6	2.6	0.19	0.37	1.9	14.2	0.17	0.06	0.04
Bf_{12}	30–42	5.45	1.66	96.9	0.5	2.6	0.18	0.30	1.6	16.9	0.20	0.03	0.04
Bf_2	42–50	5.40	1.73	81.1	10.5	8.4	0.11	0.22	1.4	17.8	0.16	0.03	0.06
Bf_3	50–60	5.10	1.73	92.0	2.7	5.3	0.14	0.03	1.6	18.7	0.22	0.06	0.02
C_1	60–70	5.40	1.67	97.5	0.0	2.5	0.19	0.22	1.8	13.9	0.22	0.00	0.03
C_2	70+	5.40	1.57	94.0	3.5	2.5	0.08	0.15	0.2	100.0	0.14	0.00	0.02
Iron River sandy loam (N.W. ¼ N.W. ¼ Sec. 24, T. 36N., R. 9 E.)													
A_2	½– 2	4.35	1.19	74.0	21.0	5.0	0.31	0.30	8.3	32.8	2.20	0.40	0.11
Birh	2– 6	5.05	1.40	84.0	8.5	7.5	0.47	2.30	5.0	36.0	1.56	0.23	0.07
Bir	6–10	5.20	1.46	82.0	15.0	3.0	0.30	1.50	3.0	40.7	1.00	0.16	0.06
Bf_1	10–20	5.35	1.54	85.0	11.5	3.5	0.26	0.64	2.6	24.2	0.55	0.04	0.04
Bf_2	20–30	5.21	1.59	84.0	13.5	2.5	0.21	0.47	2.4	20.0	0.36	0.08	0.04
C	30+	5.40	----	87.0	10.0	3.0	0.14	0.37	1.2	50.0	0.48	0.07	0.05

TABLE VI.—ANALYTICAL DATA FOR SOME SOILS OF ONEIDA COUNTY, WISCONSIN—Continued

Horizon	Depth	pH	Bulk Density	Sand >50u	Silt 2–50u	Clay <2u	Reductant-Soluble Fe	Organic matter Walkley-Black	Exchange Capacity	Exchange metallic cation sat.	Exchangeable m.e./100 g.		
											Ca	Mg	K
	Inches		Grams per cc	%	%	%	%	%	me. per 100 g.	%			
Lynne silt loam (N.E. ¼ N.E. ¼ Sec. 21, T. 36 N., R. 4 E.)													
A_2	1– 2	4.40	1.22	42.0	47.0	11.0	0.54	3.75	10.2	36.0	2.80	0.76	0.10
Birh	2– 7	4.50	1.22	46.0	40.0	14.0	1.00	6.50	16.0	25.4	3.10	0.86	0.10
Bir	7–13	4.70	1.56	38.0	41.0	21.0	1.10	0.94	10.9	10.7	0.89	0.31	0.06
Bf	13–24	4.90	1.83	34.0	57.0	9.0	0.58	0.57	6.7	47.5	2.14	0.95	0.08
D_1	24–30	4.90	1.87	60.0	29.0	11.0	0.69	0.40	7.6	60.5	3.20	1.30	0.10
D_2	30–36	5.75	1.93	72.0	19.0	9.0	0.55	0.17	5.6	62.0	2.40	1.00	0.08
Pence sandy loam (S.W. ¼ N.E. ¼ Sec. 10, T. 38N., R. 9 E.)													
A_2	0– 4	4.65	1.37	70.0	25.0	5.0	0.39	1.84	3.8	24.2	0.71	0.18	0.03
Birh	4– 6	4.70	1.25	62.0	28.0	10.0	1.30	5.85	5.1	19.2	0.64	0.17	0.06
Bir	6– 8	5.10	1.28	70.0	24.0	6.0	0.68	2.10	4.2	8.1	0.22	0.08	0.04
Bf	9–15	4.61	1.62	66.0	23.0	11.0	0.59	0.50	7.5	25.0	1.38	0.41	0.08
C	15+	5.20	1.59	94.0	3.0	3.0	0.25	0.22	1.8	33.2	0.49	0.08	0.03
Stambaugh silt loam (N. W. ¼ S. W. ¼ Sec. 6, T. 35N., R. 10 E.)													
A_2	0–2½	4.35	1.13	11.8	79.0	9.2	0.19	3.20	8.6	7.9	0.18	0.40	0.10
Birh	2½– 5	4.77	0.96	18.0	70.0	12.0	1.03	5.60	10.8	5.2	0.14	0.30	0.12
Bir	5– 9	4.86	1.25	23.0	66.0	11.0	0.73	2.50	7.4	7.3	0.37	0.09	0.08
Bf	9–26	4.85	1.62	28.0	62.0	10.0	0.50	0.67	5.5	19.1	0.74	0.24	0.07
D_1	26–32	4.70	1.72	90.0	5.0	5.0	0.27	0.30	2.6	47.8	0.91	0.27	0.06
D_2	32+	4.80	1.64	92.5	2.5	5.0	0.16	0.28	1.3	61.5	0.63	0.14	0.03
Vilas loamy sand (N.E. ¼ N.W. ¼ Sec. 21, T. 39N., R. 6E.)													
A_2	¼–2¼	3.70	1.19	87.3	7.6	5.1	0.22	1.79	5.8	15.9	0.76	0.08	0.08
A_2-Birh	2¾–3¼												
Birh	3¼–5¼	4.35	1.24	84.8	9.1	6.1	0.39	1.71	4.8	9.6	0.36	0.04	0.06
Bir	5¼–10¼	5.20	1.33	87.4	7.1	5.5	0.39	1.17	3.6	23.5	0.64	0.06	0.07
C_{11}	10¼–17	5.70	1.46	92.0	5.0	3.0	0.25	0.25	2.4	21.2	0.42	0.04	0.05
C_{12}	17–28	5.60	1.52	97.0	2.5	0.5	0.09	0.44	1.7	23.6	0.34	0.03	0.03
C_2	28+	5.40	1.59	97.0	2.5	0.5	0.07	0.15	1.5	23.3	0.30	0.03	0.02

7. *Fragipans.* Fragipans are defined (18) as subsoil horizons which seem dense and brittle when dry but soften upon moistening, unlike Ortstein pans which are irreversibly hard. Fragipans in Oneida County are weakly developed. The so called B_f horizons of the Hiawatha and Iron River soil profiles studied are not definite fragipans. For the other soil profiles, data show a narrow range in pH from 4.44 to 4.9 in the B_f, and a narrow range in clay content, from 9 to 11 per cent. It is suggested that this content of clay is prerequisite to the formation of a fragipan in soils of Oneida County, Wisconsin.

B. A STUDY OF A "CRADLE-KNOLL" (See Figs. 19, 20)

A trench was dug in Vilas loamy sand, revealing the horizons shown in Figure 20. It is presumed, from observations of recently fallen trees, that the tree, whose fall made this particular cradle-knoll, fell to the right (see the diagram). Profile "A", on the left of the diagram, shows a notable accumulation of organic matter in the 13-inch thick A_1 horizon. The 6-inch very firm fragipan may very well be a result of slight deposits of clay and organic matter made by large amounts of percolating water, concentrated in this profile. Profile "B" shows a 10-inch overburden of sand a little darker in color than the parent material, and a well developed buried A_1 horizon. Profile "C" on the right of the figure, is a normal minimal Podzol profile of the Vilas series.

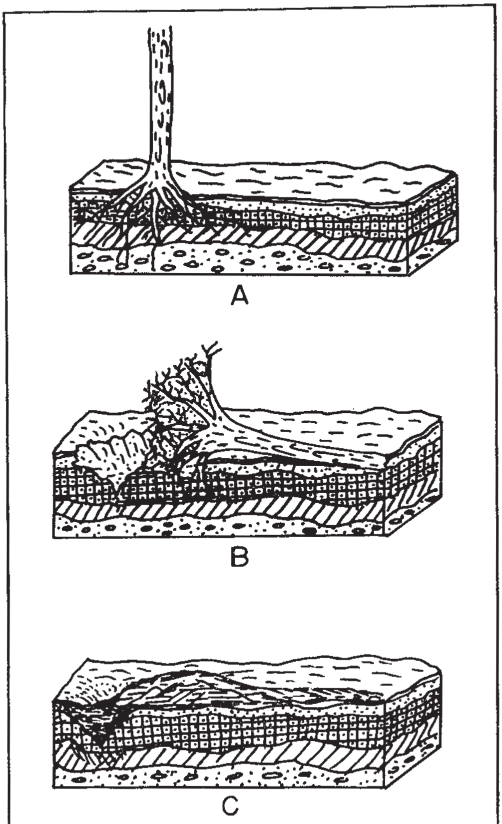


Figure 19. Stages in evolution of a "cradle-knoll".

C. MINERALOGY OF SOME SOIL PROFILES FROM ONEIDA COUNTY, WISCONSIN (5)

Mr. Thomas E. Hendrix, graduate student in the Department of Geology, University of Wisconsin, in 1958, made a study of the mineralogy of the sand and coarse silt of the Hiawatha, Vilas, Stambaugh and Clifford soil profiles. His findings are summarized below:

1. The sands and coarse silts of the four soil profiles contain minerals indicative of predominantly metamorphic source rocks. A typical mineralogical analysis shows 89% quartz, 5% feldspar, 4% quartzite and 2% heavy minerals, including garnet, tourmaline, hornblende, kyanite, sillimanite, andalusite, staurolite, leucoxene, hematite, magnetite, ilmenite, with very small amounts of zircon and apatite.
2. The soil material is glacial drift, probably largely glacio-fluvial and locally derived. The occurrence of fresh looking unstable heavy mineral grains (as of andalusite) with fairly well rounded quartz grains can be explained by assuming that the quartz was derived from nearly spherical grains in metamorphic rocks or quartzite, sandstone and arkose or that the quartz grains have been moved many more times than the andalusite grains.
3. The soil profiles, including those formed from silty material overlying sand and gravel, are rather homogeneous, mineralogically. The mineralogy of the sands and coarse silts of the silty soils is the same as that of the sandy soils.
4. The sand and coarse silt-size mineral particles have been essentially unaffected by post-depositional weathering. Most grains do carry deposits of iron and clay, which may actually have protected the mineral grains against weathering. A thin skin of clay mineral may occur on the surfaces of feldspar grains in the A_2 horizon. This is the only and slight evidence of a weathering depth-function observed in these soils in this study, although Brown and Jackson have reported a definite weathering depth-function from an investigation of clay minerals in soils of northern Wisconsin (1). The Hiawatha loamy sand shows an accumulation of montmorillonite (33% of the 2–0.2 micron clay fraction) in the A_2 horizon, presumably chemically weathered from illite and vermiculite-chlorite like those in the montmorillonite-free clay of the B horizon. Pyroxene sand grains show ragged edges in the A_2 horizon.
5. The mineral particles of sand and coarse silt sizes have apparently contributed practically nothing to the soil in the way of coloring matter or plant nutrients.

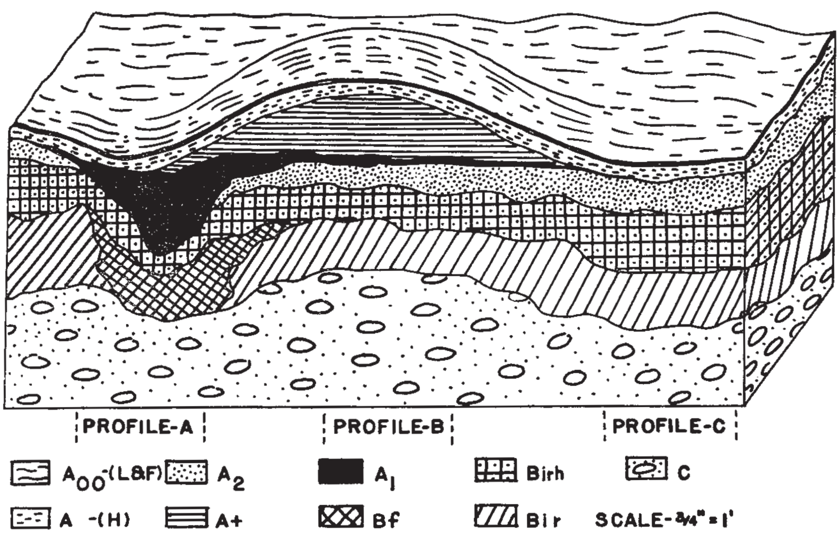


Figure 20. Cross-section of a "cradle-knoll".

D. LISTS OF PLANTS COLLECTED BY ~~ROLAND D. MEVILLE~~ Ronald D. Melville DURING THE COURSE OF THE SOIL SURVEY

Scientific nomenclature is from Gray's Manual of Botany, 8th edition, 1950.

Abies balsamea L. Mill. (balsam fir)
Acer rubrum L. (red maple)
Acer saccharum Marsh. (hard maple)
Acer spicatum Lam. (mountain maple)
Achillea Millefolium L. (yarrow)
Adiantum pedatum L. (maidenhair)
Agrostis gigantea Roth. (bentgrass)
Alnus rugosa (Du Roi) Spreng. (tagalder)
Andromeda glaucophylla Link. (bog rosemary)
Asclepias incarnata L. (milkweed)
Aster sp. (astevs)
Aster macrophyllus L.

Betula lutea Michx. f. (yellow birch)
Betula papyrifera Marsh. (paper birch)
Bromus Kalmii Gray (poverty oats)

Carex sp. (sedges)
Chamaedaphne calyculata L. Moench (leatherleaf)
Cladonia sp. (reindeer moss)
Comptonia peregrina (L.) Coult. (sweet fern)
Coptis trifolia (L.) Salisb. (goldthread)
Cornus canadensis L. (dwarf cornel)
Cornus racemosa Lam. (gray dogwood)
Corylus americana Walt. (hazelnut)
Corylus cornuta Marsh. (beaked hazel)
Cypripedium acaule Ait. (lady's slipper)

Dryopteris spinulosa var. (woodfern)

Eriophorum virginicum L. (bog cotton)
Eupatorium maculatum L. (boneset)

Fragaria virginiana Rydb. (strawberry)
Fraxinus americana L. (American ash)
Fraxinus nigra L. (black ash)

Galium triflorum Michx. (bedstraw)
Gaultheria procumbens L. (wintergreen)

Hieracium aurantiacum L. (hawkweed)
Hydrophyllum virginianum L. (waterleaf)

Impatiens capensis Meerb. (jewelweed)

Kalmia polifolia L. (pale laurel)

Larix laricina (Du Roi) K. Koch (tamarack)
Lycopodium obscurum L. (upright L.)

Nuphar sp. (spatterdock)

Ostrya virginiana, Mill., K. Koch (ironwood)

Picea mariana (Mill.) BSP (black spruce)
Pinus Banksiana Lamb. (jack pine)
Pinus resinosa Ait. (red pine)
Pinus Strobus L. (white pine)
Polygonatum biflorum (Walt.) Ell. (Solomon's seal)
Populus tremuloides Michx. (common aspen)
Prunus pennsylvanica L. (pin cherry)
Prunus virginiana L. (choke cherry)
Pteridium aquilinum var. latiusculum (Desv.) Underw. (bracken fern)

Rubus canadensis L. (blackberry)
Rubus idaeus L. (red raspberry)
Rumex Acetosella L. (sheep sorrel)

Sagittaria latifolia Willd. (duck potato)
Salix sp. (willow)
Scirpus cyperinus (L.) Kunth. (rushes)
Smilacina racemosa (L.) Desf. (false Solomon's seal)
Solidago sp. (goldenrods)
Sphagnum sp. (sphagnum moss)
Spiraea alba (Du Roi) (spiraea)
Symplocarpus foetidus (L.) Nutt. (skunk cabbage)

Thuja occidentalis L. (white cedar)
Trifolium pratense L. (red clover)
Trifolium repens L. (white clover)
Trillium grandiflorum (Michx.) Salisb. (trillium)
Tsuga candensis (L.) Carv. (hemlock)

Utricularia sp. (bladderwort)

Vaccinium augustifolium Ait. (upland blueberry)
Vaccinium myrtilloides Michx. (blueberry)
Vaccinium Oxycoccus L. (cranberry)
Viburnum Lentago L. (Nannyberry)
Viola incognita Brainerd (violet)

Voucher specimens of these are deposited in the University of Wisconsin Herbarium.

X. ACKNOWLEDGEMENTS

In addition to persons already named in the text, the following helped in the preparation of the map and report by reviewing them and offering criticisms: State Geologist George F. Hanson, Assistant Director of the Agricultural Experiment Station R. J. Muckenhirn, Chairman L. E. Englebert of the Soils Department, G. B. Lee and M. T. Beatty of the Wisconsin Geological and Nat. Hist. Survey, M. L. Jackson of the Soils Department, J. T. Curtis and H. H. Iltis of the Department of Botany, A. H. Robinson of the Department of Geography, all of the University of Wisconsin, and H. L. Becker, County Agricultural Agent, Oneida County.

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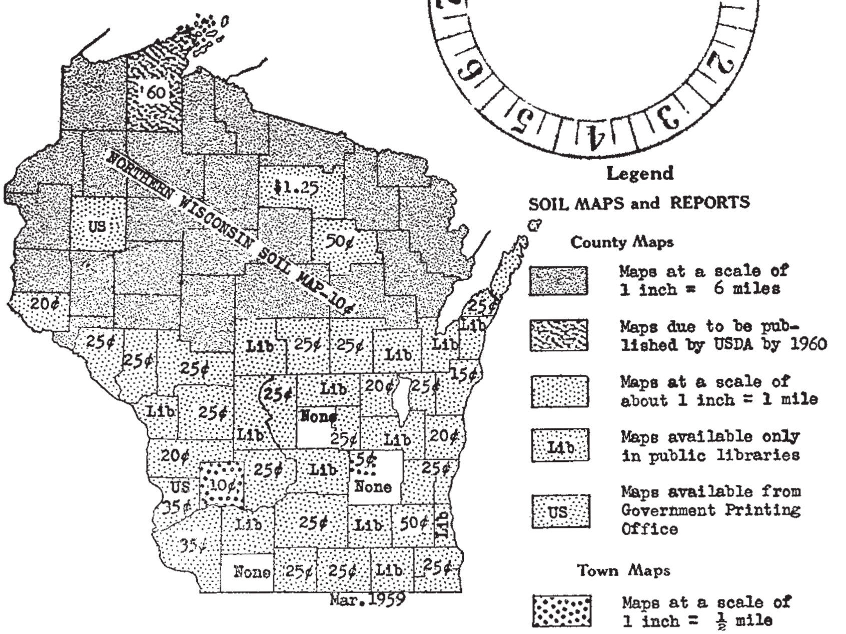

Figure 21. Index maps to soil survey publications by the Wisconsin Geological and Natural History Survey as of 1958. Requisitions and payments for the publications are handled by: Secretary, Soils Department, University of Wisconsin, 203 Soils Building, Madison 6, Wisconsin.

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