Peat Deposits of Southeastern New York

GEOLOGICAL SURVEY BULLETIN 1317-B

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By CORNELIA C. CAMERON

STUDIES IN PEAT

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The use of physical characteristics of peat and geologic settings of the deposits as guides to peat resources

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PEAT DEPOSITS OF SOUTHEASTERN NEW YORK

By CORNELIA C. CAMERON

ABSTRACT

Peat resources of 66 undeveloped deposits investigated in southeastern New York are estimated at 11,500,000 short tons of air-dried peat, mostly of good quality reed-sedge type. Most of the deposits in the upland areas are 10–100 acres in extent, average 5–15 feet in thickness, and contain 10,000–100,000 tons each on an air-dried basis. Deposits in the lowlands, although less numerous, are as much as 1,250 acres in area and as much as 25 feet in average thickness; a few contain more than 2 million tons of air-dried peat.

The principal factors that determine the commercial value of peat are water-holding capacity, organic and ash content, fiber content, and acidity. Water-holding capacity of peat in the deposits that were investigated tends to increase as the percentage of fiber greater than 0.15 mm in length increases. Fiber content and percentage of organic material is inversely proportional to the degree of diagenesis that the peat has undergone. The relation of fiber size to water-holding capacity may be demonstrated by analysis and is the basis for an American Society for Testing and Materials Committee classification for peat used for nonfuel purposes.

The quality of peat seems to be controlled primarily by the geologic setting of the basin of peat deposition. Analyses show that characteristics such as ash content are related to the shape of the basin of accumulation and to the distribution of unconsolidated material and to the rocks that compose the depression walls. A fivefold classification of depressions that contain peat deposits, originally applied to the highlands of northeastern Pennsylvania, was found to hold for highland and lowland deposits in southeastern New York. An understanding of the geologic factors relating to the fivefold classification is useful in prospecting for peat deposits in the region.

INTRODUCTION

GENERAL NATURE AND USE OF PEAT

Peat is a light- to dark-brown or black residuum formed by the partial decay and disintegration of plants that grow in marshes and swamps or in similar wet places. It may be (1) fibrous, matted material composed of mosses, ferns, grasses, rushes, reeds, sedges, and woody material from trees and shrubs, (2) finely divided plant debris so decomposed that its biological identity is lost, or

(3) nonfibrous, plastic, colloidal, and macerated material deposited at the bottom of lakes or other bodies of water. Peat has been burned as a low-rank fuel throughout historic time, but only recently has it been widely used for a soil conditioner and horticultural material. In 1966 for nonfuel use, 144 peat mines in 28 States produced more than 600,000 short tons of air-dried peat. An additional 293,843 tons was imported chiefly from Canada (U.S. Bureau of Mines, 1967).

In view of the growing demand for peat along the Atlantic seaboard, an investigation of peat resources was extended from northeastern Pennsylvania (Cameron, 1968, 1970) into the adjoining southeastern part of New York State from lat 41° to 41°45′ N. The area investigated includes Orange, Putnam, and Rockland Counties and parts of Ulster, Dutchess, and Westchester Counties.

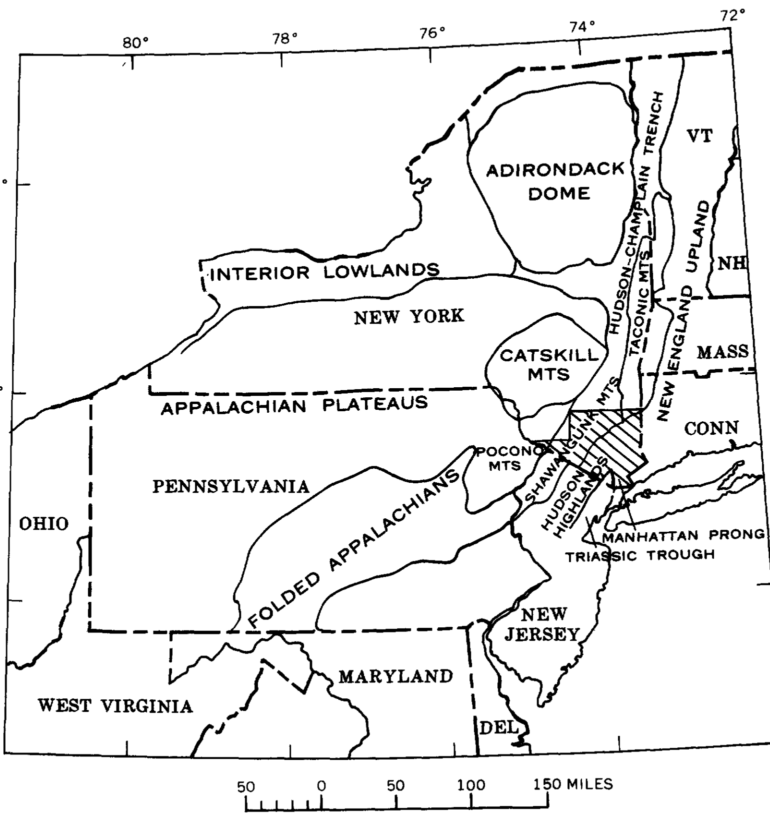


FIGURE 1.—Physiographic setting and area of study in southeastern New York (modified from Meyerhoff, 1963, fig. 1).

Physiographically, the area extends from the Appalachian Plateaus to the New England Upland (fig. 1) across the Shawangunk Mountains, the southern end of the Hudson-Champlain trench, the Hudson highlands, and the Taconic Mountains. The southeastern corner covers part of the Triassic trough and the Manhattan prong. Culturally, the area includes part of the New York metropolitan district in Westchester County, farming communities chiefly in the lowlands, and forested rugged uplands mostly suitable for recreation. Peat occurs in numerous swamps and marshes scattered over the area (fig. 2).

SCOPE OF REPORT AND ACKNOWLEDGMENTS

The purpose of this report is to provide information for use in the exploitation of peat deposits in southeastern New York and similar deposits elsewhere. Seventy-four undeveloped but representative peat deposits were investigated by traverses across swamps and marshes and by auger holes put down by hand. Auger holes were put down with a Davis sampler and by Hiller and MacAlley peat borers at frequent intervals along the traverses to collect samples of peat and to determine the stratigraphy and thickness of the deposits and the configuration of the depressions in which they lie. The amount of peat in each deposit was estimated from auger-hole data and from the surface area measured on topographic maps. In calculating tonnages, 1 acre-foot of peat in place was considered equivalent to 200 tons of air-dried peat. Samples from 66 of the 74 deposits were analyzed under the supervision of Irving May in the laboratories of the U.S. Geological Survey for moisture, ash, organic content, water-holding capacity, fiber size (exceeding 0.15 mm), and acidity.

The help of Eugene T. Sheridan, U.S. Bureau of Mines, is gratefully acknowledged. Committee reports and suggestions by members of the ASTM (American Society for Testing and Materials) Committee D–29 on peats, mosses, humus, and related products were much appreciated in interpreting sample test data. Methods used in collecting and testing samples were devised or suggested by Rouse S. Farnham, Department of Soil Science, University of Minnesota; Robert E. Lucas, Department of Soil Science, Michigan State University; and Virginia Thorpe, Michigan Testing Laboratory.

Thanks for especially due David E. Schieck who served as field assistant.

COMPOSITION AND PHYSICAL PROPERTIES OF PEAT

The properties and composition of peat vary considerably in different deposits and in different parts of the same deposit

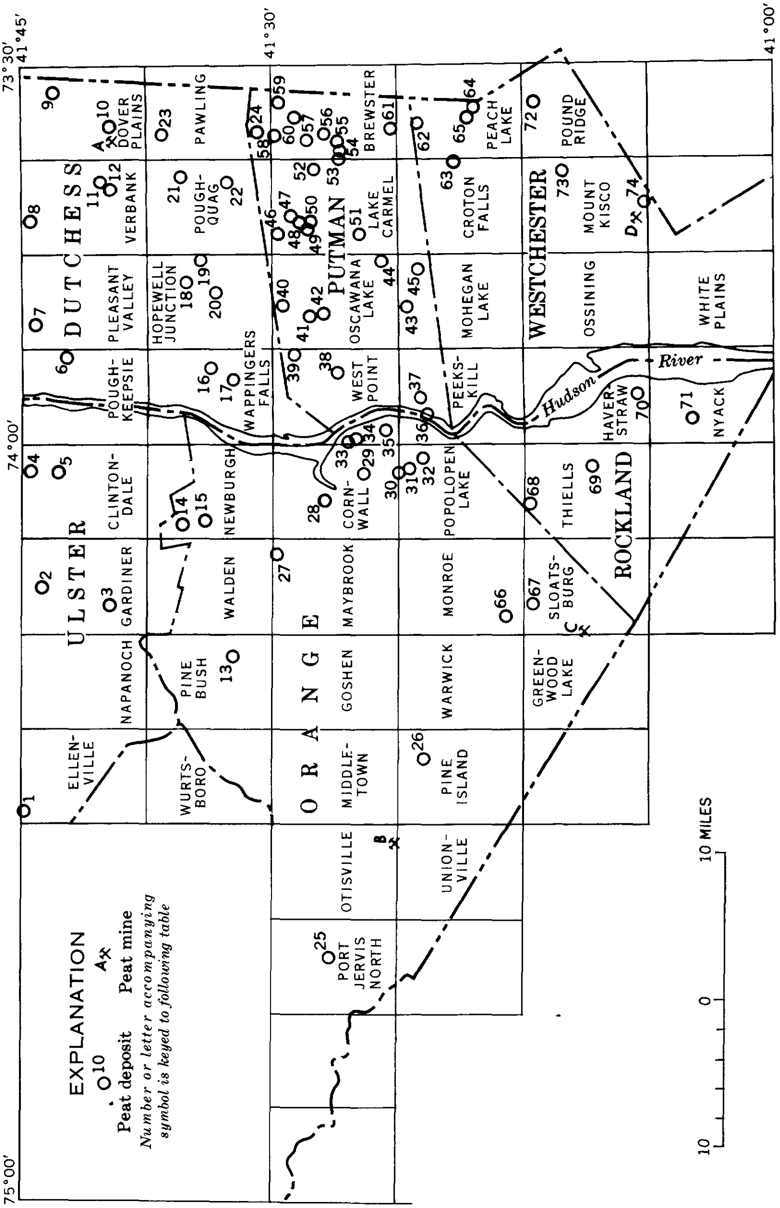


FIGURE 2.—Index map of study area in southeastern New York, showing 7½-minute quadrangles and locations of peat deposits and peat mines.

UNEXPLOITED DEPOSITS

[Locality numbers and name or location of swamp or marsh containing deposit]

1. Cedar Swamp.
2. West of Wallkill Camp.
3. 1.1 miles east of Bruynswick.
4. Between Ohioville and Elting Corners.
5. 1.04 miles south of Elting Corners.
6. East of Poughkeepsie, 0.5 of a mile northeast of crossing of Van Wagner Street and railroad.
7. Southwest of Pleasant Valley.
8. 0.5 of a mile northwest of Norris Pond.
9. Tamarack Swamp.
10. Stretch between Wingdale and railroad river crossing to the northwest.
11. 0.5 of a mile north of Pleasant Ridge.
12. 0.5 of a mile east of McKinney Pond.
13. Pine Swamp.
14. Northwest of Leptondala between Highway 300 and Prospect Road.
15. North border of Orange Lake.
16. West of New York-Albany Post Road and north of Osborne Hill.
17. Northeast of Route 52 and Red Schoolhouse Road junction.
18. Northwest of Taconic State Parkway and Highway 52 interchange.
19. Northeast of crossing of Hosner Mountain Road and Taconic State Parkway.
20. Southwest of East Fishkill.
21. 0.7 of a mile north of Whaley Pond.
22. Bear Swamp.
23. Northwest of Hurd Corners.
24. The Great Swamp.
25. 1.25 miles south of Big Pond.
26. West of Durlandville.
27. Great Swamp.
28. 0.2 of a mile southwest of Vails Gate.
29. Northeast of Sphagnum Pond.
30. Northeast of Bull Hill.
31. East of Camp Natural Bridge.
32. Along Popolopen Brook northwest of the Torne.
33. West side of Route 9W, 0.6 of a mile northwest of crest of Crows Nest.
34. West side of Route 9W, 0.4 mile southwest of crest of Crows Nest.
35. Head of Stoney Lonesome Brook north of Highland Falls.
36. In Hudson River Gorge west of Manitou.
37. Intersection of Manitou Road and Appalachian Trail.
38. West of edge of Cat Pond.
39. East side of East Mountain Road and 1.0 mile northeast of North Highland.
40. East side of Taconic State Parkway north of Fahnestock ski slope.
41. East of Intersection of Taconic State Parkway and Cold Spring-Carmel Road.
42. East of Taconic State Parkway and north of Dicktown Road.
43. North border of Barger Pond.
44. North end of Kirk Lake.
45. Along Muscoot River between Stillwater and Baldwin Place.
46. Little Buck Mountain Pond.
47. East side of Route 52 north of Lake Carmel.
48. North end of Pine Pond.
49. Southwest arm of Pine Pond.
50. Southeast arm of Pine Pond.
51. East end of Long Pond.
52. East of Field Corners.
53. 1.1 miles north of Brewster Heights.
54. West of Lake Tonetta.
55. North border of Lake Tonetta.
56. At Brewster Pond.
57. At Steinbeck Corners north of Big Elm Road.
58. The Great Swamp north of Route 22.
59. North border of Little Pond.
60. The Great Swamp south of Route 22.
61. Cedar Swamp.
62. South of Peach Lake and northeast of Baxter Road.
63. South of Titicus Reservoir and north of Nash Road.
64. East end of Lake Rippowam.
65. West end of Lake Rippowam.
66. Southeast of Prospect Mountain.
67. 0.45 of a mile northwest of Junction A17 and Long Swamp Road.
68. Green Swamp.
69. Mount Ivy Swamp.
70. West edge of Rockland Lake.
71. South of West Nyack.
72. Along Stone Hill River at margin of Ward Pound Ridge Reservation.
73. 0.8 of a mile west of Bedford.
74. East of Route 22 and 0.5 mi north of center of south quadrangle boundary

PEAT MINES

Letter	*Location*	*Letter*	*Location*
A.	0.9 of a mile northwest of Wingdale.	C.	0.7 of a mile north of McKeags Meadow.
B.	1.0 mile southwest of South Centerville.	D.	1.4 miles northeast of Armonk.

because of different types of vegetation from which peat was derived and from varying conditions under which it accumulated and has been preserved. The commercial characteristics and properties of peat vary widely, and the Cooperative Extension Service at Michigan State University (Lucas and others, 1966) has published a guide for users. The principal factors that determine the commercial value are water-holding capacity, organic content, fiber content, and acidity.

WATER-HOLDING CAPACITY

One of the most important properties of peat as a soil conditioner and horticultural material is its ability to reabsorb water after initial drying, like a sponge. Water-holding capacity, which is measured in percentage by weight, depends upon botanical character, the degree of decomposition, and the degree of drying to which peat has been subjected. Moss peat will hold water equal to 15–30 times its own dry weight; a good grade of reed-sedge peat will hold water equal to 10–20 times its own dry weight; humus which is highly decomposed peat will hold considerably less water. Peat tends to reabsorb less water when oven dried than when it is dried in the open air.

Water-holding capacity is determined in the laboratory on samples of peat that have been kept from drying after collection in the field. Twenty to fifty grams of peat is immersed in water at room temperature for 18–24 hours in a tarred-covered container having a wire-screen bottom. The sample is then heated in an oven at 105°C to constant weight, cooled in a desiccator, and weighed. The ratio of absorbed water to the oven-dry weight is computed from the difference in weight of the sample before and after drying.

Water-holding capacity in a representative sample from each of the 66 New York deposits sampled ranged from 352 to 2,488 percent. Only 12 samples had a water-holding capacity of less than 1,000 percent.

ORGANIC AND ASH CONTENT

Regulations established by the Federal Trade Commission in 1950 define peat as any partially decomposed vegetable matter which is accumulated under water or in a water saturated environment through decomposition of mosses, sedges, reeds, tule, trees, or other plants. It is unlawful to label a product "peat" unless 75 percent of the material, by dry weight, is composed of peat as defined and the remainder is composed of normally associated soil materials. In practice, the organic content is equal to the loss in weight when dry peat is heated at 550°C and the solids remaining constitute the ash.

The organic content in samples representative of about half of the New York depostis studied is at least 90 percent. Only samples from 13 deposits contained less than 75 percent organic material.

FORMULAS FOR OBTAINING MOISTURE, ORGANIC, AND ASH CONTENT

In this investigation, moisture, ash, and organic content were determined in successive steps on the same sample. Samples were carried to the laboratory in water-tigh+ containers to prevent water loss and were dried in the laboratory at 105°C for 16 hours. The percentage of moisture content equals

$$\frac{\text{weight of sample as received} - \text{weight of dried sample}}{\text{weight of sample as received}} \times 100.$$

The dried sample was then heated at 550°C until completely ashed. The percentage of ash equals

$$\frac{\text{weight of ash}}{\text{weight of dried sample}} \times 100.$$

Organic content of the sample was then calculated, in percentage as follows:

$$\frac{\text{weight of dried sample} - \text{weight of ash}}{\text{weight of dried sample}} \times 100.$$

FIBER CONTENT

Fiber content refers to the proportion of stem, leaf, or other plant fragments that make up peat. Because peat with a high percentage of fibers more than 0.15 millimeters in length also tends to have high water-holding capacity and because fiber content correlates well with weight per unit volume (a basis for the sale of peat), a tentative classification based on fiber content has been formulated by the ASTM D–29 Subcommittee I, Classification (R. S. Farnham, written commun., 1967).

The amount of fiber exceeding 0.15 mm in length has been measured for each of the 66 deposits sampled in southeastern New York (table 3). The peat samples were oven dried and screened, and the fiber content was calculated by the following formula:

$$\frac{\text{weight of fibers } (>0.15)}{\text{total dry weight}} \times 100 = \text{percentage of content more than 0.15 mm in length.}$$

The deposits were grouped by fiber content as follows:

Type I, more than 66⅔-percent fiber content greater than 0.15 mm in length.

Type II, 33⅓–66⅔ percent fiber content greater than 0.15 mm in length.

Type III, less than 33⅓ percent fiber content greater than 0.15 mm in length.

In general, sphagnum moss peat appears to be characterized by long fibers of type I. Most reed-sedge peat falls in type II, and much humus in type III. The peat deposits in southeastern New York are predominantly reed-sedge of type II fiber content.

MOISTURE CONTENT

The water content of peat in the deposit cannot be measured accurately but is very important in the mining and processing of peat. Moisture content in samples from 66 deposits in southeastern New York ranged from 74.6 to 95.0 percent. Samples from 47 of the deposits contained 90.0–95.0 percent water, and with one exception the remainder contained more than 80 percent. The water that constitutes a large part of the undisturbed peat moves through the deposit very slowly. Both drainage of deposits by ditching to permit excavation and the drying of the peat before stockpiling for sale are slow.

ACIDITY

Natural peat ranges in pH from 3.2 to 7.5. Very acid peats have a pH of 3.2–4.2, acid peats have pH 4.2–5.0, and peats with pH between 5.0 and 7.0 are regarded as low in acidity. Those with pH above 7.0 are alkaline. Peat having a pH of less than 5.0 is classed as calcium deficient, and that having a pH above 5.0 is classed as calcium sufficient.

Most of the New York deposits tested have pH values of 5–6 and are calcium sufficient.

COMMERCIAL CLASSIFICATIONS OF PEAT

Because peat is formed from many kinds of plant material under a wide range of conditions, different varieties are suitable for various uses. Many different modes of classification have, therefore, been proposed. The chief classifications are based on the following factors: (1) physical or chemical characteristics such as texture, organic and mineral composition, water content, and fuel value, (2) the soillike nature of peat and the vegetation that grows upon it, (3) origin, mainly by the type of vegetation represented, (4) the environment of formation, and (5) uses such as for fuel, as a source of chemical and other manufactured products, and as a soil conditioner. Use as a soil conditioner and horticultural material prompted the U.S. Bureau of Mines to devise specifications governing the purchase of peat by the Federal Government. The need for a more specific classification has been recognized by the peat industry, and the ASTM Committee on Peat consequently has proposed a classification.

For statistical purposes, the U.S. Bureau of Mines classifies peat into three general types: moss peat, reed-sedge peat, and peat humus. That classification is used in this report. Most peat produced in the United States and most of the unexploited deposits in southeastern New York are either reed-sedge or humus type. Peat of any type may contain a considerable amount of woody material.

Moss peat is formed principally from sphagnum, hypnum, and other mosses. Sphagnum moss peat is light tan to brown, light in weight, porous, high in water-holding capacity, of high acidity, and low in nitrogen content. "Top moss" is the living part of sphagnum and should not be confused with moss peat which has aged and partially decomposed. Hypnum moss peat is darker brown, of low acidity, and physically similar to reed-sedge peat.

Reed-sedge peat is formed principally from reeds, sedges, marsh grasses, cattails, and associated plants. Fibrous, partially decomposed peat is brown to reddish brown but more decomposed peats are darker. The water-holding capacity and the nitrogen content are of medium range.

Peat humus is peat mostly derived from reed-sedge or hypnum moss peat so decomposed that the original plant remains are not identifiable. It is dark brown to black, has low moisture-retention capacity, and a medium to high nitrogen content.

In addition to these three major types of peat, other materials high in organic matter should be mentioned. Sedimentary peat is derived from algae, plankton, pond weeds, and similar plant species. It occurs in the bottom of lakes and ponds and in the lower levels of most peat deposits. Such peat usually contains considerable mineral impurities and in this report is referred to as peaty clay or clayey peat, depending upon the organic content. It is too finely divided for most soil improvement purposes, shrinks and swells greatly with varying moisture content, and some has a sheetlike structure and hardens upon drying. Muck is highly weathered peat that has been modified greatly by soil micro-organisms and is usually granular in structure. It has low moisture-retention capacity and is poorly suited for soil-improvement purposes.

Purchase of peat by the Federal Government is subject to specifications developed by the Federal Supply Service of the General Services Administration. Federal Specification Q–P–166e, dated May 10, 1961, which covers four general types of peat for agricultural use, includes the following specifications:

	Sphagnum moss peat	Other moss peat	Humus peat	Reed-sedge peat
Moisture content as normally marketed, percentage by weight	35–45	[1] 55	[1] 55	[1] 50
Ash content, percentage by weight, maximum	10	20	20	15
Acidity [2]	3.2–4.5	3.2–7.0	4.0–7.5	4.0–7.5
Water-holding capacity at 1 gravity on oven-dry basis, percentage by weight, minimum	800	400	200	400

[1] Maximum.
[2] The approximate pH shall be specified by the purchaser.

The ASTM Committee D–29 has defined and classified peat and peat moss (R. S. Farnham, written commun., 1968). The term "peat" may be used only with respect to organic matter of geological origin, except lignite or other coal. Peat arises mainly from dead plant remains through the agency of water in the absence of air; occurs in a bog, swampland, or marsh; and has an ash content not exceeding 25 percent on a dry-weight basis. The classification, given below, is based on five major types according to kind of plant material and fiber content.

Fiber is defined as plant material retained on a No. 100 (ASTM) sieve, that is, 0.15 mm or larger, and consisting of stems, leaves, or fragments of bog plants but no wood particles larger than 0.5 inch (12.7 mm) in the greatest dimensions and excluding inorganic fragments such as shells, stones, sand, and gravel. Percentages of fiber are based on oven-dry weight, at 105°C and not on volume.

Sphagnum moss peat (peat moss).—The oven-dried peat shall contain a minimum of 66⅔ percent sphagnum moss fiber of the total content by weight. These fibers shall be stems and leaves of sphagnum in which the fibrous and cellular structure is recognizable.

Hypnum moss peat.—The oven-dried peat shall contain a minimum of 33⅓-percent fiber content by weight of which hypnum moss fibers shall compose more than 50 percent. These fibers shall be stems and leaves of various hypnum mosses in which the fibrous and cellular structure is recognizable.

Reed-sedge peat.—The oven-dried peat shall contain a minimum of 33⅓-percent fiber by weight of which reed-sedge and other nonmoss fibers shall compose more than 50 percent.

Peat humus.—The oven-dried peat shall contain less than 33⅓-percent fiber by weight.

Other peat.—All forms of peat not herein classified.

In terms of the ASTM Committee classification the selected peat deposits in southeastern New York are classed as follows:

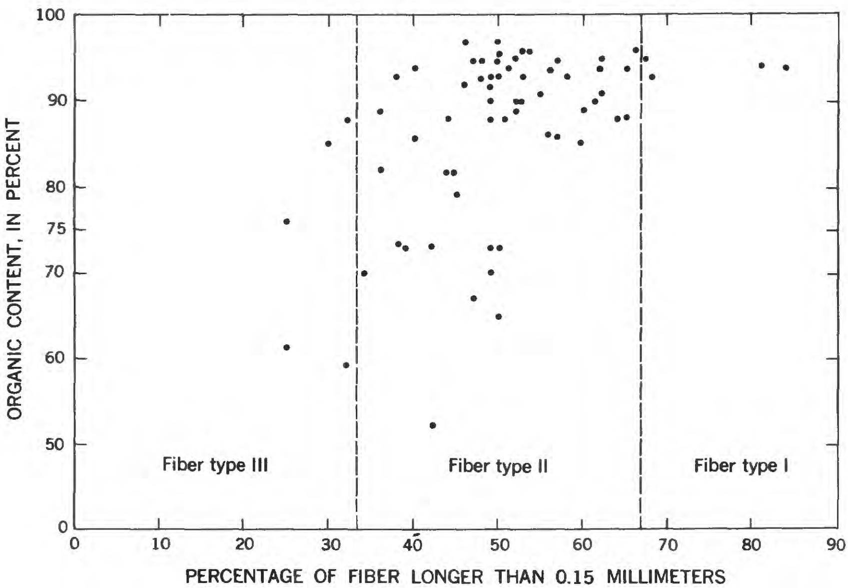


FIGURE 3.—Chart showing relation of fiber size to organic content in samples from 66 deposits in southeastern New York.

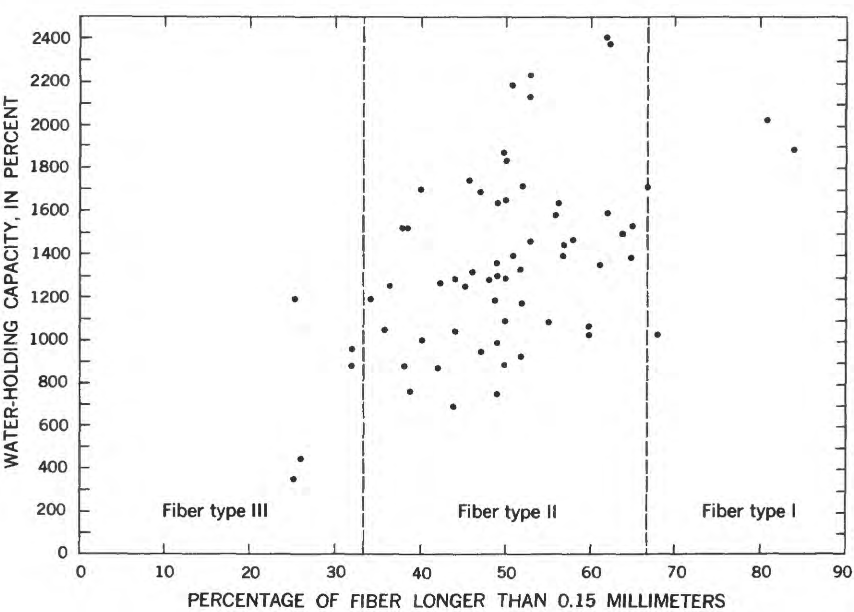


FIGURE 4.—Chart showing relation of fiber size to water-holding capacity in samples from 66 deposits in southeastern New York.

52 deposits are reed-sedge peat; two deposits are peat humus; one is sphagnum moss peat; 10 deposits are other peat; and one deposit is not classified as peat. Relation of fiber content to quality factors is shown in figures 3 and 4. Most of the deposits with organic content greater than 75 percent have 33⅓–66⅔ percent of fiber greater than 0.15 mm. As the percentage of fiber greater than 0.15 mm increases, water-holding capacity increases.

FORMATION AND ACCUMULATION OF PEAT DEPOSITS

CONDITIONS REQUIRED FOR THE ACCUMULATION OF PEAT

Peat formation requires the coincidence of several physical and biological factors: a climate and soil that favor growth of plants; a physical setting that favors accumulation of plant debris; and a geologic setting in which peat, once formed, may be preserved.

CLIMATIC ENVIRONMENT

Peat forms in many climates. Temperature is not a limiting factor; just as plants grow from the Arctics to the Tropics, peat deposits also form. The peat bogs of northern latitudes have long been studied and exploited, but the great peat deposits of Florida (Davis, 1946) are not as well known. High temperature is important in stimulating plant growth, but it also increases the rate of decay. Moisture is the most critical climatic factor in promoting plant growth and inhibiting decay, and thus largely controls the formation of peat. The anaerobic conditions in the lower parts of nearly stagnant ponds, swamps, and marshes provide maximum opportunity for preservation (Waksman, 1942, and Waksman and Stevens, 1929, 1932). In cool areas of high rainfall and humidity and consequent low evaporation, deposits of sphagnum moss may accumulate and form peat on flat or sloping land as along the coast of Maine; under these conditions some peat deposits have been built up more than 20 feet above the surrounding area.

The climate of southeastern New York is humid continental and characterized by long cold winters and short warm summers. Average summer temperatures of 70°–80°F. and precipitation totaling about 60 inches and rather evenly distributed throughout the year permit peat to form today in some places chiefly in the highlands. Most of the peat in the area of study was formed during the cooler and more favorable climatic conditions following the melting of the last glacial ice.

TOPOGRAPHIC ENVIRONMENT AND VEGETATION COVER

Three general types of peat deposits can be recognized: (1) the filled basin, (2) built-up or so-called climbing deposits on flat or gentle slopes, and (3) a composite type consisting of built-up deposits underlain by peat of the filled-basin type. The first and third types are represented in the area of study. Here the deposits are in closed depressions on the surface of bedrock or on glacial drift, at elevations ranging from near sea level in the Hudson River gorge to more than 1,000 feet above sea level on the adjacent uplands. Most deposits of peat formed in water-filled depressions left after glacial retreat. The numerous depressions at various elevations were filled and became marshes, and some changed into swamps; some again became ponds; others were drained completely.

Peat deposits in southeastern New York are chiefly in swamps and are covered dominantly by maple-ash forest type; elm, black and white birch, black gum, and white pine are other common trees. Shrubs and low trees include willow, alder, poison sumac, and high-bush blueberry. Rhododendron is common only in the Shawangunk Mountains; skunk cabbage and cinnamon, royal, and oak leaf ferns are abundant on hummocks that characterize the swamp floor. Swamps with an oak forest in general have little if any peat, apparently because of unfavorable soil and drainage conditions.

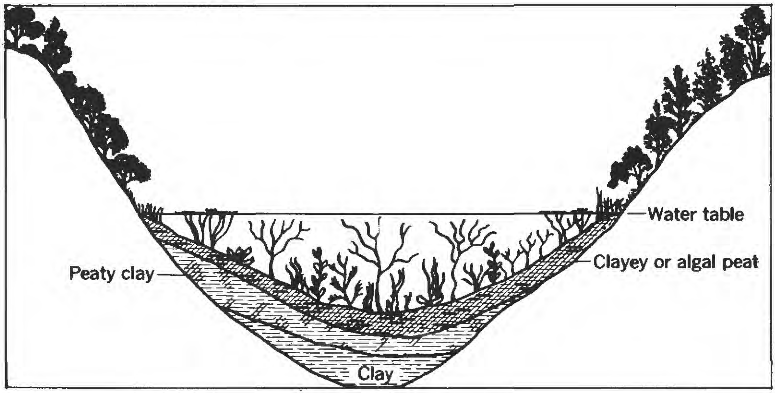
A few marshes with tall grasses contain peat chiefly in the Hudson River gorge and in uplands where forest has been cleared or killed by flooding.

The largest deposit, No. 26 in the Pine Island quadrangle in Orange County (fig. 2), is mostly planted to truck gardens.

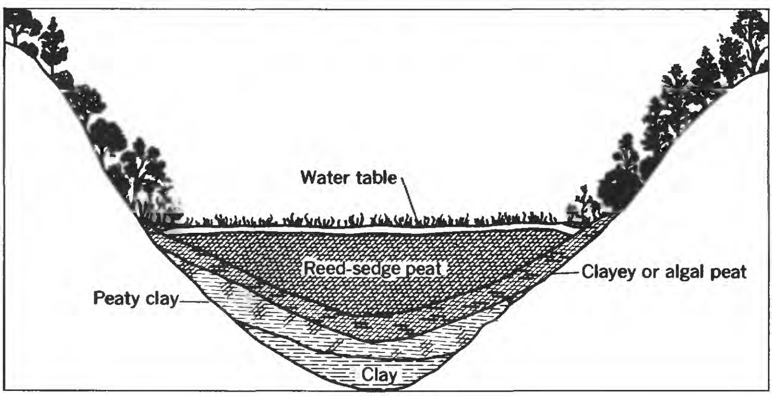
HISTORY AND STRATIGRAPHY OF PEAT DEPOSITS

Most of the marshes and swamps that contain peat consist, from bottom upward, of glacial drift or bedrock overlain by gray clay, thin layers or streaks of organic clay, peaty clay, clayey peat, and reed-sedge peat that may contain logs and stumps or sphagnum moss in its upper part. An uppermost layer of decomposed peat or muck may cover all or part of the surface of the deposit.

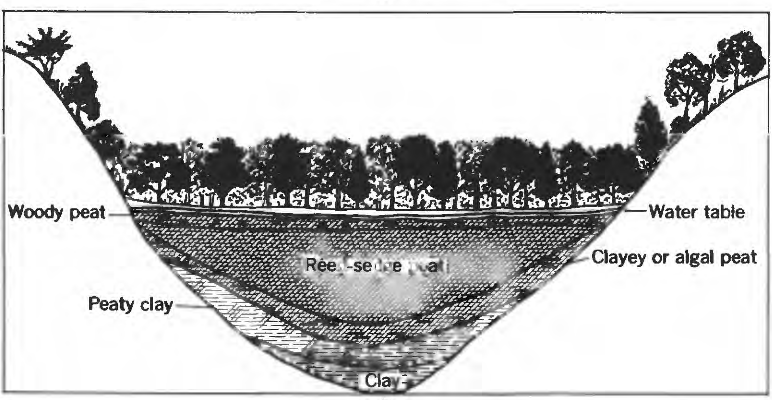
The sequence of peat formation begins when clay is washed in from the sides of a water-filled depression and accumulates on the bottom (fig. 5*A*). When floating simple organisms such as diatoms and algae die, they mix with clay particles to form the organic clay that appears in thin layers or as streaks within the basal part of the peaty clay layer. As plants increase in abundance and variety in the pond, peaty clay gives way to clayey or algal peat in the bottom, and reed-sedge peat begins to accumu-


Water table
Clayey or algal peat
Peaty clay
Clay

A


Water table
Reed-sedge peat
Clayey or algal peat
Peaty clay
Clay

B


Woody peat
Water table
Clayey or algal peat
Peaty clay
Clay

C

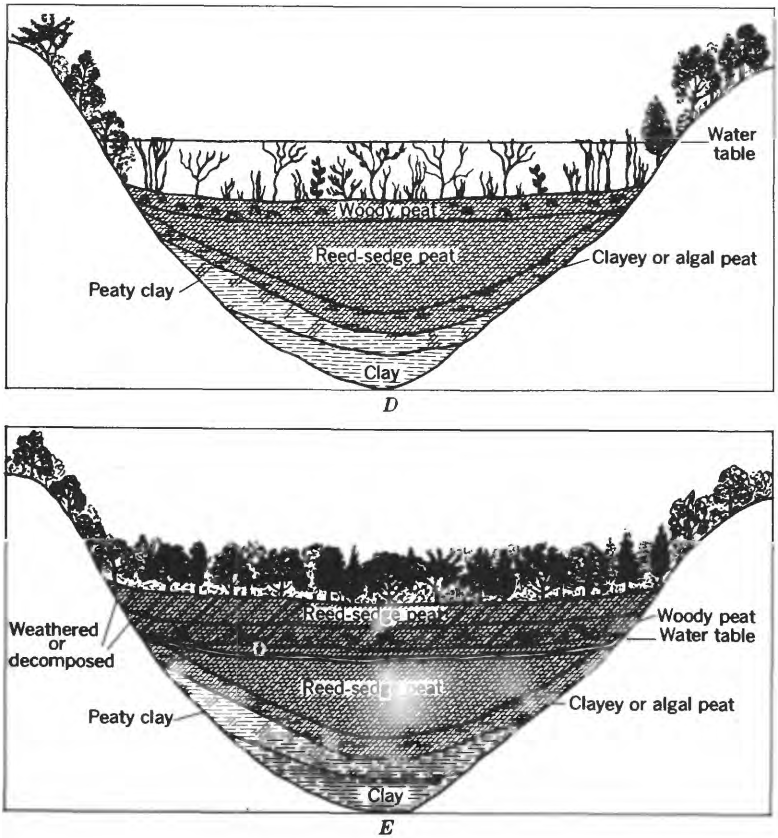


FIGURE 5.—Diagrammatic sketches showing stages in the development of peat (not drawn to scale). *A*, Pond stage. *B*, marsh stage. *C*, forest stage. *D*, return to pond stage. *E*, stage of lowered water table.

late at the shallow margins where reeds and other grasses, sedges, water lilies, and other semiaquatic plants are able to take root.

Waksman (1942) describes the peaty material deposited below the surface of the pond as the remains of a variety of plants such as pond weed, water plantain, and water lily mixed with sediment brought in by streams. It varies from coarsely macerated to finely divided material. This gray, green, brown, and black material may be intermingled with the roots of sedges and reeds. Deep-water peaty material may be mixed with or underlain by white or gray marl, a form of calcium carbonate deposited in large part by a few species of algae. The plants absorb calcium from the water and deposit it in the form of an encompassing scale. When the plants die, this calcium carbonate scale accumulates as marl. Sedges and sphagnum moss may grow out from the rim of the pond as a mat on the surface of the water. As this mat builds up, pieces break off and sink to the floor of the pond. This process eventually converts the pond into a marsh (fig. 5*B*). The water table rises toward the center of the marsh where the accumulation of peat is greater than near the edges.

Formation of soil above the water table at the marsh edge permits the advance of the forest and the development of a swamp (fig. 5*C*). A layer of peat with logs and stumps accumulates over the layer of reed-sedge peat formed during the marsh stage. As the forest floor rises above the water table and changes in soil character occur, a predominantly needle-leaf forest is replaced by one that is mostly broad leaved.

A new cycle of peat deposition may be started at either the marsh or forest stage by flooding which kills the surface vegetation (fig. 5*D*). Flooding is caused by such phenomena as construction of a dam by beaver, man, or landslide, as well as natural or artificial drainage change. Lowering of the water table by drainage initiates destruction of the peat by causing an inflow of oxygen which permits aerobic micro-organisms to flourish (fig. 5*E*). These biologic agents promote rapid decomposition of peat, but are unable to grow or are limited in growth in the zone of ground-water saturation. Drying and rewetting peat greatly accelerates decomposition.

RATE OF DEPOSITION

The rate at which peat accumulates probably varies greatly from bog to bog. Davis (1946) computed the rate of deposition of sawgrass peat in the Everglades of Florida at 1 foot per 225 years, based on the work of Miller (1918) on plant growth and inorganic composition. This rate was almost equaled in a bog in

Quebec, Canada, as shown by the radiocarbon studies of Potzger and Courtemanche (1954). Mitchell (1965), however, calculated the rate of accumulation at Littleton Bog in Ireland at 1 foot per 480 years, by using radiocarbon dates. An average but not constant rate of 1 foot per 1,400 or 1,500 years according to radiocarbon dates was computed for peat accumulation in Bear Meadows Bog in central Pennsylvania by Westerfeld (1961). No radiocarbon dates are available in the area of this report, but average accumulation in nearby Sussex County, N.J., was probably 1 foot per 500–1,200 years (Minard, 1959).

GEOLOGY OF SOUTHEASTERN NEW YORK DEPOSITS

REGIONAL GEOLOGY AND PHYSIOGRAPHY

The Hudson highlands, dominating the area of study, rise abruptly from lowlands on the north and south (fig. 1). They are a northeast-trending upland chiefly of granite, gneiss, and schist of Precambrian age. The highlands extend from New Jersey into the complex New England Upland which includes the Taconic Mountains and the Manhattan prong (New York State Museum and Science Service, Geological Survey, 1962). Most elevations in the Hudson highlands range from 500 to 1,300 feet above sea level. This conspicuous topographic feature is marked by ridges and valleys trending northeast parallel to the bedrock structure and is cut by the Hudson River.

The lowlands comprising the southern extension of the Hudson-Champlain trench have been developed by erosion of soft Ordovician shales between the folded harder rocks that form the ridges of the Shawangunks, the Hudson highlands, and the Taconic Mountains. The Triassic trough south of the Hudson highlands is developed in sandstone and shale and is bordered on the north by the Triassic border fault and the Palisades.

The Taconic Mountains trend north; schists form the hills, and limestone strata underlie the valleys. The topographic grain is much less prominent on the granite and metamorphic rocks in the Manhattan prong.

Glacial drift covers most of the area. At least six moraines, each caused by a temporary ice stand during the retreat of the glacier on the lowlands, caused ponds and lakes to form between the bedrock highlands and moraine features or between the moraines. Swamps and marshes, many containing peat deposits, mark sites of former lakes and ponds that formed during deglaciation.

CLASSIFICATION OF PEAT DEPOSITS

A fivefold classification of basins of peat accumulation, developed during the study of deposits in the highlands of northeastern Pennsylvania (Cameron, 1970), was found to apply to both the uplands and the lowlands of southeastern New York. The kinds of basins are as follows:

A1. Bedrock trough closed at both ends by unconsolidated material.
  2. Bedrock trough with unconsolidated material closing both ends and partly mantling the trough.
  3. Depression in bedrock closed by unconsolidated material.

B1. Depression in unconsolidated material closed by bedrock.
  2. Depression completely within unconsolidated material.

The peat deposits (fig. 2) fall into the following groups:

Lowland:
- A1. Deposits 16–20.
- 2. Deposits 6, 7, 10, 23, 24, 58.
- 3. Deposits 4, 5, 13.
- B1. Deposit 71.
- 2. Deposits 2, 3, 14, 15, 26–28, 69, 70.

Upland:
- A1. Deposits 22, 25, 29, 33, 40, 51, 52, 54, 55, 64–66, 68.
- 2. Deposits 8, 12, 21, 32, 43, 45, 60, 62, 67.
- 3. Deposits 9, 11, 30, 31, 34–39, 42, 46–50, 57, 59, 74.
- B1. Deposits 1, 38, 41, 44, 53, 56, 61, 63, 72, 73.

The 50 deposits in the upland group are in the Shawangunk Mountains, Hudson highlands, Manhattan prong, and Taconic Mountains. The topographic grain of these areas roughly parallels the direction of glacial movement from the north and northeast. The 24 deposits in the lowland group are in plains areas within the lower extension of the Hudson-Champlain trench, the Triassic trough, and a broad valley within the Taconic Mountains which contain deposits 10, 23, 24, and 58 in Dover Plains, Pawling, and Brewster quadrangles.

Figure 6 shows the proportion of deposits of commercial quality. Peat deposits of types of A1 and A3 are more apt to have higher organic content, higher water-holding capacity, and a higher proportion of long fibers than the others. Deposits of type A2 are higher in organic content than those of type B1.

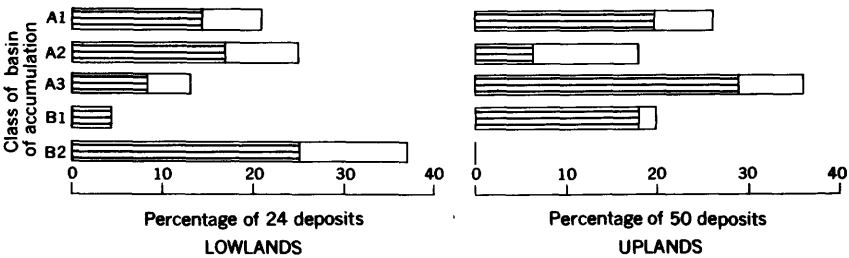


FIGURE 6.—Percentage of peat deposits according to class of basin of accumulation. Percentage of deposits in each class is shown by length of bar; hatched part indicates percentage of deposits of commercial quality.

RESOURCES

The resources of peat in deposits that were sampled in southeastern New York are estimated at about 11,500,000 short tons. This estimate is for air-dried peat on a basis of 200 tons of peat per acre-foot. Deposits that were not sampled probably contain about 1,500,000 tons (table 1).

TABLE 1.—*Estimated resources of peat in southeastern New York summarized by county*

[Estimates given in short tons on an air-dried basis]

County	Sampled deposits	Nonsampled deposits
Dutchess	550,000	200,000
Orange	5,700,000	650,000
Putnam	4,000,000	150,000
Rockland	300,000	100,000
Ulster	230,000	160,000
Westchester	720,000	240,000
Total	11,500,000	1,500,000

Size of the peat deposits range from 1 to 1,245 acres, with most exceeding more than 2 acres. Thickness of peat in the deposits ranges from 1 to 25 feet (fig. 7). A description of the peat in sampled deposits is shown in table 2, and size, thickness, and quality of the peat is given in table 3. The samples were chosen to represent the quality of most of the peat in the deposit. Quality of peat is summarized by county in table 4.

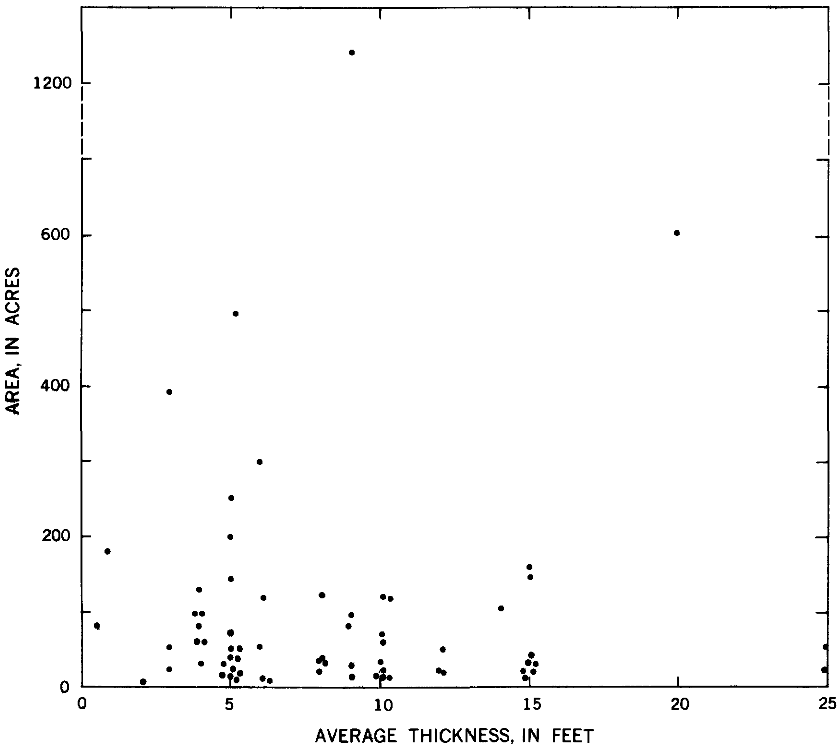


FIGURE 7.—Chart showing relation between area of deposit and average thickness in 66 deposits in southeastern New York.

TABLE 2.—*Test-hole locations, geologic sections, and depths of sampled intervals*

[Analytical data for samples are given in table 3]

Locality (in fig. 2)	Test hole data: Hole location	Geologic section: Thickness (in feet)	Geologic section: Description	Depth of sample (feet)
1	Center of southern half of swamp.	0–1	Peaty muck.	7–9
		1–12	Reed-sedge peat, wood.	
		12–16	Peaty clay.	
		16+	Blue-gray clay.	
2	Center of swamp	0–0.5	Muck over gray sandy silt.	....
3	400 ft east of center of west margin of swamp.			.33
		0–0.33	Moss peat.	
		0.33–1.5	Black soil.	
		1.5–2	Tan clay over gray clay.	
		2+	Sand and gravel.	
4	400 ft west of powerline and Swarte Kill intersection.			....
			Water over sandy silt.	5–6

TABLE 2.—*Test hole locations, geologic sections, and depths of sampled intervals*—Continued

Locality (in fig. 2)	Test hole data: Hole location	Geologic section: Thickness (in feet)	Geologic section: Description	Depth of sample (feet)
5	300 ft east of west edge of swamp and 500 ft south of outlet stream.	0–1	Water.	5–6
		1–9	Reed-sedge peat, wood.	
		9–13	Clayey peat.	
		13–17	Peaty clay.	
		17–18.5	Light-blue-gray clay.	
6	Center of swamp, 1,500 ft northeast of outlet.	0–1	Muck.	9
		1–9	Reed-sedge peat.	
		9–13	Clayey peat.	
		13–14	Peaty clay.	
		14+	light-blue-gray clay.	
7	Center of swamp	0–1	Muck.	
		1–2	Disintegrated peat.	....
		2+	Silt.	
8	1,100 ft northeast of outlet and 200 ft west of east edge.	0–1	Muck.	5
		1–7	Reed-sedge peat.	
		7–8	Peaty clay.	
		8–10	Light-blue-gray clay, sandy.	
		10+	Silt.	
9	600 ft west of center of east edge.	0–12	Reed-sedge peat.	7–9
		12–15	Clayey peat.	
		15–16	Peaty clay.	
		16–17.5+	Soft light-blue-gray clay.	
10	900 ft west of point on west bank of river 0.55 of a mile northwest of highway bridge in Wingdale.	0–0.17	Muck.	
		0.17–0.33	Light-gray soapy clay.	....
		0.33+	Light-gray sandy silt.	
11	1,300 ft northeast of outlet and 300 ft west of east edge.	0–1	Muck.	5–9
		1–2	Peaty muck.	
		2–5	Reed-sedge peat, wood.	
		5–15	Reed-sedge peat.	
		15–18	Light-blue-gray clay.	
		18+	Gravel.	
12	Center of swamp	0–2	Muck.	....
		2+	Sandy silt.	
13	200 ft north of center of south edge.	0–1	Muck.	4–6
		1–13	Reed-sedge peat.	
		13–15	Clayey peat.	
		15+	Light-blue-gray clay.	
14	Center of swamp west of point on east edge 1 mi northwest of Leptondale.	0–3	Muck.	4–5
		3–5	Peat, slightly clayey.	
		5–7	Peaty clay.	
		7+	Light-blue-gray clay.	
15	400 ft west of a point on edge of swamp 0.77 mile south of Leptondale.	0–3	Muck and peaty muck.	5–6
		3–7	Reed-sedge peat.	
		7–9	Clayey peat.	
		9–13	Clay and silt.	
		13+	Light-blue-gray clay.	
16	Center of swamp	0–1	Muck.	5
		1–8	Reed-sedge peat.	
		8–12	Clayey peat.	
		12+	Light-blue-gray clay.	
17	do	0–1	Muck.	5
		1–9	Reed-sedge peat.	
		9–18	Peaty clay.	
		18+	Gray silty clay.	

TABLE 2.—*Test hole locations, geologic sections, and depths of sampled intervals*—Continued

Locality (in fig. 2)	Test hole data: Hole location	Geologic section: Thickness (in feet)	Geologic section: Description	Depth of sample (feet)
18	200 ft west of east edge of swamp at point 1,500 ft northwest of interchange.	0–0.5	Water	5
		0.5–1.5	Muck.	
		1.5–3	Slightly disintegrated peat.	
		3–8	Reed-sedge peat.	
		8–12	Peaty clay.	
		12+	Very sandy silty clay.	
19	200 ft northwest of southeast edge of swamp at point 2,600 ft east of Taconic State Parkway.	0–0.5	Water.	5
		0.5–2.5	Muck.	
		2.5–6	Reed-sedge peat.	
		6–7	Peaty clay.	
		7+	Dark-gray sand and gravel.	
20	Center of swamp 1,500 ft south of Highway 52 at swamp outlet stream crossing.	0–2	Muck.	5
		2–4	Slightly disintegrated peat.	
		4–6	Reed-sedge peat, twigs.	
		6–9.5	Clayey peat.	
		9.5+	Gray silt.	
21	Center of swamp 300 ft south of Highway 55.	0–2	Muck.	..
		2+	Silt.	
22	200 ft southwest of northeast end within the 810-ft contour line.	0–15	Reed-sedge peat.	6
		15–16	Light-gray clay.	
		16+	Sand and gravel.	
23	1,800 ft west of point on west side of State Highway 22, 800 ft north of culvert.	0–0.5	Water.	4
		0.5–2.5	Muck.	
		2.5–6.5	Humus, some wood.	
		6.5–7.58	Peaty clay.	
		7.58–8	Light-blue-gray clay.	
		8+	Sand and gravel.	
24	Along Cotton River, 1,000 ft north of Pine Island.	0–1	Water.	8–9.5
		1–3	Silt.	
		3–20	Reed-sedge peat, wood.	
		20+	Silty peaty muck.	
25	Center of swamp, 1,800 ft northeast of outlet.	0–18.5	Moss peat.	11–13
		18.5–19.5	Peaty clay.	
		19.5–21	Light-blue-gray clay.	
		21+	Silty sandy clay.	
26	1.8 mile southwest of Durlandville and 0.85 mile southeast of Wallkill River.	0–10.5	Reed-sedge peat.	5–6
		10.5–12	Peaty clay.	
		12+	Blue-gray clay, silty.	
27	0.65 mile southwest of Buchanan Hill and 500 ft. west of east edge of swamp.	0–1	Peaty muck.	7–9
		1–13	Reed-sedge peat, wood.	
		13–13.75	Peaty clay.	
		13.75+	Light-blue-gray clay.	
28	200 ft. west of east edge of swamp at a point 0.45 of a mile south-southwest of Vails Gate.	0–0.33	Water.	6–7
		0.33–13	Reed-sedge peat.	
		13–16.5	Clayey peat.	
		16.5+	Peaty clay.	

TABLE 2.—*Test hole locations, geologic sections, and depths of sampled intervals*—Continued

Locality (in fig. 2)	Test hole data: Hole location	Geologic section: Thickness (in feet)	Geologic section: Description	Depth of sample (feet)
29	Center of marsh	0–0.25	Water	2–3
		0.25–1	Muck and disintegrated peat.	
		1–3	Reed-sedge peat.	
		3–6.75	Clayey peat.	
		6.75–7.33	Peaty clay.	
		7.33+	Blue-gray clay, black streaks.	
30	do	0–11	Reed-sedge peat, wood.	5–6
		11–12	Clayey peat.	
		12–15	Peaty clay.	
		15–21.5	Blue-gray clay.	
		21.5+	Sand and gravel.	
31	do	0–5	Muck.	7–9
		5–6	Peaty muck.	
		6–13	Reed-sedge peat.	
		13–14	Peaty clay.	
		14–18	Blue-gray clay.	
		18+	Sandy silty clay.	
32	do	0–1	Gray silt.	....
		1+	Sandy silt, gravel.	
33	do	0–13	Reed-sedge peat.	
		13–17	Clayey peat.	
		17–45	Peaty clay, leaves of trees and shrubs.	3–6
		45–50	Black organic clay.	
		50–54.5	Gray clay, black streaks.	
		54.5+	Sand and gravel.	
34	do	0–0.5	Water.	6–7
		0.5–2	Peaty muck.	
		2–8.5	Reed-sedge peat.	
		8.5–12.5	Clayey peat.	
		12.5–16.66	Peaty clay.	
		16.66+	Gray clay.	
35	South center of swamp	0–2	Peaty muck.	4–5
		2–5	Moss peat, wood.	
		5–12	Reed-sedge and moss peat.	
		13–17	Clayey peat.	
		17–22	Peaty clay.	
		22+	Greenish gray clay.	
36	Center of marsh, 150 ft. south of road crossing.	0–5	Muck.	15.33–17.33
		5–9	Reed-sedge peat, clay.	
		9–24	Reed-sedge peat.	
		24–35	Clayey peat.	
		35–36	Clay and gravel.	
37	Center of swamp	0–0.33	Water.	1–1.5
		0.33–0.66	Muck.	
		0.66–2	Moss peat.	
		2+	Silty peaty clay.	
38	West edge of Cat Pond, 200 ft north of outlet.	0–15	Moss peat, wood.	7–9
		15–18	Clayey peat.	
		18–25	Peaty clay.	
		25+	Sand and gravel.	
39	South end of area shown as lake on topographic map.	0–1	Muck.	5
		1–7	Reed-sedge peat.	
		7–12	Peaty clay.	
		12+	Greenish-gray clay.	

TABLE 2.—*Test hole locations, geologic sections, and depths of sampled intervals*—Continued

Locality (in fig. 2)	Hole location	Thickness (in feet)	Description	Depth of sample (feet)
40	200 ft south east of parkway embankment and 3,500 ft northeast of ski slope.	0–3	Muck and peaty muck.	6
		3–11	Reed-sedge, wood.	
		11–13.5	Clayey peat.	
		13.5+	Sand, angular; rock fragments.	
41	720 ft east of point on west center edge.	0–5	Peaty muck.	6–7
		5–11	Reed-sedge peat.	
		11–13	Clayey peat.	
		13–21	Peaty clay.	
		21+	Blue-gray clay.	
42	Center of swamp	0–1	Muck.	5
		1–7	Reed-sedge peat.	
		7+	Sand over rock.	
43	1,400 ft west of Taconic State Parkway and 3,300 ft north of east end of Berger Pond.	0–5	Peaty muck.	9
		5–17	Woody peat.	
		17–27	Reed-sedge peat.	
		27–33	Clayey peat.	
		33–40.17	Peaty clay.	
		40.17+	Blue-gray clay.	
44	Along stream 600 ft north of mouth.	0–2	Water.	7–9
		2–5	Peaty muck.	
		5–15	Reed-sedge peat.	
		15–21	Peaty clay.	
		21–27	Gray organic clay.	
		27+	Sand and silt.	
45	200 ft from west edge 2,500 ft north of county line.	0–2	Peaty muck.	4–5
		2–11	Moss peat.	
		11–14	Blue-gray clay.	
		14+	Sand.	
46	West edge of pond	0–2	Water and muck.	6–7
		2–14.5	Reed-sedge peat.	
		14.5–17	Clayey peat.	
		17–23	Peaty clay.	
		23+	Clay, black and gray.	
47	Center of swamp	0–1	Muck.	4–5
		1–6	Reed-sedge peat.	
		6–7	Peaty clay.	
		7+	Rock.	
48	Center edge of pond	0–2	Water and muck.	5–5.5
		2–19	Reed sedge peat, wood.	
		19–21	Clayey peat.	
		21+	Blue-gray sand.	
49	Center of lake margin	0–2	Water.	9
		2–16	Reed sedge.	
		16–23	Clayey peat.	
		23–26.5	Light-blue-gray clay.	
		26.5	Sand and gravel.	
50	do	0–1	Water.	5–6.5
		2–19	Reed-sedge peat, wood.	
		19–23	Clayey peat.	
		23–28	Peaty clay.	
		28–37	Blue-gray clay.	
51	100 ft southwest of center of northeast edge.	0–2	Muck.	5–6
		2–3	Peaty muck.	
		3–7	Humus.	
		7–9	Clayey peat.	
		9–19	Clay and silt.	
		19+	Sand.	

TABLE 2.—*Test hole locations, geologic sections, and depths of sampled intervals*—Continued

Locality (in fig. 2)	Test hole data: Hole location	Geologic section: Thickness (in feet)	Geologic section: Description	Depth of sample (feet)
52	100 ft southeast of center of northwest edge.	0–1	Muck.	7–9
		1–15	Reed-sedge peat.	
		15–18	Dark organic clay.	
		18+	Sand.	
53	Near center of swamp	0–1	Muck.	7–9
		1–14.5	Reed-sedge peat.	
		14.5–21	Peaty clay.	
		21–24	Slightly organic gray clay.	
		24+	Gravel.	
54	Center of swamp	0–2	Muck.	5
		2–9	Sedge peat.	
		9–12	Clayey peat.	
		12–15	Peaty clay.	
		15+	Blue-gray clay.	
55	500 ft west of center of east edge.	0–1	Muck.	5
		1–12	Reed-sedge peat.	
		12–24	Clayey peat.	
		24–25	Blue-gray clay.	
		25+	Sand.	
56	Center of north edge of pond.	0–17	Reed-sedge peat.	3–6.5
		17+	Reed-sedge peat, slightly clayed.	
57	Center of marsh	0–6	Peaty muck.	12–13.5
		6–10	Muck and reed-sedge peat interlayered.	
		10–15.5	Reed-sedge peat slightly clayey.	
		15.5–18	Dark-greenish-brown peaty clay.	
		18–20	Blue-black organic clay.	
58	500 ft east of south tip of Pine Island.	0–1	Muck.	5
		1–6	Reed-sedge peat, wood.	
		6–9	Clayey peat.	
		9–21	Reed sedge peat.	
		21–25	Clayey peat.	
		25–31	Clayey silt.	
		31+	Sandy silt.	
58A	700 ft northwest of north end of ponded part of East Branch Coton River north of Route 22.	0–0.66	Water.	5.33–7
		0.66–1.5	Muck.	
		1.5–27	Slightly weathered reed-sedge peat, wood.	
		27–32	Reed-sedge peat.	
		32–45	Clayey peat, catfish fossil at 30 feet.	
		45–53.5	Peaty clay.	
59	Center of north margin	0–9	Moss peat.	0–7
		9–26.5	Peaty clay.	
60	200 ft northeast of point on river, 450 ft upstream from north end of ponded part.	0–1	Muck.	7–9
		1–9	Reed-sedge peat.	
		9–13	Reed-sedge peat, very slightly clayey.	
		13–17.5	Peaty clay.	
		17.5–	Gray sand.	
61	100 ft west of point on east margin.	0–0.5	Muck.	7–9
		0.5–15	Reed-sedge peat.	
		15+	Silty light-blue-gray clay.	

TABLE 2.—*Test hole locations, geologic sections, and depths of sampled intervals*—Continued

Locality (in fig. 2)	Hole location	Thickness (in feet)	Description	Depth of sample (feet)
62	400 ft east of a point on west margin 1,400 ft north of outlet.	0–1	Muck.	6–7
		1–16	Reed sedge peat.	
		16–22	Clayey peat.	
		22–26	Peaty clay.	
		26–30	Light-blue-gray clay.	
		30+	Gray sandy silt.	
63	200 ft northwest of point on east margin of south arm of swamp 500 ft northeast of road.	0–3	Muck.	6
		3–8	Moss peat.	
		8–10	Peaty clay.	
		10–12	Silty clay.	
		12+	Sandy silt.	
64	At edge of lake	0–5	Water.	6–7
		5–13	Reed-sedge peat.	
		13+	Reed-sedge peat slightly clayey.	
65	At edge of lake	0–4	Muck.	5–6
		4–19	Reed-sedge peat.	
		19–22	Peaty clay.	
		22+	Light-gray clay.	
66	0.85 of a mile southwest of crest of mountain at edge of stream.	0–3	Peaty muck.	6–7
		3–10	Reed-sedge peat, wood.	
		10+	Clayey peat.	
67	Center of marsh on northeast side of road.	0–3	Muck and peaty muck.	4–5
		3–7	Reed-sedge peat.	
		7–9	Clayey peat.	
		9+	Peaty clay.	
68	Center of swamp, 200 ft northeast of Route 210.	0–0.25	Moss.	4.5–5.5
		0.25–4.5	Red brown humus.	
		4.5–5.5	Red brown moss peat.	
		5.5+	Rock.	
69	Center of swamp, south of Route 202.	0–1.5	Muck.	....
		1.5+	Sand, gravel, boulders.	
70	Center of swamp, 500 ft west of Route 9W.	0–2	Muck.	4–5
		2–7	Reed-sedge peat, wood.	
		7–9	Peaty clay.	
		9+	Pink sandy clay, sand.	
71	East center	0–4.5	Silt and clay niterlayed with muck.	6–7
		4.5–9.5	Reed-sedge peat mixed with silt clay.	
		9.5–21	Peaty clay.	
		21–30+	Tan clay.	
72	Near outlet of Gilmore Pond; 200 ft downstream from artificial dam on south side of stream	0–1.5	Muck.	1.5–4.17
		1.5–4.83	Reed sedge peat, wood.	
		4.83–5.75	Peaty clay.	
		5.75+	Sand and gravel.	
73	100 ft south of north edge of swamp and north of main stream.	0–1.5	Muck.	3–4
		1.5–4	Reed-sedge peat.	
		4–4.5+	Gray silt.	
74	100 ft east of west edge of swamp at point 1,000 ft north of Banksville Road and Route 22.	0–1	Muck.	8.5–9.5
		1–3	Peaty muck.	
		3–14	Reed-sedge peat, wood.	
		14–17	Reed-sedge peat, slightly clayey.	
		17–25+	Peaty clay.	

TABLE 3.—*Extent, thickness, and quality of representative samples of peat deposits in southeastern New York*

[See table 2 for location of representative samples. Analyses by C. L. Burton, P. J. Aruscavage, and Leung Mei, U.S. Geol. Survey]

County	Deposit (fig. 2)	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Quality of representative sample: Organic content (percent)	pH	Water-holding capacity (percent)	Percentage of fiber longer than 0.15 mm
Dutchess	6	50	5	88	5.6	1,006	49
	7	185	1	----	----	----	----
	8	15	5	73	6.5	1,332	49
	9	35	8	96	6.0	1,470	53
	10	150	0	----	----	----	----
	11	15	10	86	5.8	1,024	40
	12	40	0	----	----	----	----
	16	90	4	92	5.8	1,211	49
	17	20	5	96	5.3	2,269	53
	18	40	5	88	6.0	1,412	51
	19	140	5	95	6.4	1,668	50
	20	90	4	52	5.8	866	42
	22	20	15	93	5.5	1,305	48
	23	60	4	88	5.8	902	32
Orange	13	80	9	93	5.5	1,306	50
	14	395	3	73	5.3	746	39
	15	500	5	90	6.0	1,360	49
	25	120	10	94	6.5	2,198	51
	26	1,245	9	90	6.3	1,368	52
	27	300	6	82	6.0	1,065	44
	28	60	10	94	5.6	2,063	81
	29	10	6	90	4.8	1,386	61
	30	15	9	93	5.7	913	38
	31	12	10	92	5.4	1,364	46
	32	40	0	----	----	----	----
	33	6	15	94	5.6	2,400	62
	34	5	6	91	5.3	1,100	55
	35	7	10	95	5.6	1,307	48
	66	45	5	73	6.0	1,286	42
	67	40	5	70	5.2	741	49
Putnam	24	60	4	85	3.9	1,077	60
	36	57	25	76	6.3	352	25
	37	1	2	67	5.3	967	47
	38	20	12	94	5.8	1,392	65
	39	15	5	79	5.6	1,251	45
	40	125	8	90	6.2	1,768	52
	41	35	4	97	4.9	1,778	46
	42	30	5	93	6.7	2,166	53
	43	160	15	93	5.9	1,489	58
	44	70	10	88	5.7	1,541	65
	45	150	15	86	5.5	1,417	57
	46	20	12	95	5.8	1,180	52
	47	20	8	88	5.9	1,517	64
	49	40	15	70	5.8	1,190	34
	50	30	15	95	5.2	1,714	67
	51	18	5	85	6.0	436	26
	52	35	10	86	5.8	1,676	56
	53	30	8	95	6.3	1,459	57
	54	130	4	65	5.7	1,123	50
	55	45	12	94	6.0	1,726	40
	56	20	25	61	5.8	1,212	25
	57	22	10	73	5.1	1,529	38
	58 } 58A }	610	20	{ 89	5.9	947	52
				{ 88	5.2	714	44
	59	18	5	96	4.5	2,488	66
	60	250	5	73	6.0	907	50

TABLE 3.—*Extent, thickness, and quality of representative samples of peat deposits in southeastern New York—Continued*

County	Deposit (fig. 2)	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Quality of representative sample: Organic content (percent)	pH	Water-holding capacity (percent)	Percentage of fiber longer than 0.15 mm
	61	120	10	91	6.1	2,417	62
Rockland	68	55	3	96	5.9	1,856	50
	69	150	0	----	----	----	----
	70	70	5	89	6.6	1,070	60
	71	200	5	89	5.5	1,078	36
Ulster	1	55	6	95	5.5	1,731	47
	2	85	0	----	----	----	----
	3	80	0.5	94	3.9	1,907	84
	4	330	0	----	----	----	----
	5	85	9	95	6.2	1,595	62
Westchester	62	105	14	97	6.3	1,877	50
	63	120	6	94	5.6	1,616	56
	64	30	9	59	5.6	994	32
	65	20	15	82	5.7	1,285	36
	72	80	4	93	3.0	1,040	68
	73	20	3	82	4.9	1,319	44
	74	30	15	93	6.1	1,670	49

The analyses indicate that of 11,500,000 short tons of air-dried peat, more than 10 million tons have an organic content exceeding 75 percent; most is fiber type II (fig. 3).

TABLE 4.—*Quality of peat in southeastern New York, summarized by county*

County	Organic content (percent)	pH	Water-holding capacity (percent)	Percentage of fiber longer than 0.15 mm
Dutchess	52–96	5.3–6.4	866–2,269	32–53
Orange	70–95	5.2–6.5	741–2,400	39–81
Putnam	61–96	3.9–6.3	352–2,488	30–67
Rockland	89–96	5.5–6.6	1,070–1,856	36–60
Ulster	94–95	3.9–6.2	1,595–1,907	62–84
Westchester	59–97	3.0–6.3	994–1,877	32–68

RELATION OF QUANTITY AND QUALITY OF PEAT TO GEOLOGIC SETTING

The deposits in southeastern New York are estimated to contain about 10,300,000 short tons of air-dried peat having more than 75 percent organic material. Of this amount, about 3,650,000 tons are in the upland group, and 6,650,000 tons are in the lowland group where deposits tend to be fewer as shown in table 2. The greatest tonnage in the upland group is in class A deposits (fig. 8). Class B1 contains only 750,000 tons, and class B2 contains none at all. This pattern is similar to that in northeastern Pennsylvania (Cameron, 1970).

The ash content in both upland and lowland deposits tends to be highest in classes A2 and B2 which are characterized by a dominance of unconsolidated material in both the A and B groups.

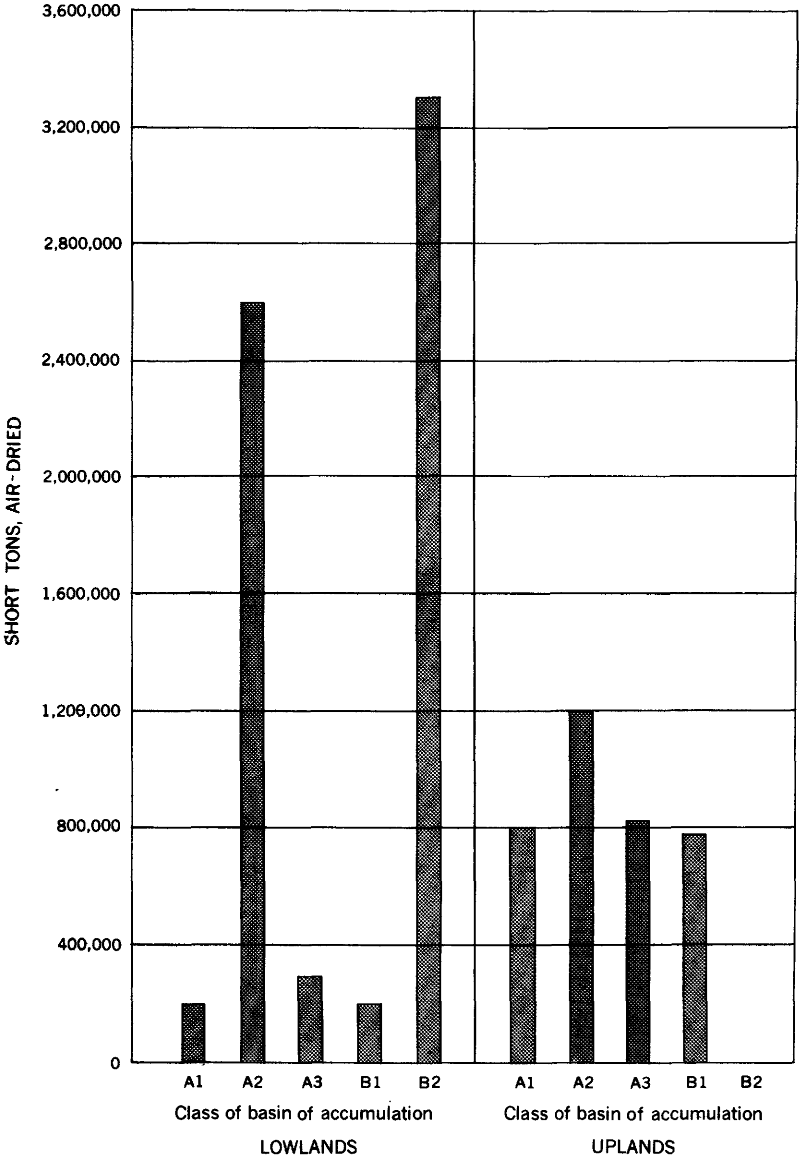


FIGURE 8.—Tonnage of commercial quality peat according to class of basin of accumulation.

PEAT MINING

The United States produced 611,085 short tons of air-dried peat in 1966 at 144 plants, and sold 605,858 tons at an average price of $10.73 per ton, for a total of $6,501,281. New York reported five operations with total reserves at active operations of 942,000 short tons of air-dried peat (U.S. Bureau of Mines, 1967). Three of these peat mines are in the area studied—two are in Orange County (fig. 2, mines B and C) and one is in Westchester County (mine D). Since 1966, a mine in Dutchess County (mine A) near Wingdale opened operations. All four mines handle reed-sedge peat and humus peat and sell in bulk; peat is also packaged at mine C in Orange County.

Compared with other mineral commodities, the investment cost for peat mining is low. A typical operation requires about $90,000 for excavating and hauling equipment and $20,000 for buildings.

Mining usually consists of (1) clearing the bog of timber and brush and removing tree roots and logs buried in the upper few feet, (2) draining the bog, usually by digging drainage ditches rather than by pumps, (3) loosening the surface of the peat with disk and harrows to aid in drying the peat, (4) hauling the dried peat to the nearby plant, and there (5) sieving the peat to remove wood, shredding it, and bagging it or storing it in bulk for sale.

Various mining methods may be adopted for deposits difficult to drain.

SUGGESTIONS FOR PEAT EXPLORATION

In exploring for peat having low ash content in southeastern New York, the search should be for deposits with a minimum of introduced silt and clay, for those that are not badly decomposed, and for those large enough to be minable.

Peat deposits having low ash content tend to be in a swamp or marsh (1) not crossed by silt-laden streams subject to overflow, (2) without indications of stream piracy showing that such a silt-laden stream had been present, and (3) in a drainage basin with effective drainage area not more than 10 times the size of the swamp or marsh.

Peat deposits with low ash content and low rate of decomposition also tend to be in swamps or marshes in which the water table has fluctuated little. Such swamps and marshes may be recognized by: (1) absence of outlet streams, (2) outlet streams flowing over bedrock that is not easily eroded, (3) outlet streams with very low gradients for a distance of several hundred feet after leaving the swamp or marsh, and (4) a pond that is within the swamp or marsh, is especially near the outlet, and cannot be easily drained.

Quality and quantity of the peat are affected by the size of the deposits. Deposits in swamps and marshes less than an acre or two in size normally have a high ash content. Such deposits also are too small to mine commercially.

Human activities may adversely affect peat deposits and decrease their value; for example, long delay in exploitation following draining of the deposits accelerates oxidation; creation of dams for industrial, agricultural, or recreational use may cause silting by backwater; and burning over a swamp to raise blueberries, or to drive out game animals during the season of lowest water table.

The most favorable localities for peat deposits in the lowlands are in basins classed as A2 and B2 (p. B18). In the uplands, basins classed under the A1 and A3 categories are more apt to provide favorable localities for peat deposits.

OUTLOOK FOR THE AREA

Southeastern New York is readily accessible to major metropolitan areas along the Atlantic seaboard, in which there is a good market for peat products. The deposits generally are in easily drained localities in contrast with deposits near or at sea level in coastal areas, where drainage is a severe problem. The relatively small size of the deposits in the uplands and the linear shape of those in the lowlands together with the fact that most of them are underlain by firm bedrock or glacial till facilitate mine excavation and hauling. These factors, plus the number of available peat deposits of which 66 are estimated to contain an aggregate of more than 10 million short tons of peat, mostly of a quality adequate to meet Federal trade regulations, give an optimistic outlook for increased peat production. On the other hand, relatively small peat producers in southeastern New York must sell their product in competition with larger out-of-State producers. All domestice producers must compete with imported peat, which in 1966 totaled 293,843 short tons valued at $11,615,000 (U.S. Bureau of Mines, 1967).

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