Peat Deposits of Northeastern Pennsylvania

GEOLOGICAL SURVEY BULLETIN 1317-A

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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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By CORNELIA C. CAMERON

ABSTRACT

Peat resources in a 900-square-mile area in northeastern Pennsylvania are estimated at more than 13 million short tons of air-dried peat, chiefly of good quality reed-sedge type. Most deposits are 10–100 acres in extent, average 5–16 feet in thickness, and contain from 10,000 to 100,000 tons of potential resources. Individual mining operations are relatively small but require minimum facility investment. Accessibility to operation sites and to markets is good.

Ninety-five peat deposits in the Appalachian Mountains of northeastern Pennsylvania were studied. These represent various geologic settings related to structural control of bedrock and to differential erosion. Physical and chemical analyses of samples show that specific characteristics of the peat can be related to distribution of bedrock and unconsolidated material surrounding each deposit and to the size and position of the drainage basin. Ash content, water-holding capacity, and fiber size reflect the form and the kinds of material of the depression walls and of the surrounding drainage basin.

Terrane factors provide a convenient means of classifying the different types of bogs and for estimating the quantity of peat in each. Such a descriptive classification also can be used to aid recognition of geologic environments during and after peat accumulation, and consequently aids in estimating the quality of peat resources. High ash content results from weathering during periods of lowered water table, which also is reflected in a decreased size of fibers. High ash content may also result when extraneous sediment is brought into the deposit by surface water. High water-holding capacity is directly related to the type of peat-forming vegetation, which in a given region is determined by moisture and soil conditions. These are governed by specific geologic processes such as weathering and ground- and surface-water regimen. The degree of acidity is related to predictable organic-inorganic relations.

Basically, the quality of peat depends upon the extent to which peat-forming vegetation flourishes and upon the accumulation and preservation of this vegetation under conditions free from weathering and contamination by sediment. Geologic settings of peat deposits depend upon size, shape, and material of the depression containing the deposit and upon the topographic position relative to past and present regional ground- and surface-water patterns.

The use of a nongenetic classification applicable to any type of terrane is recommended for peat exploration because it permits wide flexibility in matching quality characteristics of peat with their many geomorphic causes. The exploration tool is then a pattern of factors and conditions rather than an individual factor or condition. The glaciated swamps and marshes of northeastern Pennsylvania, which have vegetation, climate, and geology favoring formation of numerous peat deposits at elevations generally exceeding 1,000 feet above sea level and which are typical of folded and glaciated mountain areas, serve to illustrate this approach.

INTRODUCTION

Peat has been used as a low-rank fuel since the dawn of civilization but only recently has it become widely recognized as a soil conditioner and horticultural material. Its use for these latter purposes has increased significantly during recent years. Pennsylvania has been a notable producer during this recent period of increased peat-mining activity and in 1966 ranked second in the Nation, with an output of 49,912 short tons of air-dried peat (U.S. Bureau of Mines, 1967).

The growing demand for peat in major metropolitan areas along the Atlantic seaboard and the desire to stimulate mineral output from the economically depressed Appalachian region led to informal discussions between officials of the Pennsylvania Geological Survey and the U.S. Geological Survey, and subsequently to the preparation of this report. Because peat mining in Pennsylvania is centered in the northeastern part of the State, study was limited to deposits in an approximately 900-square-mile area, from lat 41° to 41°45′ N. and long 74°45′ to 76°30′ W. Included in the area are parts of Susquehanna, Wayne, Wyoming, Lackawanna, Pike, Columbia, Luzerne, Carbon, and Monroe Counties (fig. 1). Swamps and marshes, some recently flooded, are common throughout the area, and many contain deposits of peat. Small communities and farms predominate in the western part of the area, the Scranton and Wilkes-Barre coal district is in the central part, and resorts and game lands characterize the eastern part.

This report is intended to provide information for use in exploration for peat deposits in northeastern Pennsylvania and in other areas of similar geologic environment and terrane. The report is based on studies of the drainage-basin characteristics, geologic settings, and contents of 136 undeveloped but representative peat deposits as shown in figure 2. Data were obtained from traverses across swamps and marshes. Drill holes were put down by a Davis sampler at frequent intervals along the traverses

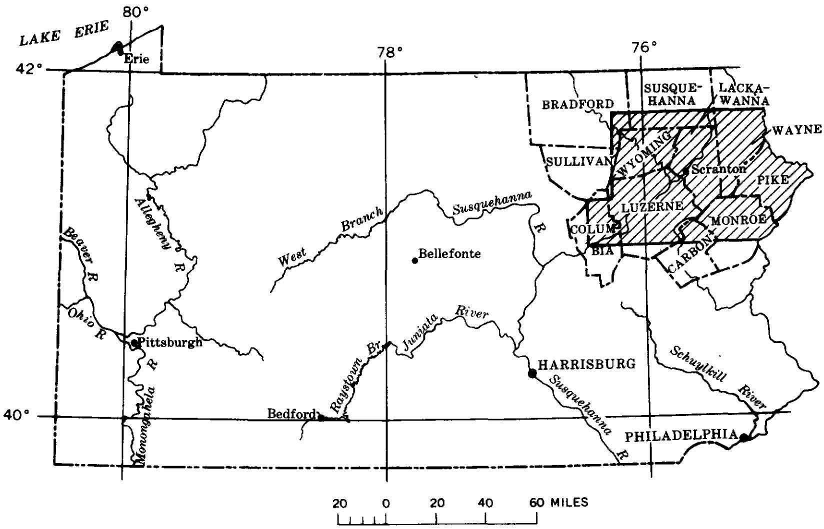
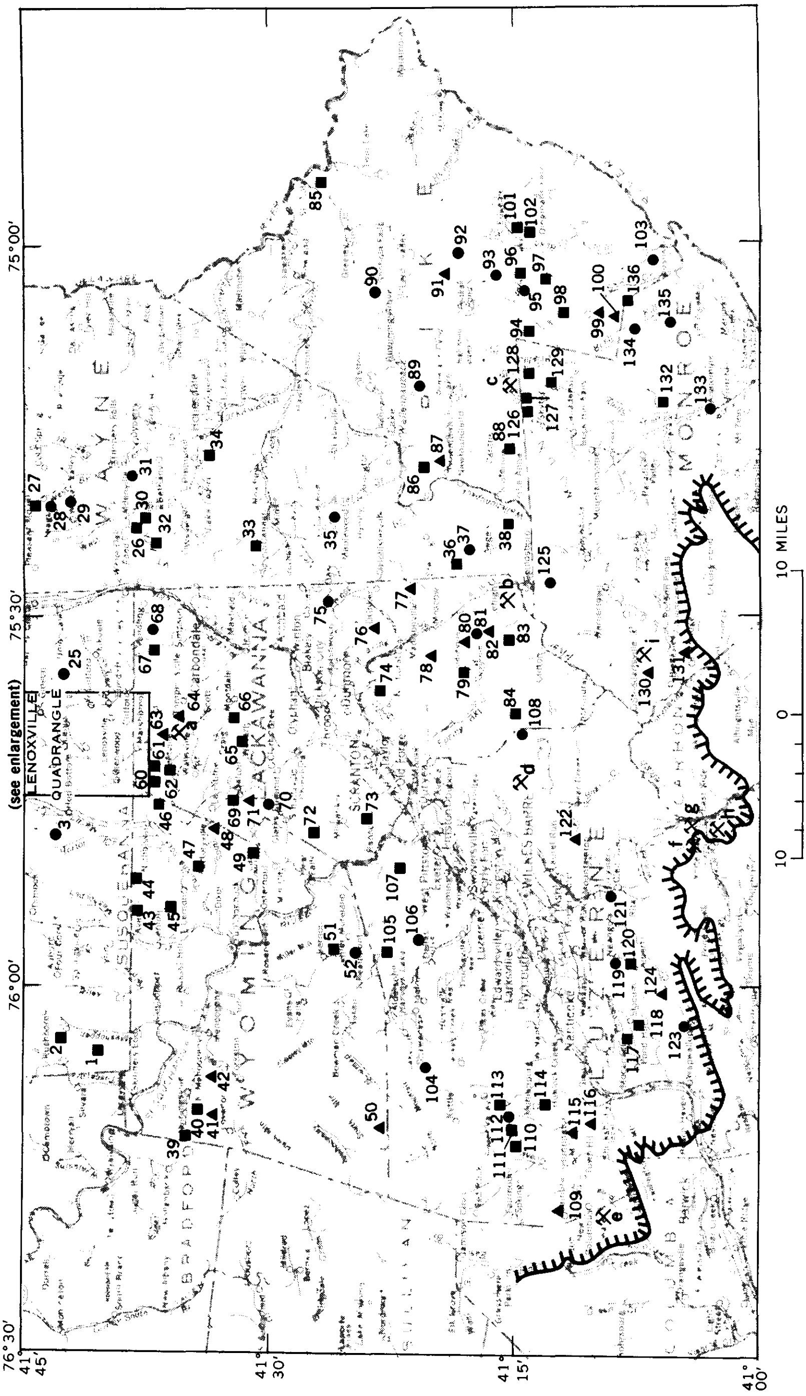


FIGURE 1.—Index map of Pennsylvania showing area of this report (shaded).

to collect samples of peat, to obtain stratigraphic information, and to determine the thickness of the deposits and the configuration of the depressions in which they lie. Quantity of peat in each deposit was calculated from surface area and average thicknesses determined from the drill holes and terrain interpretation of the areas surrounding the deposits. Samples of potentially exploitable peat were collected from 95 deposits and submitted to the laboratories of the U.S. Geological Survey for analyses. Moisture, ash, organic content, water-holding capacity, fiber size (exceeding 0.15 mm) and acidity were determined.

Acknowledgments—The cooperation of Arthur A. Socolow and Edwin F. Kope, Pennsylvania Geological Survey, and of Eugene T. Sheridan, U.S. Bureau of Mines, is gratefully acknowledged. Committee reports and suggestions by members of the American Society for Testing and Materials Committee D–29 on peats, mosses, humus, and related products were much appreciated. Specific suggestions 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, formed the bases for collecting and analyzing the peat samples. Analyses were performed under the supervision of Irving May, U.S. Geological Survey. Harriet C. Cameron provided a valuable fund of experience and assistance to the field party in the identification and study of the vegetation types. David E. Schieck served ably as field assistant.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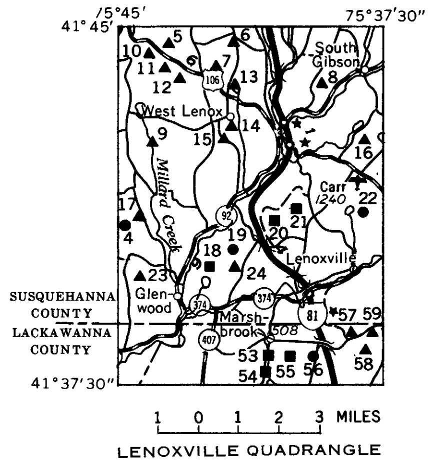


EXPLANATION

a — Active peat mine

33 — Unmined peat deposit containing more than 75 percent organic content

3 — Unmined peat deposit containing less than 75 percent organic content

6 — Swamp or marsh traversed, but not sampled; may or may not contain a peat deposit

Southern limit of Wisconsin Glaciation

FIGURE 2.—Location of peat deposits investigated in northeastern Pennsylvania. Locality numbers listed in table 1.

PEAT

ENVIRONMENT

Peat is an accumulation of partly decomposed vegetable matter that lived and died where water abounds. Peat may include (1) fibrous, matted, turflike material composed of mosses, ferns, grasses, rushes, reeds, sedges, and woody material from shrubs and trees, (2) finely divided plant debris so decomposed that its biological identity is lost, or (3) nonfibrous, plastic colloidal, and macerated material such as deposited at the bottom of lakes and other bodies of water.

Peat deposits form from the debris of many generations of plants living in communities adapted to rather specific water and soil conditions. Such a community is a marsh (an area of saturated ground supporting dominantly rushes, reeds, grasses, sedges, and other herbaceous plants), or a swamp (an area of saturated ground supporting dominantly trees and shrubs). A particular peat deposit may be the result of a sequence of communities of plants that lived in somewhat different water and soil conditions and perhaps under different climatic conditions.

Peat formation requires the coincidence of several physical and biological factors: a climate and a 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 factors associated with peat formation are quite varied. Peat formation is not limited by temperature; just as plant growth extends from the Arctics to the Tropics, peat deposits are equally extensive. The peat bogs of northern latitudes have long been studied and exploited, but the great peat deposits of Florida (Davis, 1946) and those of the tropical mangrove swamps are not as well known. Temperature is important in that plant growth is more abundant as the mean annual temperature increases—but the rate of decay is also favored by higher temperatures. Temperature is probably most important in its role of humidity control, for moisture is the most critical climatic factor in promoting plant growth and inhibiting decay. Moisture is thus the chief control in the formation of peat.

Physical settings in which plant debris may accumulate in significant amounts are very limited. Foraging animals, insects, bacteria, molds, and fungi, plus chemical oxidation thrive on the products of plants. Only in circumstances where plant debris is rapidly buried or trapped in a nonoxidizing environment is it likely to be converted to peat. Such environments as ponds, swamps, and marshes offer rapid immersion into a suitable peat-forming environment.

The biological and chemical environments favoring development of peat are those in which oxygen is very limited and movement of solutions is slow. 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). Depressions containing quiet or slow-moving water part of the year act as sites for peat formation and range greatly in size from the small areas in hills and mountains to large areas of low relief such as occur in Minnesota, Michigan, and Canada. In areas of high rainfall, low evaporation, and consequent high humidity, deposits of sphagnum moss may accumulate and form peat independently of flooded conditions. For example, along the coast of Maine, where the air is humid and cool, some peat deposits are built up more than 20 feet above the original surface of the land.

PHYSICAL PROPERTIES

Although the properties and composition of peat vary considerably in different deposits and in different parts of the same deposit, all peats are a mixture of water and partly decomposed plant matter plus varying amounts of mineral matter that washed into the deposit while it was forming. The physical and physiochemical characteristics and properties such as texture and structure, soil reaction, and heat values vary greatly because of different types of vegetation from which the peat was derived and the different environmental conditions under which it accumulated and has been preserved. The characteristics and properties are so many that the Cooperative Extension Service at Michigan State University has published a guide for peat consumers (Lucas and others, 1966) which lists what to look for in commercial peat. This list includes organic-matter content, degree of decomposition, pH, percentage of water, weed-seed contamination, structure, water-holding capacity, and nitrogen content. The guide points to characteristics of raw peat that are of primary importance both to the processed product and the processing of the products. Chief among these are: organic content, moisture content, water-holding capacity, fiber content, and acidity.

ORGANIC CONTENT

Organic matter should not be less than 75 percent to meet regulations established by the Federal Trade Commission in 1950 to govern the sale of peat. The regulations define peat as any partially decomposed plant matter that has accumulated under water or in a water-saturated environment. 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 (the ash content) is composed of normally associated soil materials. Government purchases of peat are subject to specifications developed by the Federal Supply Service, General Services Administration. Federal Specification Q–P–166e, dated May 10, 1961, sets maximum ash content for the several types of peat as follows: sphagnum moss peat, 10 percent; other moss peat, 20 percent; humus peat, 20 percent; and reed-sedge peat, 15 percent.

The organic-matter content of peat described in this report was calculated after moisture and ash content had been determined. The sample, which had been brought to the laboratory in a watertight container to prevent water loss after collection, was dried uncovered 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 heated at 500°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:

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

MOISTURE CONTENT

Water content of peat in a deposit is very difficult if not impossible to measure accurately, but it is a very significant property in the mining and processing of peat. Measurements of moisture content in samples from 95 bogs in northeastern Pennsylvania indicate a high percentage of water in freshly excavated peat. On an over-dried basis, moisture content of samples as received ranged from 72.3 to 95.7 percent. Samples from 77 percent of the deposits contained 90–95.7 percent water, and samples from 20 percent of the deposits contained 85–90 percent water. Only 3 percent of the samples were in the 72.3–85 percent range. All the deposits sampled, whether drained or undrained, contained a high percentage of water in the undisturbed peat. Water therefore would move through such deposits very slowly, a fact significant to both the drainage of the deposit by ditching to permit excavation and to the drying of the peat before stockpiling for bulk or package sales.

WATER-HOLDING CAPACITY

One of the properties that makes peat valuable as a soil conditioner and horticultural material is its ability to reabsorb water like a sponge after initial drying. Water-holding capacity, which is measured in percentage by weight, varies depending upon botanical character, the degree of decomposition, and the degree of drying to which the peat has been subjected. Moss peat has tremendous water-holding power and will hold water 15–30 times its own weight; a good grade of reed-sedge peat commonly will hold water 10–20 times its own weight; whereas decomposed peat such as humus will hold considerably less water. Oven-dried peat tends to reabsorb less water than air-dried peat.

Federal Trade Commission regulations do not specify water-holding capacity, but Federal Specification Q–P–166e specifies minimum water-holding capacity expressed in percentage by weight compared to oven-dried weight for the several types of peat as follows: sphagnum peat, 800 percent; other moss peat, 400 percent; humus peat, 200 percent; and reed-sedge peat 400 percent.

Water-holding capacity is determined in the laboratory from samples of peat that have not been subjected to partial preliminary drying after collection in the field. Twenty to 50 grams are placed in a tarred-covered container having a wire-screen bottom and immersed in water at room temperature for 18–24 hours. The laboratory sample is then heated in an oven at 105°C to constant weight, cooled in a desiccator, and then weighed. The percentage of absorbed water, based on the oven-dried weight, is computed from the difference in weight between the saturated sample and the oven-dried sample.

FIBER CONTENT

Fiber content refers to stem, leaf, or other plant fragments. It is, therefore, a property common to all types of peat. Because peat with a high percentage of fiber greater than 0.15 mm in length also tends to have high water-holding capacity and because fiber content correlates well with weight per unit volume (a common basis for the sale of peat), a classification based on fiber content has been formulated by the ASTM (American Society for Testing and Materials) D–29 Subcommittee I, Classification (Rouse Farnham, written commun., 1967).

The amount of fiber exceeding 0.15 mm in length has been measured for each of the 95 deposits sampled in northeastern Pennsylvania and the results tabulated in percentage. The peat samples were oven dried and screened, and the following formula applied:

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

All deposits were grouped into the following three fiber types for convenience of discussion:

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; and

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 having long fibers typical of type I. Most reed-sedge peat falls in type II, and much humus in type III. Peat in northeastern Pennsylvania is predominantly reed-sedge with type II fiber content.

ACIDITY

The pH scale is used to designate the degree of acidity or alkalinity. A pH of 7.0 is neutral. Very acid peats have a pH of 3.2–4.2. Acid peats have pH 4.2–5.0. Peats with pH values from 5.0 to 7.0 are low in acidity. Those with a pH over 7.0 are alkaline. Peats may be classified into two major acidity types. Those with pH values below 5.0 are calcium deficient; those above pH 5.0 are called calcium sufficient.

Federal Specification Q–P–166e specifies pH values of 3.2–4.5 for sphagnum moss peat; 3.2–7.0 for other moss peat; 4.0–7.5 for both humus peat and reed-sedge peat.

CLASSIFICATION

Peat can be formed from many varieties of plant material, throughout a wide range of climatic and geomorphic conditions, and subsequently can have a widely varied geologic history. Different peats have been found suitable for differing uses. Complexity in the nature and origin of peat and the varying usage of it has led to development of many different modes of classification.

The chief classifications are based on (1) physical or chemical characteristics such as texture, organic and mineral composition, water content, and fuel value, (2) peat as a soil and the vegetation that grows on it, (3) origin, mainly by the type of vegetation represented, (4) the environment of formation, or (5) uses, such as for fuel, as a source of chemical and other manufactured products, and as a soil conditioner.

For statistical purposes, the U.S. Bureau of Mines has classified peat into three general types: moss peat, reed-sedge peat, and peat humus. This classification is used in this report. Peat deposits also may contain a considerable amount of woody material regardless of type. Most peat produced in the United States and the vast majority of the unexploited peat deposits in northeastern Pennsylvania are either reed-sedge or humus type.

MOSS PEAT

Moss peat is formed principally from sphagnum, hypnum, and other mosses. Sphagnum moss peat is light tan to brown, is light in weight, porous, high in water-holding capacity, and is 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 is partially decomposed. Hypnum moss peat is a darker brown, of low acidity, and possesses physical characteristics similar to reed-sedge peat. In the bogs sampled in northeastern Pennsylvania, moss peat is abundant in only three deposits: in Pike County 2.2 miles south of Shohola; in Susquehanna County at Tea Pond; and on the west border of Lackawanna County in the Avoca quadrangle.

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

Peat humus is peat that is of such an advanced stage of decomposition that the original plant remains are not identifiable. It is usually derived from reed-sedge or hypnum moss peat. Peat humus 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 found in the bottom of lakes and ponds and in the lower levels of most peat deposits. It is derived from algae, plankton, pond weeds, and similar plant species. Such peat usually contains considerable mineral impurities and in this report is referred to as peaty clay or clayey peat depending upon the degree of organic content. It is too finely divided for most soil improvement purposes; it shrinks and swells greatly with varying moisture content, and some has a sheet-like structure and hardens upon drying. Muck is highly weathered peat that has been modified greatly by soil microorganisms and is usually granular in structure. It has low moisture retention capability and is poorly suited for soil improvement purposes.

REGIONAL GEOLOGY

Depressions in which peat has accumulated in northeastern Pennsylvania are of several general types. Most of them formed in areas where the bedrock strata are only moderately resistant to erosion and where geologic structure has provided an initial localized weak point. The regional distribution of such strata controls the most likely sites for peat accumulations. Geomorphic development during glacial advances provided major changes in drainage patterns, and glacial erosion and deposition created additional sites for peat accumulations. The following summary of the regional geologic settings for peat deposits in northeastern Pennsylvania is presented to summarize the principal controls as guides to the search for additional peat deposits elsewhere in the region.

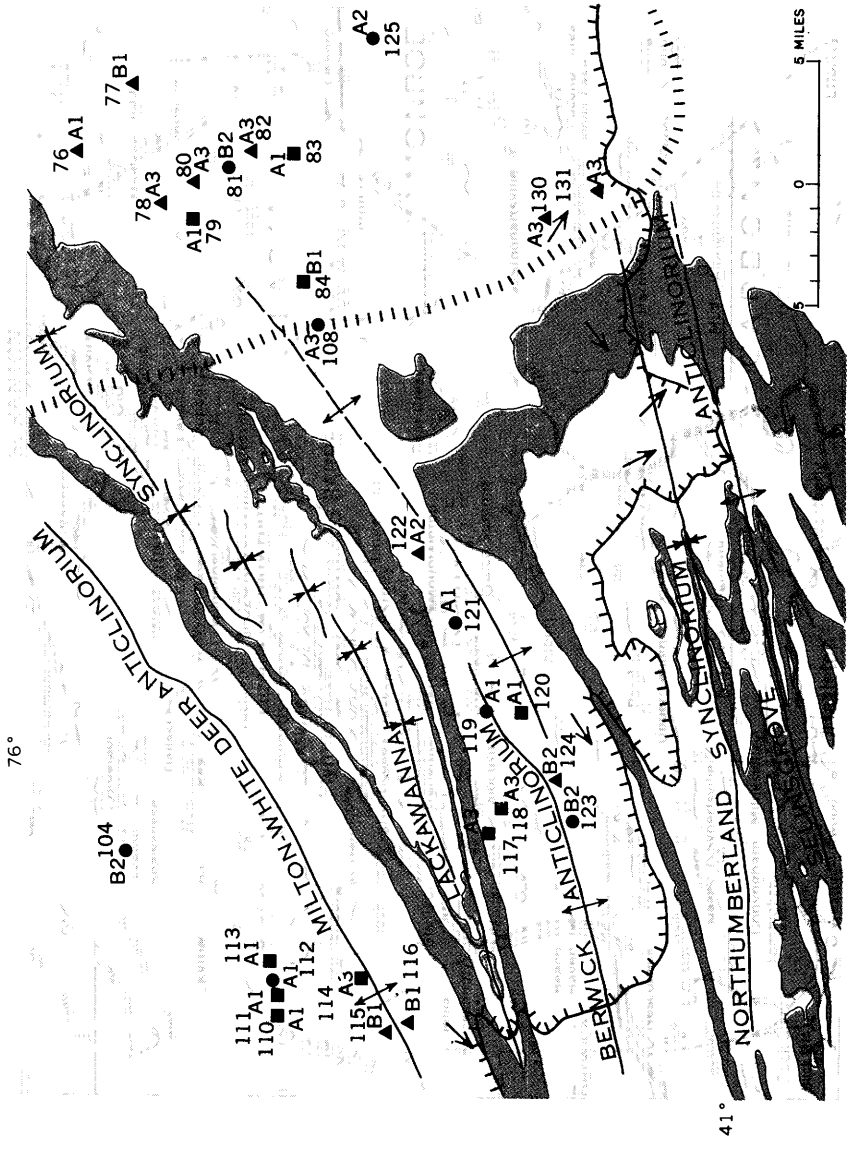
PALEOZOIC ROCKS

Silurian rocks crop out or underlie flood-plain and terrace sediments in a narrow belt along the Delaware River in Monroe County; shale, limestone, and sandstone are the principal types of rock. Devonian rocks are by far the most widespread and constitute the bedrock surface outside the ridges of Mississippian sandstone and conglomerate. Resistant rocks (Pocono Formation, fig. 3), form the rim of the Lackawanna synclinal basin in which Scranton and Wilkes-Barre are located and the high plateaus in western Wyoming and northern Luzerne Counties. Included in the Devonian are the Oriskany Sandstone and Helderberg Formation in a belt along the Delaware River in Monroe County, and in a narrow wedge separating the northern and southern parts of Columbia County. Elsewhere, the Devonian is represented by the red, gray, and green shale and sandstone of continental origin belonging to the Catskill Formation (Devonian and Mississippian) and, locally, by the older marine beds of gray shale and sandstone, chiefly the "Portage" beds. Rocks of Mississippian age, represented by hard sandstone and conglomerate of the Pocono Formation and softer shale of the Mauch Chunk Formation, are associated areally with sandstone, shale, and coal of Pennsylvanian age.

All these formations were folded during the Appalachian orogeny and subsequently beveled by erosion so that the youngest rocks lie in the synclines and the oldest crop out in the anticlines. Axes of these folds trend generally in a northeast-southwest direction. Harder layers of rocks in the folded sequence were more resistant to erosion, thus the topography that developed on the folds paralleled the structural trends. The folds do not continue indefinitely in both directions along their axes but plunge in many places as illustrated by the Lackawanna synclinorium. This is the dominant structural and topographic feature of the area. Anthracite coal beds in the deep basin are of economic interest and the subject of detailed studies (Wood and others 1969, p. 117–137). Long before glacial advances in the Quaternary Period differential erosion had brought into sharp relief the ridges of hard sandstone and conglomerates outlining the Lackawanna synclinorium. A high double rim of resistant sandstone and conglomerate rises above the softer sandstone, shale, and coal. The complex synclinorium is composed of many generally parallel folds of lesser magnitude. Valleys separate the areas of competent strata following the folds in some places and crossing them in others as shown best by the course of the Susquehanna River. The course is in accord with one system of joints that parallels the strike and a second system at right angles to the strike (fig. 3).

Ridges of hard Devonian sandstone flank the lesser folds and cap the hills and plateaus where folding in negligible. These lesser folds are shallow anticlines and synclines located northwest, north, and northeast of the Lackawanna synclinorium. They spread into still lesser folds that compose the plateaus. As the folds become less prominent the joint systems which are parallel and at right angles to the strike become more conspicuous and control the drainage pattern.

The Allegheny topographic front separates the less folded from the more intensely folded parts of the area. The more pronounced topography on the southerly side of the Allegheny front duplicates the pattern of the less pronounced topography on the northerly side because the joint patterns are similar. Near the edge of the


76°
41°
MILTON-WHITE DEER ANTICLINORIUM
SYNCLINORIUM
LACKAWANNA
BERWICK ANTICLINORIUM
NORTHUMBERLAND SYNCLINORIUM
SELINSGROVE
ANTICLINORIUM
5 MILES
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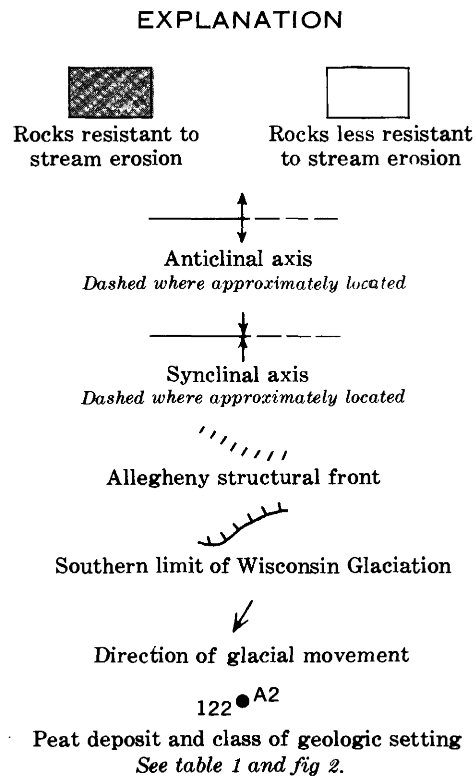


FIGURE 3.—Geologic sketch map of northeastern Pennsylvania with selected examples showing geologic settings of peat deposits relative to topography, regional geologic structure, glacial movement, and limit of Wisconsin Glaciation. Base, distribution of rock type, and limit of Wisconsin Glaciation from Gray and others (1960); tectonic features from G. H. Wood, Jr., and M. D. Carter (unpub. data, 1967).

Allegheny front, beds dip with increasing steepness toward the Delaware River. The folds in the southwestern part of the area of this report, including the Northumberland synclinorium and Selinsgrove anticlinorium, become increasingly intense in the vicinity of Hazleton. The Berwick anticlinorium reaches Luzerne County between this series of anticlines and synclines and the Lackawanna synclinorium. In the vicinity of East Stroudsburg are numerous folds that merge northerly into the anticline marked by Wallpack Ridge.

QUATERNARY ROCKS

The area covered by this report was strongly glaciated during the Quaternary Period. Over most of the region, the Paleozoic sedimentary rocks are mantled by a varying thickness of glacial deposits (Lohman, 1937). The glacial deposits or drift are in two different types, namely till and outwash. Till is a heterogeneous mass of predominantly impure clay containing stones of all sizes and shapes, most of which are of local derivation but some of which were transported from other areas. The dominantly fine-grained nature of the till is due to the high percentage of shale in the Devonian formations. The outwash, having been sorted by the melt waters, is usually clay, sand, and gravel that show varying degrees of stratification.

The glacial till and outwash and modern alluvium covering the glaciated area range in thickness from a few feet to several hundred feet, except in places where subsequent erosion has removed them. Many valleys were filled and the streams relocated in new channels over and around the buried valleys. Other streams were dammed by thick deposits of drift, and lakes were formed. Still other streams were diverted from their preglacial courses by hills of drift and forced to flow over cliffs. In these places waterfalls were formed. Much of the drift-covered terrane presents a hummocky topography, with irregular shaped hills and mounds of drift and undrained depressions.

Streams issuing from the melting glacier carried immense quantities of material which were deposited as outwash in some of the larger valleys. Later as the streams carried lighter burdens, they cut through this clay, sand, and gravel and left terraces. Many of the preglacial valleys were partly to completely filled by glacial debris so that modern streams may in part flow over deeply buried valleys. Locally the depth of sediment filling these old valleys in the bedrock is more than 300 feet.

GLACIAL MECHANICS

The extent of the most recent Pleistocene glaciers, the Wisconsin Glaciation, is shown in figure 3 (Lewis, 1884; National Research Council, Division of Earth Sciences, 1959). As the ice advanced, the soil and decayed rock were scraped off and shoved along. Masses of bedrock were plucked out by the ice and formed tools with which the glacier scoured the bedrock. Grooves and striae produced in the scoured bedrock show the direction of ice movement. The terminal moraine of the Wisconsin ice sheet is well defined as a series of low hills, hummocks, knobs, and ridges interspersed with depressions called kettles, many of which contain or have contained water. These depressions are due to slumping when masses of ice contained in the drift melted. Lewis, studying the terminal moraine in detail along its irregular and sinuous course from southern Monroe County to northern Columbia County, observed that the general direction of ice movement was about S. 30° W., but variations are common. In principal valleys, observed Lewis, the striae conform approximately to the direction of the valley; whereas upon the mountains they give the more general movement of the glacier. In all places the striae near the marginal moraine indicate a movement approximately at right angles to the course of the moraine.

The distribution patterns of Wisconsin glacial drift on bedrock in the marginal moraine area is duplicated in the less obvious distribution pattern of glacial drift on bedrock in the glaciated area northeast of the moraine.

Tongues of ice advanced generally southwestward through valleys parallel to ridges that were subsequently overridden by the main part of the glacier. Masses of ice, broken from the main mass, filled wind gaps and water gaps and dissected the ridges at right angles to their trends. After the ice melted, lakes and ponds were impounded by dams of glacial drift at either end of the gaps.

Drift in some places piled against a steep-sided ridge or high hill as the glacier moved forward. At other places it was dropped on the lee side, but in the final phase of stagnation nearly everywhere that masses of ice were incorporated in the drift, lakes and ponds formed.

Melt waters flowing through bedrock valleys caused irregular deposition of outwash on valley floors and along valley walls. This deposition resulted in poorly drained depressions. Temporary stands of the glacial margin during retreat caused drift dams with valleys parallel to the trend of the ridges. Some of the channels cut by melt water in both drift and bedrock during final stages of glaciation were dammed by outwash to become basins occupied by lakes and ponds.

The lakes and ponds resulting from glacial action have been natural sites for the formation of peat deposits.

PEAT DEPOSITS

PHYSICAL FEATURES

Approximately 500 swamps and marshes are shown on 1:24,000-scale topographic maps that cover the 900-square mile study area in northeastern Pennsylvania (fig. 4). Of this number, 136 that contained peat deposits were chosen for representative study (table 1). All selected deposits were traversed and 95 of them were sampled (table 2). Included are all deposits within the 55-square mile area of the Lenoxville quadrangle. Susquehanna and Lackawanna Counties (fig. 2). This quadrangle was selected as representing average density of swamps and marshes throughout the area.

Size of the peat deposits ranged from 1 acre to 240 acres with 92 percent containing 10 or more acres. Thickness of peat in the deposits averages from 1 foot to 25 feet, and 92 percent have a thickness of 5 or more feet. The 136 deposits that were traversed contain potential resources that total about 8,100,000 short tons of air-dried peat.

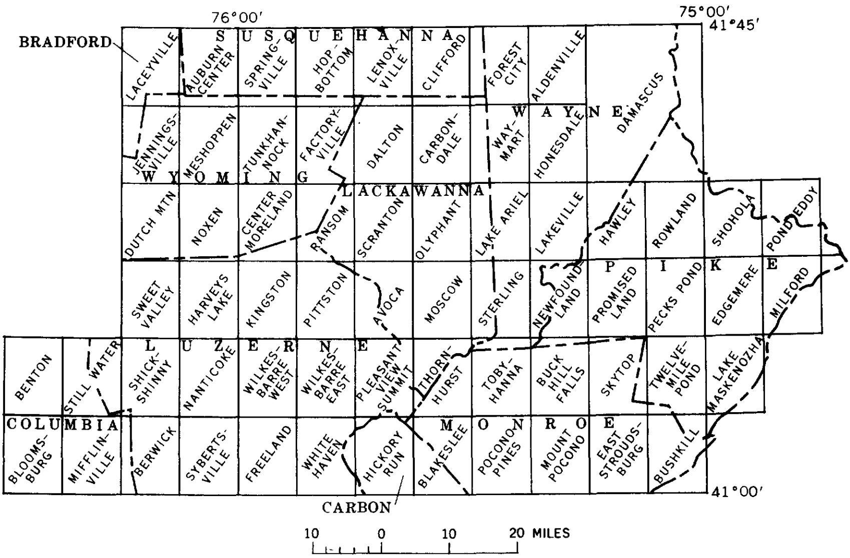


FIGURE 4.—Index map showing location and names of U.S. Geological Survey topographic quadrangles in area of study.

Analyses from the 95 peat deposits that were sampled indicate that 63 have an organic content of 75 percent or greater. Of this number, 12 are in the 95–100 percent category, 31 in the 90–95 percent category, eight in the 85–90 percent category, and 12 in the 75–85 percent category. The majority have water-holding capacities exceeding 1,000 percent. Two deposits have water-holding capacity of 2,500–3,500 percent. Thirty-five deposits are in the 1,500–2,500 percent category, 34 in the 1,000–1,500 percent category, 11 in the 800–1,000 percent category, and 13 in the less than 800 percent category. A deposit (loc. 96) in the 2,500–3,500 percent water-holding capacity category has type I fibers. Peat in 65 deposits has type II fibers and in 29 deposits has type III fibers. The pH values in 90 deposits range from 5.0 to 7.0 and in five deposits from 4.2 to 5.0.

According to these analyses, the 8,100,000 tons of peat resources probably contain about 5,300,000 tons that have organic content 75 percent or greater and 6,297,000 tons that have water-holding capacity 1,000 percent or greater.

FORMATION OF THE PEAT DEPOSITS

The peat deposits in the area of study are in closed depressions on the surface of Paleozoic sedimentary rock, or on glacial drift of Quaternary age, commonly at elevations above 1,000 feet. The bulk of the peat formed in places originally occupied by ponds left after glacial retreat; parts of some of the deposits are possibly contemporary with Wisconsin Glaciation and some may be even older. The general pattern of sedimentation that gives rise to the peat deposits in northeastern Pennsylvania and the changes within individual deposits are rather uniform in general aspect. Numerous ponds and lakes at various elevations filled to become marshes; these may in turn change into swamps, or again become ponds; they may even be drained completely. Stratigraphy of most of the marshes and swamps that contain peat consists of glacial drift or bedrock overlain by gray clay, which in turn is overlain by 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 parts of the surface of many deposits. The typical sequence of peat forming events is shown in figure 5.

The sequence of deposit formation, which may eventually fill the pond, begins when clay, washed in from the sides of a water-filled depression, accumulates on the bottom (fig. 5A). Floating forms of simple organisms such as diatoms and algae grow and

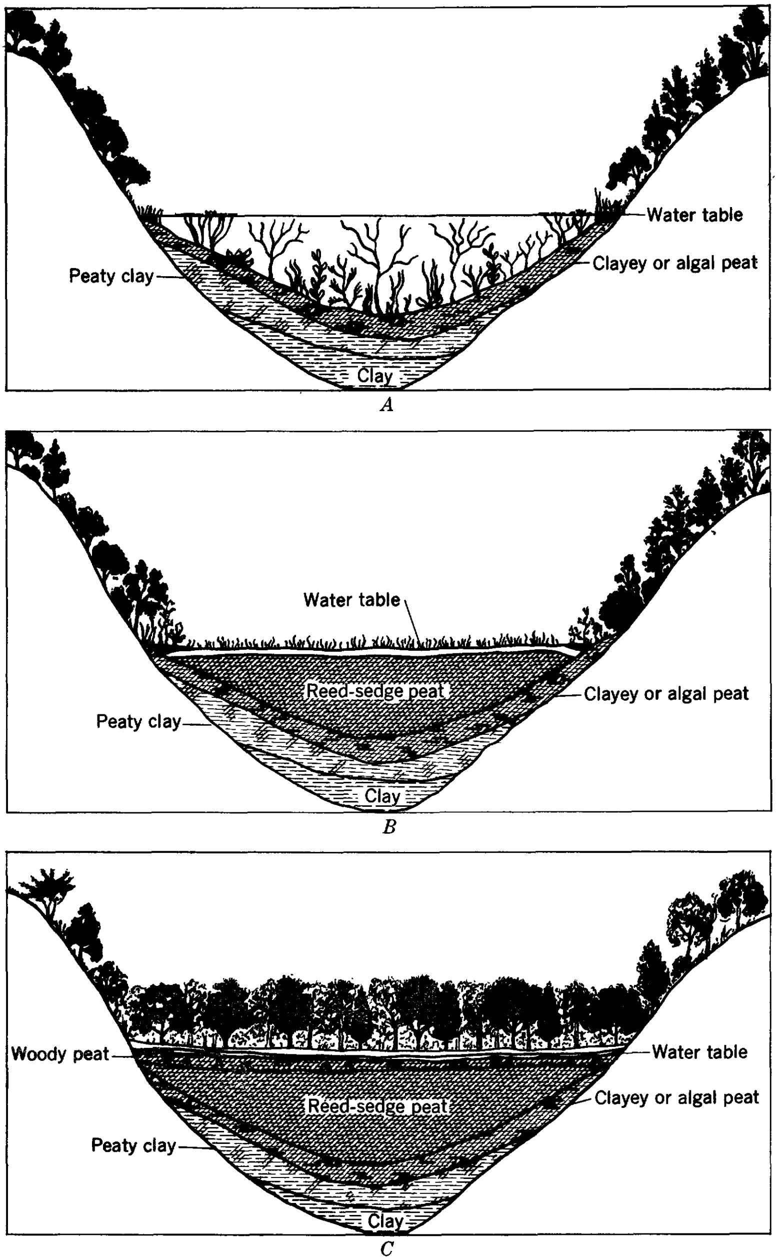
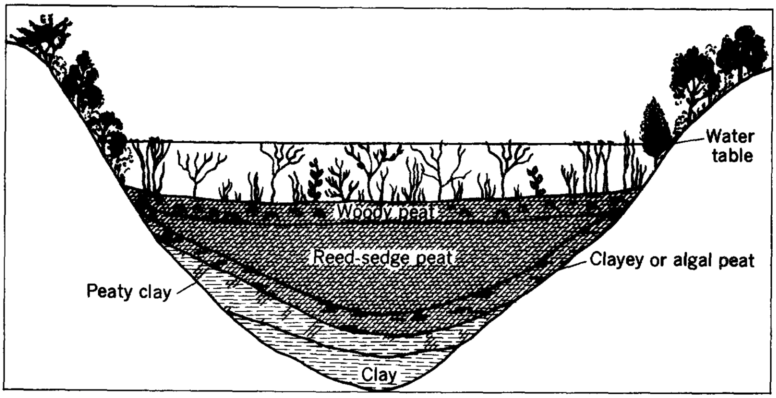


FIGURE 5.—Diagrammatic sketches showing steps in development of peat deposits in northeastern Pennsylvania.



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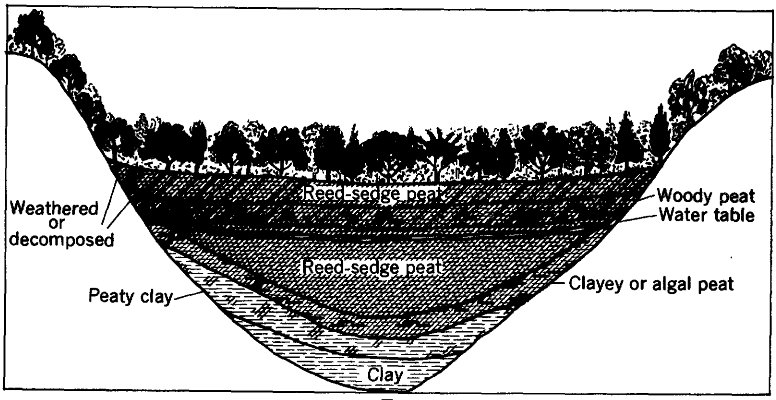


E

A, Pond stage. Clay from the sides of the depression has accumulated in the deepest part. Algae, pond weeds, and other submerged plants helped flocculate colloidal particles and contribute organic material to the clay. As plants increase in abundance and variety in the pond, peaty clay changes to clayey or algal peat and reed-sedge peat begins to accumulate at the shallow margins where reeds and other grasses, sedges, water lilies, and other semiaquatic plants are able to take root.

B, Marsh stage. The semiaquatic plants continue to migrate from the margin causing the pond to shrink in area and depth as reed-sedge peat accumulates. Moss may grow on top of the reed-sedge peat and produce a layer of moss peat. The pond is finally obliterated and the water table rises toward the center of the marsh where accumulation of peat is greater than near the edges.

C, Forest stage. Formation of soil above the water table favorable to the growth of trees at the margin of the marsh permits the advance of the forest and the shrinking of the marsh area until the site becomes a swamp. A layer of peat with logs and stumps developed over the layer of reed-sedge peat formed during the marsh stage. As the water table lowers with rising forest floor accompanied with changes in soil character, a predominantly needle-leaf forest is replaced by one that is mostly broad leaved.

D, Return to pond stage. A new cycle of peat deposition may be started at either the pond or forest stage by flooding which kills the surface vegetation. Flooding is caused by such phenomena as construction of a dam by beaver, man, or landslide as well as natural or artificial drainage change.

E, Stage of lowered water table. At any point in the cycle of peat accumulation the water table may be lowered by natural erosion, artificial draining, or by long periods of decreased rainfall. Aeration of the peat permits oxidation and aerobic micro-organisms to flourish. This aeration results in an increase in ash and consequent decrease in organic content.

die, and their remains sink and 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. Deposition continues until nonfloating aquatic 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 weeds, water plantain, and water lilies 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, it often breaks off and eventually sinks to the floor of the pond. This mat helps fill the pond and eventually converts it into a marsh. Further steps in the development of peat are shown schematically in figures 5B through 5D.

Once formed, the peat deposit may be subjected to one of three major courses. Woody peat may continue to be developed; the swamp may be changed back into a pond, generally as the result of beaver or manmade dams, or it may be drained naturally or artificially. Returning to the pond stage (fig. 5D) initiates a new cycle that may progress through the marsh and swamp stages with appropriate changes in peat accumulation. On the other hand, lowering of the water table (fig. 5E) by drainage initiates destruction of the peat by causing an inflow of oxygen which permits aerobic micro-organisms to flourish. 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 of peat, followed by remoistening, greatly stimulates decomposition.

RATE OF DEPOSIT FORMATION

The rate of accumulation of peat is a function of climate, ecological environment, hydrologic regimen, and local geomorphic events. Sites where luxuriant plant growth and rapid immersion of plant debris are favored and where decomposition and other destructive factors are minimized will have maximum accumulation rates. The range in rates from deposit to deposit is wide, so that the thickness of peat itself is not a very precise time indicator. For example, Davis (1946) computed the rate of deposition of saw-grass 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 peat bog in Quebec, Canada, as shown by the radiocarbon studies of Potzger and Courtemanche (1954). However, Mitchell (1965) computed the rate of accumulation at Littleton Bog in Ireland at 1 foot per 480 years also 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 Westerfield (1961). No radiocarbon dates are available for 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).

CLIMATE OF AREA

Northeastern Pennsylvania has a humid continental type of climate, but regional physiographic features produce marked local effects as shown by the precipitation and temperature records from 1931 to 1952 and freeze records from 1921 to 1950 (Kauffman, 1960). Mean annual precipitation ranges from 36 inches in the northwest and 40–44 inches in the east to more than 52 inches on the east slope of the Pocono Plateau. Although the annual rainfall is fairly well distributed throughout the year, the heaviest precipitation occurs in June, July, and August with the maximum in July and the minimum in February. The average annual snowfall is about 50 inches, and most of it occurs between November 1 and April 30. The combination of melting snow and spring rains causes flooding in swamps and marshes until about the middle of June. The high summer precipitation that keeps the water table high in undrained swamps and marshes protects peat from exposure to air and subsequent decomposition below a depth of about 1 foot.

January is the coldest month and July the warmest. In January, temperature ranges from a mean maximum of 36° to 38°F in the east and southwest to 30° to 32°F in a belt extending through Susquehanna and Wyoming Counties and the Pocono Plateau. The mean minimum for the entire month reaches a low of 12°–14°F on the Pocono Plateau. Elsewhere the mean minimum for the same month is 20°–22°F. The mean maximum temperature for July ranges from 84° to 86°F in the northwest and southwest to 74° to 76°F on the Pocono Plateau, and the mean minimum temperature for July is 58°–60°F, but on the Pocono

Plateau it is 54°–56°F. Mean number of days per year, 1921–50, during which temperature remained above freezing ranged from 130 at Hawley, Wayne County, to 174 at Scranton, Lackawanna County. Mount Pocono, Monroe County, had 136 and Freeland, Luzerne County, had 155 days per year above freezing.

The mountain and valley influence on air movements causes greater temperature extremes than are characteristic of level areas. The effects of nocturnal radiation in the valleys and the tendency for cool air masses to move down them at night causes freezes later in the spring and earlier in the fall; whereas the cool summer nights favor growth and accumulation of peat-forming vegetation.

VEGETATION OF PEAT DEPOSIT AREAS

Most of the peat deposits are forest covered; red maple (*Acer rubrum* L.) is abundant and is accompanied by black spruce, hemlock, birch, white pine, alder, high-bush blueberry, rhododendron, and viburnum. Rhododendron is a very characteristic shrub of northeastern Pennsylvania especially east of the Scranton-Wilkes-Barre anthracite basin. The shrub grows densely in a belt of varying width in the zone where the water table is at or near the surface during the wet season and drops during the dry season. Thus it borders many of the peat deposits. Some peat deposits are overgrown with herbaceous vegetation consisting of many kinds of grass and sedge, water lilies, cattails, and sparse shrubs and trees; others are under the water of beaver- or man-formed ponds and lakes.

The areas surrounding the swamps, marshes, and ponds containing peat deposits are also forested, except where cleared for pasture and cultivation, but the upland vegetation is quite distinct from that covering the peat. For example, oaks and hard maple (*Acer saccharum* Marsh) which are so very common on the well-drained land throughout northeastern Pennsylvania are absent in the areas of saturated ground containing the peat deposits.

In northeastern Pennsylvania the limits of the peat deposits commonly may be recognized by the contact between several species of blueberries (*Vaccinium*); the low-bush species are common to the slopes, whereas the high-bush species are common to the swamp and grow over peat even where the forest floor has built up high enough so that the swamp has been obliterated.

As former marshes are converted to forest areas, the initial forests are predominantly evergreen, especially east of the

Scranton-Wilkes-Barre anthracite basin, and buried peat in such areas tends to be quite acid. With time, and accumulation of forest floor litter, these evergreen forests change to predominantly broad-leaf forests. This progression of vegetation types, with many intermediate stages, may be observed above peat deposits throughout the study areas.

DRAINAGE BASIN FEATURES

Although each peat deposit is the unique product of its specific drainage basin, it shares many common features with other deposits in the region. The details of individual stratigraphy have limited regional significance, but instead reveal the local sequence of changes in the drainage basin. Data on the 136 peat deposits and their drainage basins are summarized in table 1.

In the northeastern Pennsylvania study area, most of the peat deposits are restricted to elevations above 1,000 feet. Local relief in the immediate drainage area of these deposits ranges widely, from about 80 feet to as much as 900 feet. Slopes bounding the drainage basins also have a considerable range in steepness with almost half having slopes exceeding 10 percent. The steepest slopes are developed on resistant bedrock with only very shallow sandy soils. The less-resistant bedrock and areas of glacial drift have only gentle to moderately steep slopes, on which predominantly clayey soils have developed. Most of the slopes in the region are covered by vegetation, either broad-leaf forests or pasture. Severe soil erosion is limited and is restricted to cultivated areas.

Most of the peat deposits are in relatively small drainage basins and are near the headwaters. This fact effectively limits the sediment-producing area that might contribute sand, silt, and clay into the peat. As shown in table 1, only 21 of the 94 sampled deposits have sediment-producing areas 10 or more times the size of the surface area of the peat. As the size ratios increase, so does the probability of the peat having a higher ash content and lower organic content. In this region, however, almost half of the drainage basins having larger sediment-producing areas have some local sediment traps above the peat accumulations, such as smaller swamps and marshes, that serve to filter the water draining into the peat deposit. Three-fourths of the peat deposits with ash contents less than 15 percent lie in drainage basins with ratios between two and seven; that is, the areas of effective drainage within the basins are between two and seven times larger than the swamps and marshes containing the peat deposits. Absence of flooding is an important factor in the reduction of ash content.

GEOLOGIC SETTING CLASSIFICATION

Many factors might be chosen to use in classifying peat deposits, but perhaps the most descriptive single factor is the kind of materials that form the depression containing the peat. Both the quality and quantity of peat in each deposit can be related to the nature of these materials. The method of origin of the depression generally is quite closely related to the materials of which it is formed.

In northeastern Pennsylvania, the depressions containing peat are principally bedrock or glacial debris, in varying association and amounts in different deposits. Within this region, depressions wholely in bedrock are quite small, and no potentially useful peat deposits were observed in such a setting. (Such settings do contain exploited peat in other regions, for example, in limestone terranes where small karst ponds may develop into peat deposits.) Most of the peat deposits are in depressions of various combinations of bedrock and glacial debris, and some are completely in glacial deposits.

The relation of quality of peat to the kind of material in which the depression has formed involves several aspects, such as water-transmitting characteristics, solubility, resistance to erosion, and weathering products. Empirical observations have shown, for example, that deposits in bedrock troughs that are closed by unconsolidated material are more apt to have higher organic content, higher water-holding capacity, and a greater frequency of long fibers than deposits in bedrock-unconsolidated material depressions, whereas deposits in depressions completely within unconsolidated material have the lowest organic content and the shortest fibers. Deposits in bedrock troughs mantled with unconsolidated material are higher in organic content than those in depressions closed only on one side.

To facilitate descriptions of the geologic controls on quality and quantity of peat, the geologic settings of the basins of accumulation of the deposits in the area have been grouped into five classes:

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.

CLASS A1, BEDROCK TROUGH CLOSED AT BOTH ENDS BY UNCONSOLIDATED MATERIAL

Thirty-nine of the 136 deposits traversed (table 1) are in bedrock troughs that were parts of preglacial valleys dammed by glacial drift at both ends. Smiths Swamp (fig. 6) contains a peat deposit in a typical class A1 setting. The swamp depression lies between two bedrock walls that formerly were valley walls of a stream flowing across the strike of the regional geologic structure. The depression is closed at both ends by glacial drift that was deposited by the ice that moved roughly parallel to the strike of the regional geologic structure. Blocks of ice were pushed into and filled this former water gap or wind gap. Eventually the ice melted to form the pond, which in turn was filled with clay and organic material and thus became the site of a peat deposit.

Peat samples from 31 of the 39 class A1 deposits were analyzed. Peat in the remaining eight deposits was too shallow or of quality obviously too poor to merit analyses. Analyses show a predominantly low ash content for the class as a whole. Twenty-two deposits have ash content of less than 15 percent, five have ash content of 15–35 percent, and four have ash content of 50–60 percent. Only one deposit with ash content of less than 15 percent has type III fiber.

Ninety-one percent of the deposits in this setting occupied swamps and marshes in drainage basins that had effective drainage areas of no more than 10 times their sizes. The average slope of basin sides in the effective sediment-contributing area ranges from 4 to 18 percent. The highest slopes are controlled dominantly by bedrock that contributes very little fine material to the ash content of the peat deposit.

The deep depression formed by the steep bedrock walls of a former wind gap or water gap enclosed by till is a site favorable to rapid accumulation of peat-forming vegetation. Most such sites are offset from modern drainage and are not subject to silting from flooding which raises ash content. Also because they are offset from principal drainage, the bulk of peat accumulation took place prior to erosion of the depression walls with accompanying shifts in water table and consequent fiber disintegration and increased ash content.

CLASS A2, BEDROCK TROUGH WITH UNCONSOLIDATED MATERIAL CLOSING BOTH ENDS AND PARTLY MANTLING THE TROUGH

Twenty-one of the 136 deposits traversed (table 1) originated in bedrock troughs that were parts of preglacial valleys dammed at both ends by glacial drift and with considerable glacial drift

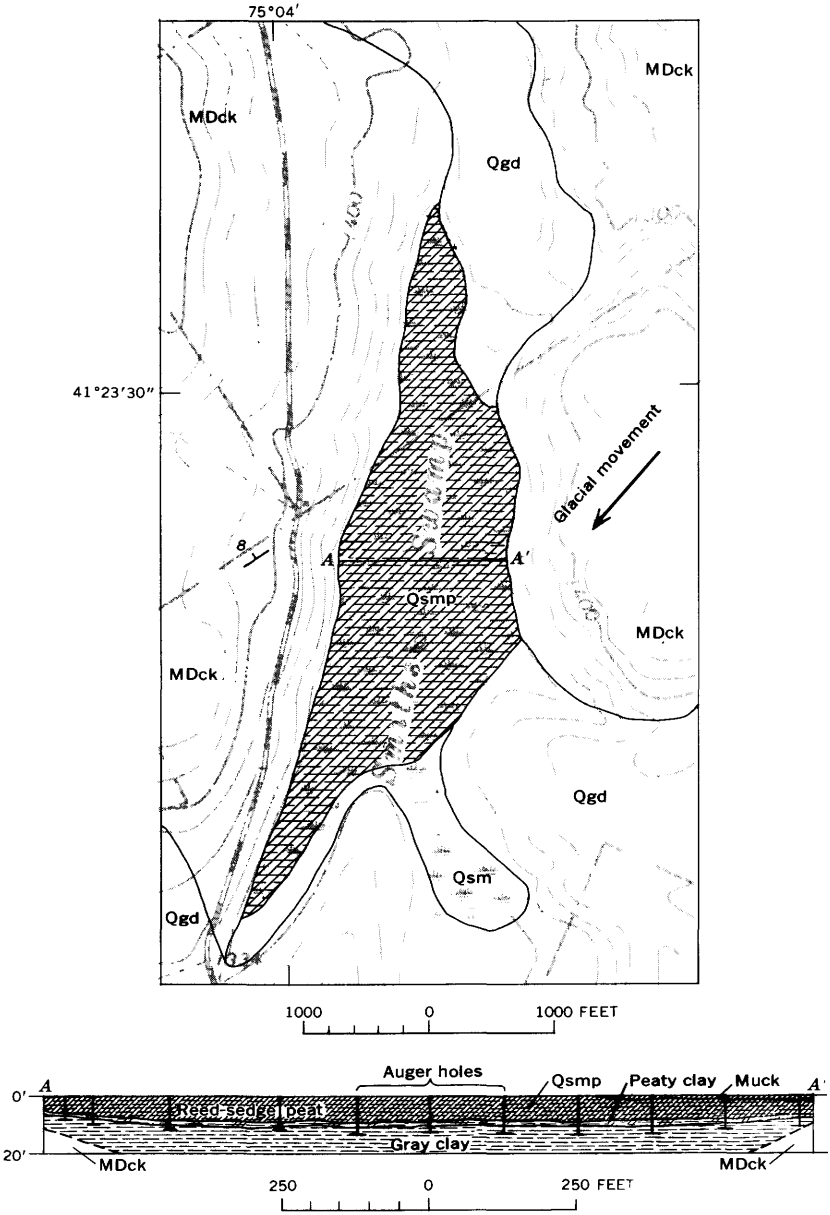


FIGURE 6.—Plan and cross section of typical peat deposit in class A1 geologic setting, Smiths Swamp, Rowland quadrangle, Pike County (90 in fig. 2 and table 1). The depression containing the exploitable body of peat (Qsmp) is a trough in bedrock (MDck) of the Catskill Formation (Devonian and Mississippian) closed at both ends by glacial drift (Qgd). Peat is too thin to mine in the part of the swamp designated Qsm.

partly mantling the trough. The troughs are generally parts of bedrock valleys through which tongues of ice moved in the southerly course of ice-sheet movement, or through which fluvioglacial outwash poured. As shown in figure 7, Big Swamp contains a typical example of peat deposits in till in the class A2 setting. The depression containing this swamp lies between two bedrock walls that were the preglacial walls of a stream flowing in the direction of the strike of the regional geologic structure. The depression is closed at either end by glacial drift. The drift not only forms dams in the preglacial valley, but mantles the lower bedrock slopes and buries the bedrock ridge that marks a bend in the course of the preglacial stream. Glacial ice, moving southwest along the preglacial stream, filled the valley and deposited drift along the valley walls. Melt water from the ice, particularly from the deeper part of the valley, where deep ice was lodged against the partial bedrock barrier, filled the depression and gave rise to the pond. The original pond was almost filled with clay washed in from the glacial drift lining the walls of the depression. Pond level of the water at the time vegetation began to grow was approximately at the highest elevation of the peaty clay layer as shown in figure 7, profile B–B′. Marsh vegetation accumulated and spread laterally. Slight flooding may have given rise to the layer of peat mixed with silt on which marsh vegetation again accumulated. This accumulation filled the depression and created the present peat deposit.

Melting of ice in other preglacial strike valleys more narrow than that containing Big Swamp gave rise to ponds in which deposits such as those southeast of Marshbrook (53 and 54) were formed in Lackawanna County. Peat is thickest near the steep bedrock walls and thinner over the gently sloping valley walls of glacial drift.

Examples of deposits chiefly on fluvioglacial outwash in the class A2 setting are half a mile southwest of Factoryville, Wyoming County (48); 0.7 mile east of East Lenox, 1.3 mile northeast of Lenox, and 0.4 mile southeast of Loomis Lake in Susquehanna County (16, 8, and 9); and 0.7 mile northeast of Behren Pond in Luzerne County (122). Peat is generally so thin in these shallow depressions as to be of little commercial value.

Of the 21 peat deposits in class A2 geologic settings, seven contained only very shallow peat or peat of obviously poor quality. Only five of the deposits from which samples were analyzed contained peat with 15 percent or less ash, with medium to high water-holding capacity, and with fiber types I and II. Peat in the

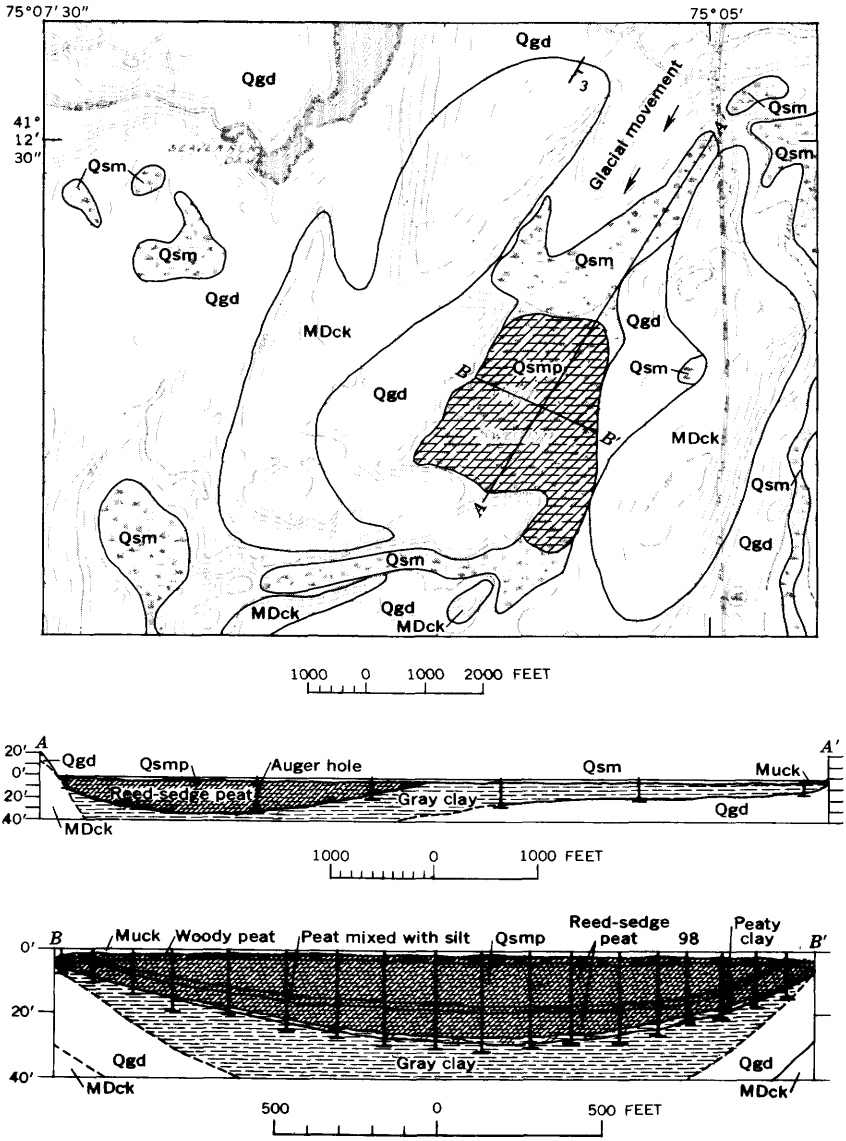


FIGURE 7.—Plan and cross section of typical peat deposit in class A2 geologic setting, Big Swamp, Twelvemile Pond quadrangle, Pike County (98 in fig. 2 and table 1). The depression containing the exploitable body of peat (Qsmp) is a trough in bedrock (MDck) of the Catskill Formation (Devonian and Mississippian) partly mantled and closed with glacial drift (Qgd). Peat is too thin to mine or too low in grade in the part of the swamp designated Qsm.

remaining nine deposits had greater ash content, medium to low water-holding capacity, and fiber types II and III.

Those deposits having peat with low ash content are generally in deep bedrock troughs mantled by glacial till, whereas the peat deposits containing more ash tend to be in shallower bedrock troughs mantled by glacial outwash. The deeper troughs are less subject to water-table fluctuation, and peats in such sites are therefore less decomposed than in the shallower troughs.

The bedrock walls of the depressions in geologic settings of class A2 typically are parts of preglacial valleys parallel to the regional strike of the beds and folds. These valleys have been modified by glacial events and are both dammed and mantled by glacial deposits. Typically, such sites are also along the modern drainage system and consequently are subject to occasional flooding, and the peat therefore contains more ash. Also, the sites are more subject to water-table fluctuations, with accompanying decomposition of peat fibers.

CLASS A3, DEPRESSION IN BEDROCK CLOSED BY UNCONSOLIDATED MATERIAL

The depressions in class A3 geologic settings of peat deposits are associated with less glacial material, either till or outwash, than the other classes. Of the 136 deposits studied, 37 were in bedrock depressions with glacial material irregularly distributed about the upper part of the basin or concentrated along the lower edge. Many of the depressions occupy the sites of small isolated valley-head glaciers or ice fields and probably formed in the waning stages of glaciation as the broad ice sheet retreated. Other depressions that are not associated with well-defined preglacial valleys were scoured by actively moving ice in areas of less resistant bedrock. Still another group includes the depressions created by the scouring action of debris-laden melt-water streams where they flowed across preglacial bedrock upland areas at or near the glacial margins.

The swamp adjacent to Robinson Lake, Susquehanna County, contains a peat deposit in a basin typical of the class A3 setting (fig. 8). Bedrock in this area is nearly horizontal but has well-defined jointing. Glacial movement towards the southwest scoured a site that during glacial retreat was the site of an ice field and subsequently became the headwaters of a small drainage. The swamp is retained by a dam of glacial drift at its southern end. Jointing in the bedrock in this typical deposit facilitated quarrying by the glacier. Bedrock may be very near the surface as shown in figure 8 by the shallow swamp deposit in a part of profile *A–A′*.

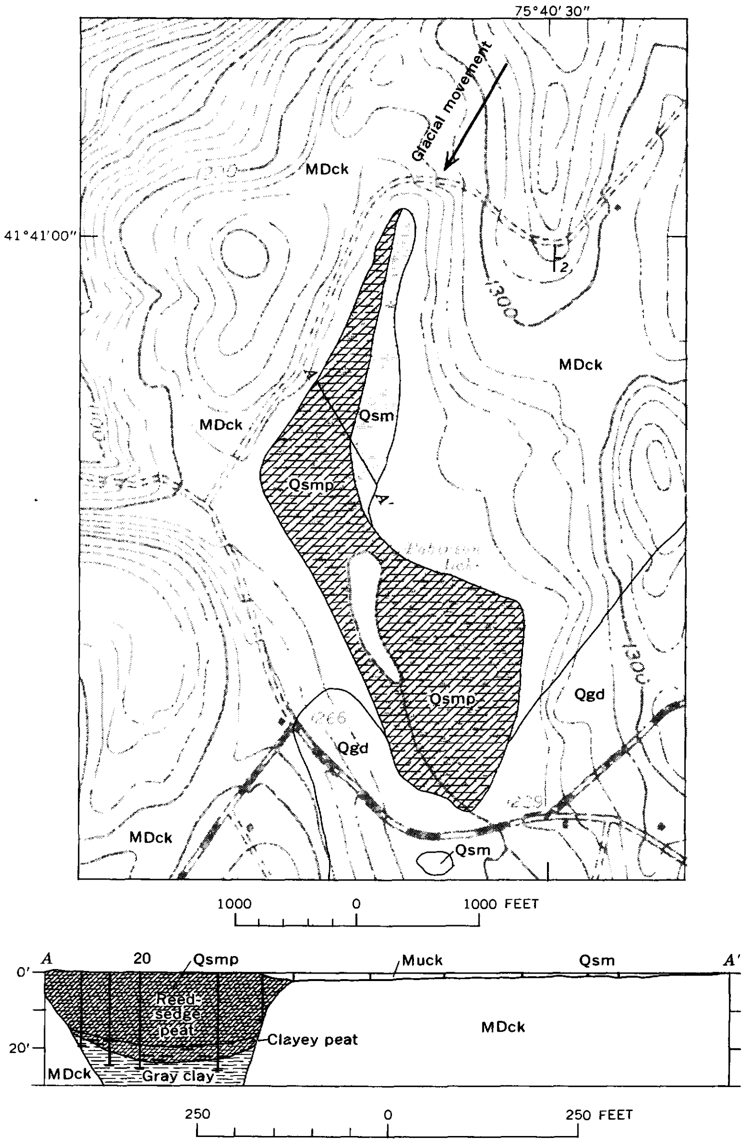


FIGURE 8.—Plan and cross section of typical peat deposit in class A3 geologic setting, swamp adjacent to Robinson Lake, Lenoxville quadrangle, Susquehanna County (20 in fig. 2 and table 1). The exploitable body of peat (Qsmp) is in the deepest part of the depression in bedrock (MDck) of the Catskill Formation (Devonian and Mississippian) closed by glacial drift (Qgd). Peat is too thin to mine in the part of the swamp designated Qsm.

In other deposits of this type, the bedrock may be deep as shown by depressions containing deposits northwest of Kochners Corners (60), Lackawanna County; Broadbent Swamp (47), Wyoming County; and Tamarack Swamp (21) and on Hickory Ridge (4) in Susquehanna County. Peat in these deposits averages 18 feet in thickness.

Peat samples from 26 of the 37 class A3 deposits were analyzed. Eleven deposits were too small to justify analysis. The analyses show 12 deposits with ash content less than 15 percent, medium to high water-holding capacity, and fiber belonging to type II. The remaining 14 deposits are characterized by ash content of 15–65 percent, low to medium water-holding capacity, and fiber belonging to types II and III.

Nineteen of the class A3 deposits analyzed have effective sediment-contributing areas in their drainage basins that are not more than 10 times as large as the swamp or marsh containing the deposit. The lowest ratios of effective sediment-contributing areas to swamp or marsh area generally correlate with the group of deposits having an ash content of less than 15 percent.

Geologic conditions most favorable to development of peat with low ash content and little fiber disintegration are those associated with (1) ice erosion at the heads of preglacial valleys through quarrying along joint planes and (2) ablation by lingering valley glaciers after melting of the ice cap.

The quality of peat in the deposits in Class A3 geologic settings are generally only moderate, but individual deposits may exhibit extremes in quality, with the deeper depressions tending to have higher quality peats. Other terrane factors show an equally large range in these deposits, because bedrock walls may slope gently or steeply, the glacial dam and adjacent debris may have furnished little or much sediment to the accumulating peat, and the depression may or may not be along modern drainage and thus subject to flooding and inwash of sediment.

CLASS B1, DEPRESSION IN UNCONSOLIDATED MATERIAL CLOSED BY BEDROCK

Eighteen of the 136 deposits traversed are listed in the class B1 setting (table 1), characterized by depressions formed in glacial drift resting against a bedrock hill that is not associated with a well-defined preglacial valley system. Bedrock forms only one part of the sides of the depression. Glacial drift is much more prevalent in class B1 settings than in class A settings. All the deposits in the class B1 settings are at relatively high elevations and north of the

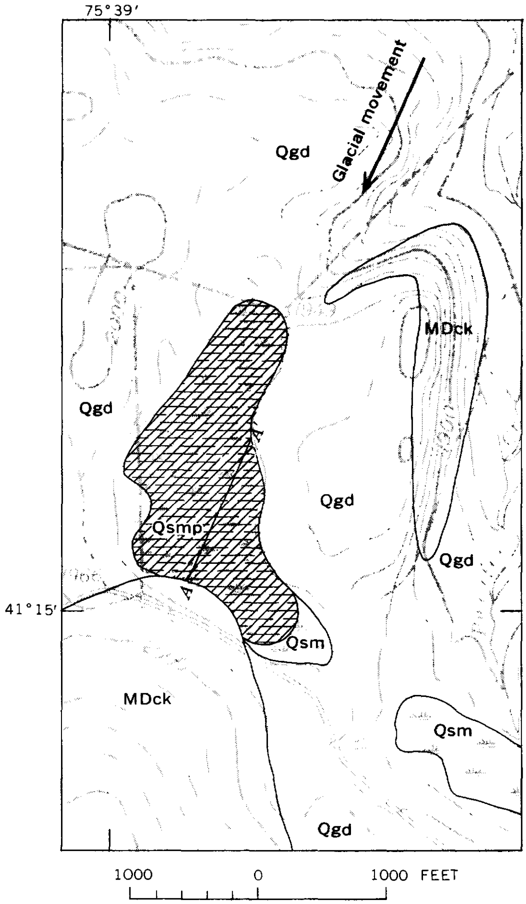
Allegheny topographic front. Some of the deposits are in till deposited in the lee of bedrock barriers to glacial movement; others are in till pushed against bedrock barriers such as the swamp southeast of Big Shiney Mountain, Lackawanna County (fig. 9).

Peat samples from 12 of the 18 deposits were analyzed. The remaining six had too little peat or the peat was too silty to justify analysis. Analyses show that half of the 12 samples have ash content of less than 15 percent, fiber belonging to type II, and fair water-holding capacity. The remaining six samples have an ash content between 15 and 41 percent fiber belonging to type II and III and lower water-holding capacity. Seven of the deposits are in drainage basins that have an effective sediment-contributing area of not more than 10 times the size of the swamp or marsh containing the peat. Ash content higher than that in deposits of class A1 settings is attributed to clay washed into the peat-forming environment from the adjacent till.

CLASS B2, DEPRESSION COMPLETELY WITHIN UNCONSOLIDATED MATERIAL

Twenty-one of the 136 deposits traversed are listed in class B2 settings (table 1), characterized by depressions caused by the stagnation of glacial ice blocks in till that completely buries the bedrock topography. Nebo Swamp (fig. 10) contains a peat deposit typical of those in class B2 settings. Peat samples from 12 of the 21 deposits were analyzed. The remaining nine deposits were too small or too silty to justify analysis. Only five samples have ash content less than 10 percent; the remaining seven have ash content ranging from 30 to 55 percent. Samples in the low-ash-content group have medium to high water-holding capacity and type II fiber; whereas those in the high-ash-content group have medium to low water-holding capacity and type III fiber. Seven of the deposits are in drainage basins that have an effective sediment-contributing area of not more than 10 times the size of the swamp or marsh containing the peat.

FIGURE 9.—Plan and cross section of typical peat deposit in class B1 geologic setting. This swamp contains a vestigial pond southeast of Big Shiney Mountain, Avoca and Pleasant View Summit quadrangles, Lackawanna County (84 in fig. 2 and table 1). The depression containing the exploitable body of peat is in glacial drift (Qgd) closed on one side by bedrock (MDck) of the Catskill Formation (Devonian and Mississippian). The peat deposit (Qsmp) is in the process of development as shown by zoned vegetation.


75°39′
Glacial movement
Qgd
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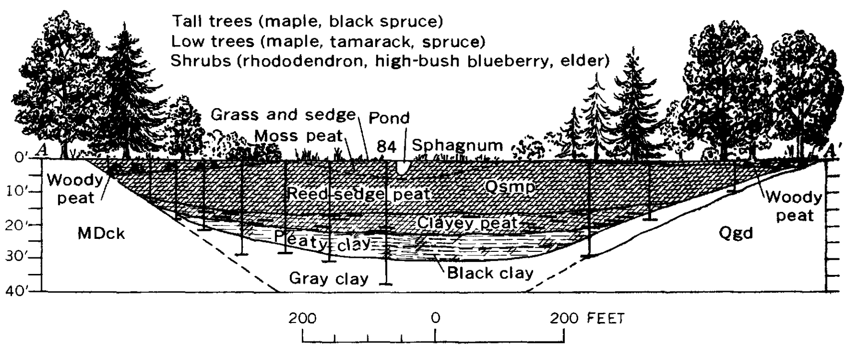
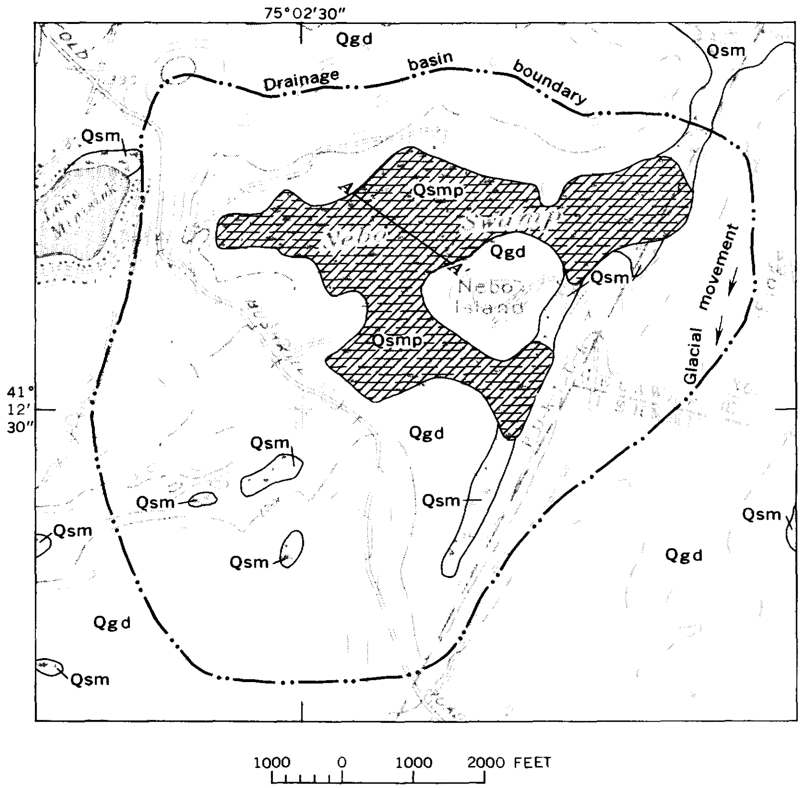
0
1000 FEET


Tall trees (maple, black spruce)
Low trees (maple, tamarack, spruce)
Shrubs (rhododendron, high-bush blueberry, elder)
Grass and sedge
Pond
Moss peat
84
Sphagnum
A
A′
0′
10′
20′
30′
40′
Woody peat
Reed sedge peat
Qsmp
Woody peat
MDck
Clayey peat
Qgd
Peaty clay
Gray clay
Black clay
200
0
200 FEET



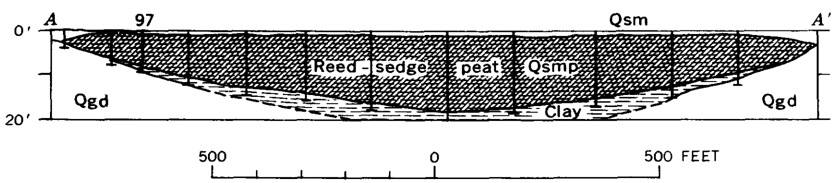


FIGURE 10.—Plan and cross section of typical peat deposit in class B2 geologic setting, Nebo Swamp, Twelvemile Pond quadrangle, Pike County (97 in fig. 2 and table 1). Bedrock within the drainage basin is completely covered by glacial drift (Qgd) and swamp and marsh deposits (Qsm). An appreciable body of peat is delineated as Qsmp.

The degree of water-table fluctuation has been much less in the group of deposits with low ash content. Tims Swamp (136) in Monroe County and Nebo Swamp (97) in Pike County are without outlets which may facilitate water-table instability; a pond at the outlet of the deposit northwest of Loyalville (104) in Luzerne County has helped to maintain a high water table; Robert Swamp (1) in Susquehanna County is spring fed and has an outlet stream with a very gentle gradient for about 800 feet after leaving the swamp, a condition favoring water-table stability. The deposit 1 mile northwest of White Pond (2) in Susquehanna County is similar to Robert Swamp, but the outlet stream has a steeper gradient after it leaves the swamp; the ash content is higher than in the Robert Swamp deposit, presumably due to greater decomposition of the peat during periods of lowered water table.

Deposits in the group with high ash content have histories of artificial and natural ponding and artificial and natural draining, and some deposits show evidence of having been burned over.

Ash content is higher and fiber disintegration greater in class B2 settings than in any of the other classes of settings in which deposits are of comparable size. This is explained by the washing in of clay from the adjacent margins of the depression within a drift mantle that covers the preglacial bedrock topography, and slow accumulation of peat-forming vegetation in a saucer-shaped depression which permits a greater amount of weathering than in a deep steep-sided depression.

RELATION OF QUANTITY AND QUALITY OF PEAT TO CLASSES OF GEOLOGIC SETTINGS

QUANTITY RELATIONSHIP

Distribution of peat deposits by area, thickness, and geologic setting classification is shown in figure 11 for the deposits containing 10,000 or more short tons of air-dried peat. Of these, 34 are in class A1, 29 in class A3, 15 in class A2, and 12 each in classes B1 and B2. Class A1 deposits have the widest range of area and thickness, followed in order by classes A2, A3, B1, and B2.

Total resources of peat in all 136 deposits that were studied amount to 8,100,000 short tons of air-dried peat. The 39 deposits in class A1 contain 32 percent of the total tonnage and, in decreasing order of total tonnage, 37 peat deposits are classed as A3, 21 as A2, 21 as B2, and 18 as B1.

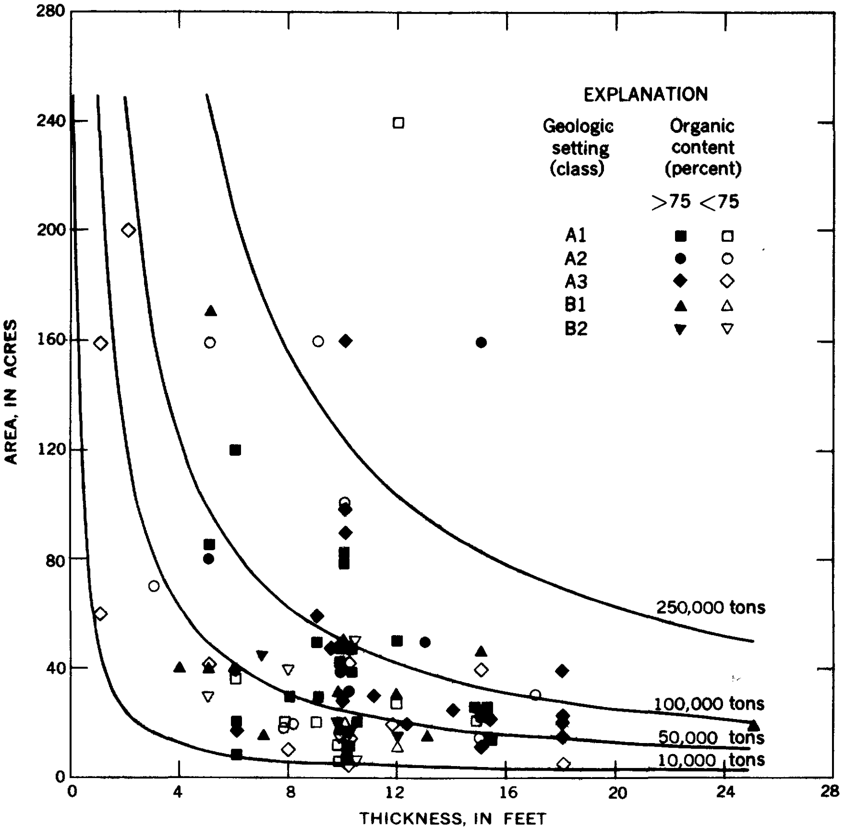


FIGURE 11.—Area, thickness, geologic setting, and organic content of selected peat deposits in northeastern Pennsylvania. Estimated tonnage curves were based on 200 tons of air-dried peat per acre foot.

QUALITY RELATIONSHIP

The 95 deposits that were sampled are estimated to contain 7,800,000 short tons of air-dried peat. Figure 12 shows that the deposits in class A1 have higher organic content (lower ash content), higher water-holding capacity, and a greater frequency of type II fiber than any of the other classes of geologic settings. Three-fourths of the deposits in class A1 have an organic content of more than 85 percent, whereas not more than half of the deposits in the other classes have as high organic content.

The amount of fiber decomposition increases generally as the amount of ash increases. Class A1 deposits have the lowest percentage of type III, followed in order by classes B1, A3, and A2 deposits. Class B2 deposits have the highest percentage of type III fibers. Class A1 deposits have the greatest percentage with ash

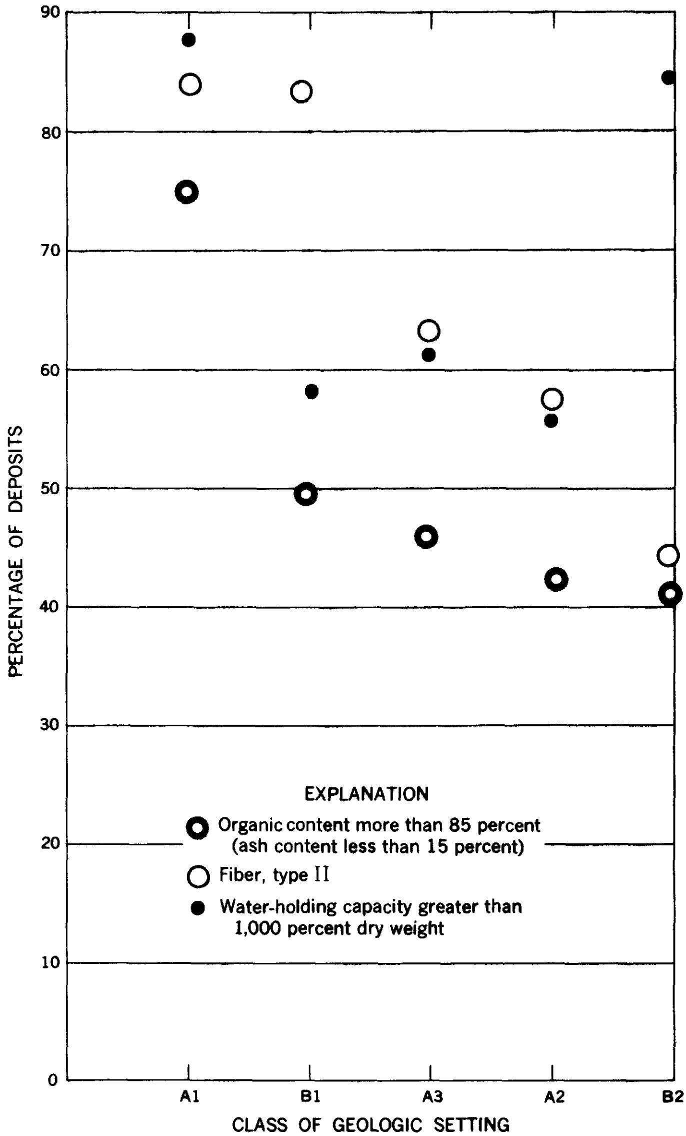


FIGURE 12.—Quality of peat in each class of geologic setting based on analyses of samples from 95 deposits.

content less than 15 percent, followed in similar order by classes B1, A3, and A2 through class B2 which has the lowest percentage of deposits with ash content less than 15 percent.

Water-holding capacity is high in each of the five classes. More than half of the deposits in classes B1, A3, and A2 and from between 80 to 90 percent of the deposits in classes A1 and B2 are able to absorb more than 10 times their dry weight of water.

All the deposits in classes A2 and B1 are low in acidity (pH 5.0–7.0) as are 96 percent of the deposits in class A3. Four percent of the class A3 deposits are more acidic (pH 4.2–5.0) ; 94 percent of the deposits in Class A1 and 85 percent of the deposits in Class B2 are low in acidity.

ENGINEERING ASPECTS OF PEAT

Many peat deposits are worthy of exploitation as an economic commodity, but others may well deserve preservation as vital to regional hydrologic economy. Movement of water through peat, shrinkage of peat, and the permeability and stability of the foundation on which peat deposits rest are engineering aspects that should be considered in utilization of the northeastern Pennsylvania peat deposits.

MOVEMENT OF WATER THROUGH PEAT

Studies have not been made of the rate of water movement through the Pennsylvania peat deposits. Most of the samples that were tested contained 85–95 percent water as received and had water-holding capacities that generally exceeded 1,000 percent. This high content of water held by adsorption and capillarity in the peat indicates that rate of water transfer through the deposit is likely to be very slow. Varying textures of the peat, looseness or compaction, or depth and degree of decomposition make application of data from one area to another, or from one type of peat to another, hazardous; however a general idea of transmissibility may be taken from the work of Clayton, Neller, and Allison (1942). These men have shown that the rates of seepage downward through Everglades peat range greatly from 0.3 foot per day through the top 18 inches to 27.3 feet per day through the layers from 18 to 36 inches below the surface. Horizontal transmission was 27.3 feet per day at a depth of 3 feet where the peat contained more than 82 percent water.

WATER TRANSFER BETWEEN PEAT DEPOSIT AND COUNTRY ROCK

Transfer of water between peat and the material composing the sides of the depression is limited in many peat deposits. The area of transmissibility lies above the relatively impermeable clay and clayey peat that underlies the peat and below the relatively impermeable weathered muck at the surface of the peat. The peat profiles of deposits shown in profile in figures 6 and 8 show wide areas in which water can pass back and forth between the peat and the country rock. Those shown in figures 7 and 9 show small areas in which water transfer can take place; whereas the deposit in figure 10 is effectively sealed by clay and muck. Generally impermeable sediments beneath peat are more widespread over glacial drift than over bedrock. It follows, therefore, that peat deposits in geologic settings A3 and A1 are more favorable to water transfer because of the greater area of bedrock adjacent to peat deposits. Geologic settings A2 and B1 are less favorable as only one side is adjacent to the peat deposit, and geologic setting B2 is not favorable because impermeable clay and clayey peat lines the depression containing the peat deposit.

PEAT DEPOSIT SUBSIDENCE

When a peat bog is fully or partly drained, two groups of processes set in: (1) The peat is compacted physically, and (2) increased aeration results in aerobic decomposition of some of the organic constituents. The combined processes cause the organic colloids that make up the major part of the peat to undergo a considerable amount of shrinking and consequent subsidence. One of the oldest records of peat subsidence concerning the Fenland deposits of Great Britain was summarized by Okey (1918). In 1848, a graduated iron column was sunk into the Fenland peat bog and anchored in the underlying clay, so that the top of the column was level with the surface of the bog in which the peat was 18 feet thick before drainage of the bog was started. By 1870 a subsidence of 7 feet 8 inches had been recorded, which had increased to 7 feet 9 inches by 1875. Pumps were then installed to remove excess surface water, a procedure necessitated by the extensive subsidence. The continued lowering of the water table resulted in a further subsidence. In 1913 after 65 years had elapsed since measurements started, subsidence of peat was 10 feet.

In the United States, studies of peat subsidence resulting from drainage show that peat deposits in southern Louisiana and Florida, ranging in depth from a few inches to 16 feet, subsided approximately 18 inches during 8 years. The studies also show that as the density of the surface peat layer increased, there was an increasing check to aeration and subsidence (Okey, 1918). Certain peat deposits in Oregon, with an initial thickness of 7 feet, subsided 18 inches in 10 years as the result of drainage and cultivation (Powers, 1932). In other Oregon localities, subsidence was about 2 feet in 20 years. In the design of drainage systems of peat areas, Powers (1932) has suggested an allowance for 33 percent subsidence of the peat. Subsidence of peat is greatest during the first years following drainage, the total amount depending upon the depth of the drainage canals, as well as on the depth and composition of the peat.

Smock (1893) reported that drainage of peat bogs in New Jersey resulted in long continued subsidence of the land, the amount varying with the depth and character of the peat deposit. He noted the following approximate subsidences for the period 1869–87: 3–3.5 feet at Hackensack Meadows; 2.5–3 feet at Cohansey, Cumberland County; about 1 foot at Mays Landing; and 3.5–4.5 feet at Salem.

Clayton (1936), in the study of peat soils in Florida, found the rate of subsidence to be proportional to the depth of the deposit above the permanent water table, or to the total depth in those places where the water table is below the bottom of the deposit.

An example of destruction of peat caused by drainage may be seen in the southwestern corner of the area covered in this report. Soper and Osbon (1922) described a deposit near the town of Espy in the Susquehanna River valley as consisting of 160 acres of peat that ranged from 3 to 10 feet in thickness and contained an estimated 216,000 short tons of air-dried peat. All but about 15 acres was drained during the course of cultural development near Epsy, and in the drained area, the shallow peat was converted to muck by 1944.

PEAT DEPOSIT DRAINAGE

Saturated peat has a low bearing strength. As the level of the water table is at or near the surface in all deposits that were studied, the saturated condition poses access problems to mining operation vehicles. Although operational roads and buildings may be constructed on firm ground at the margin of deposits, vehicular access to the peat can be effectively attained only through drainage of the deposits. Drainage information, stream gradient data, and slope percentages of nearby areas are given for a number of deposits in table 3.

Generally, artificial drainage is easiest to establish in class A1 and B1 deposits. The relief between the surface of these deposits and adjacent valleys usually is sufficient to permit mining the entire thickness of peat. On the other hand, deposits in class A2 and many in A3 lie in larger valleys near or cut by principal streams, where gradient sufficient for artificial drainage is more difficult to achieve. Peat deposits in class B2 are the most difficult to drain because of low regional relief.

ECONOMIC GEOLOGY

RESERVES AND RESOURCES OF PEAT IN THE AREA OF STUDY

Peat is produced at nine localities in northeastern Pennsylvania (fig. 2). Most of the peat is of reed-sedge and humus type, but moss peat is produced near Stillwater, Columbia County; near White Haven, Luzerne County; and in Pike County northeast of Skytop. At these localities, areas being mined range from 2 to 500 acres, and the thickness of peat from 1 to 40 feet (Cameron, 1968). The peat deposits aggregate about 1,270 acres, and the average thickness of peat is at least 10 feet. A conservative reserve estimate of 2,500,000 short tons of air-dried peat may be calculated for the aggregate area of these mine operations.

To the foregoing estimate may be added the 8,100,000 short tons of air-dried peat calculated to be in the 136 deposits that were studied. Most of this tonnage is of reed-sedge type, although some moss peat chiefly in Luzerne and Pike Counties is included in the estimate.

Additional resources of peat have been estimated for the deposits which were known to occur in the area of study but which were not examined in the field. Estimates for these deposits have been compiled through studies of topographic and geologic maps and of aerial photographs.

These additional resources are scattered throughout the area in 55 swamps and marshes that are probably underlain by peat deposits. The peat deposits are in the same classes of geologic setting as are the deposits that were studied. Also, the peat in these deposits is probably similar in physical and analytical characteristics to that in deposits that were studied. The deposits range from 10 to 120 acres in size and are assumed to range from 5 to 10 feet in thickness. Aggregate size of the deposits is about 1,800 acres. At an average thickness of 7 feet, they are estimated to contain about 2,500,000 short tons of air-dried peat, the organic content of which should exceed 75 percent. Total peat resources of the study area are estimated to be more than 13 million tons.

PEAT MINING IN NORTHEASTERN PENNSYLVANIA

The United States produced 611,085 short tons of air-dried peat in 1966 at 144 plants and sold 605,858 tons for a total of $6,501,281 at an average price of $10.73 per short ton. (U.S.

Bureau of Mines, 1967). Pennsylvania ranked second in the nation with production of 49,912 tons and commercial sales of 52,912 tons valued at $561,521, averaging $10.61 per short ton of air-dried peat. Most of the peat, which is reed-sedge and humus, is sold in bulk and package. Minor amounts of moss peat are sold.

The center of the peat industry is in Luzerne, Lackawanna, and Monroe Counties (fig. 2, mines a–i). Size of the deposits ranges from 2 acres to 500 acres, and individual operations are chiefly small. Compared with the cost for mining of other mineral commodities, the investment cost for peat mining is low. A typical operation requires about $90,000 for purchase of excavating and hauling equipment and $20,000 for plant 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 diging 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 (5) sieving the peat to remove wood, shredding it, and bagging it or storing it in bulk for sale.

Variations of mining methods have been adopted for deposits difficult to drain or by preference of the producer.

SUGGESTIONS FOR PEAT EXPLORATION

Northeastern Pennsylvania is well suited for production of reed-sedge peat, moss peat, and humus. Vegetation, climate, and geologic environment have favored formation of numerous deposits, generally at elevations greater than 1,000 feet above sea level. The search for deposits of better quality peat in northeastern Pennsylvania can be guided by considering factors that cause silt and clay to be brought in to the deposit and factors that cause decomposition within the deposit once it has formed.

Peat with the least ash and the highest organic content tends to occur in swamps and marshes that are not along the main drainage of silt-laden streams subject to flood overflow, nor along former stream courses now diverted elsewhere by stream piracy. The better quality peat deposits tend to occur in drainage basins with effective sediment-producing areas not more than 10 times as large as the size of the swamp or marsh. The nature of the materials forming the steeper slopes surrounding the drainage basin, as well as the nature of the materials along drainage courses into and walling the depression, also strongly influence potential sedimentation.

Peat deposits with minimum decomposition tend to be in a swamp or marsh in which water table fluctuation has been slight. Such swamps and marshes may be recognized by (a) absence of outlet streams, (b) outlet streams flowing over bedrock not easily eroded during breaching of dams, (c) outlet streams with very low gradients for a distance of several hundred feet after leaving the swamp or marsh, and (d) ponds within the swamp or marsh, especially near the outlet, which cannot be easily drained or enlarged by construction of dams.

Deposits in swamps and marshes less than an acre or two in size tend to have high ash content regardless of thickness, whereas deposits 3 feet or less in thickness tend to have high ash content regardless of areal extent. A swamp or marsh that is in a depression entirely or partly composed of glacial outwash is apt to have a shallow peat deposit. The thickest peat with highest organic content tends to lie adjacent to steep bedrock walls and decreases in thickness and organic content toward the direction of glacial drift.

In northeastern Pennsylvania the limits of the peat deposits commonly may be recognized by the contact between several species of blueberries (*Vaccinium*), the low-bush species are common to the slopes of the drainage basin, and the high-bush species are common to the vegetation cover of the peat deposits.

Human activities may adversely affect peat deposits and decrease their value; for example, (1) burning over a swamp for the raising of blueberries or to drive out game animals during the season of lowest water table, (2) long delay in exploitation following drainage of the peat deposit, and (3) creation of dams for industrial, agricultural, or recreational use with ensuing backwater silting.

OUTLOOK FOR THE AREA

Northeastern Pennsylvania is readily accessible to major metropolitan areas along the Atlantic seaboard, in which there is a good market for peat products. The Pennsylvania deposits are at higher elevations, and most of them are easily drained, in contrast to deposits in coastal areas, where drainage is a severe problem. The relatively small size of the deposits and the fact that most of them are underlain by firm bedrock or glacial till facilitates mine excavation and hauling. These factors, plus the number of available peat deposits, of which 196 are estimated to contain an aggregate of more than 13 million tons of peat, mostly of a quality adequate to meet Federal Trade Commission regulations, give an optimistic outlook to peat production.

On the other hand, relatively small peat producers of northeastern Pennsylvania must sell their product in competition with larger out-of-State producers. All domestic 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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TABLES 1–3

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				SUSQUEHANNA COUNTY				
				Auburn Center quadrangle				
1	Roberts Swamp	15	12	White pine, aspen, and maple forest.	Center of swamp: Muck (0–1). Reed-sedge peat (1–14). Pebbly blue-gray clay (14–16). Gravel (16+).	3	5.0	B2
2	1.0 mile northwest of White Pond.	20	10	Elm, ash, maple, hemlock, and yellow birch forest.	Center of swamp: Muck (0–2). Reed-sedge peat and some wood (2–14). Peaty clay (14–20). Light-blue-gray clay (20–22+).	5	17.0	B2
				Hopbottom quadrangle				
3	1.4 miles northwest of Hopbottom.	20	8	Maple, elm, and hemlock forest; partly cleared.	Center of swamp: Muck (0–1). Dark reed-sedge peat (1–12). Clayey peat (12–17). Gray clay with thick beds of black greasy-textured clay (17–21). **Gray, clay, slightly sandy (21–24).**	7–9	19.0	A1

Lenoxville quandrangle							
4---1.7 miles west of Oak Knob on Hickory Ridge.	5	18	Yellow birch, maple, and hemlock trees; high-bush blueberry common.	Center of swamp: Muck (0–1). Reed-sedge peat (1–17). Reed-sedge peat, slightly clayey (17–21). Gray clay (21–25+).	7–9	6.0	A3
5---0.3 mile east-northeast of crest of Morgan Hill.	15	1	Pond recently made by beaver; dead trees include hemlock and yellow birch.	150 ft west of center of east edge of swamp: Water and mud (0–2). Reed-sedge peat (2–3). Blue-gray clay (3–5+).	----	----	A1
6---0.95 mile northwest of Harding Corners.	5	6	Cattail, alder, and small bushes.	Center of northwest edge of small pond: Muck (0–0.5). Reed-sedge peat (0.5–8). Clayey peat (8–10). Fine sand (10+).	----	----	A1
7---0.25 mile north of Acre Pond.	6	5	Alder thicket ----------	South center of swamp: Muck (0–1.5). Reed-sedge peat with wood and sandy layers (1.5–6). Fine sand and peaty clay (6–8). Clayey peat (8–9). Blue-gray clay (9–10+).	----	----	A1
8---1.3 miles northeast of Lenox.	12	0	Hemlock, white pine, and maple adjacent to small patches of cattail.	Center of swamp: Muck (0–1). Peaty clay (1–2). Light-blue soft clay (2–14). Silty sand (14+).	----	----	A2

See footnotes at end of table.

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				SUSQUEHANNA COUNTY—Continued				
				Lenoxville quadrangle—Continued				
9	0.4 mile southeast of Loomis Lake.	45	0	Pond created by man-made dam; used for recreation.	Northeast center of pond 500 ft from north inlet: Water (0–4). Gray silty clay (4–5).	----	----	A2
10	0.9 mile east of Oakley.	2	0	Mud, grass, shrubs (pond shown on map is dry).	Center of depression: Clay and silt (0–0.5). Till (0.5+).	----	----	B2
11	0.7 mile northwest of Acre Pond.	13	0	Cattail marsh	Center of marsh: Sandy silt (0–1.5). Fine sand (1.5–2). Wood mixed with clay (2–5). Till (5+).	----	----	B2
12	0.5 mile west of Acre Pond.	3	4	Elm, maple, and hemlock forest with high-bush blueberry and willow at edge of swamp.	Center of swamp: Silt and muck (0–2). Reed-sedge peat and wood (2–7). Clayey peat (7–16.5). Light-blue-gray clay (16.5–17+).	----	----	A1
13	0.5 mile northeast of West Lenox.	15	10	Pond, created by man-made dam, used for recreation.	100 ft north of inlet in center of pond: Water (0–4). Reed-sedge peat (4–16). Silty sand (16+).	----	----	A3
14	0.8 mile south of West Lenox.	1	4	Maple-ash forest	Center of swamp: Muck (0–1). Reed-sedge peat (1–5).	----	----	A1

				Gray clay (5–10). Peaty Clay (10–15). Sandy Clay (15+).			
15___0.7 mile northeast of crest of Jeffers Hill.	10	0	Pond. Many dead trees indicate recent flooding.	Center of pond: Water (0–0.5). Blue-gray clay (0.5–4). Sand and gravel (4+).	----	----	B2
16___0.7 mile east of East Lenox.	15	0	Highbush blueberry and alder thickets.	Center of swamp: Clay (0–1). Sandstone (1+).	----	----	A2
17___1.4 mile west of Oak Knob.	5	10	Maple, white pine, and yellow birch forest.	Center of swamp: Muck (0–4). Reed-sedge (4–14). Brown peaty clay (14–18). Black clay, soapy texture (18–25). Light-blue-gray clay (25–30+).	----	----	A1
18___At Hartley Pond____	20	12	Trees and shrubs killed by flooding.	Center of southwest edge near pond margin: Water (0–1). Muck (1–2). Reed-sedge peat (2–13). Peaty clay (13–15). Light-blue-gray clay (15–17+).	9	6.7	A3
19___At west side of abandoned Mount View airport.	12	8	Grass, sedge, and low shrubs bordered by willow, alder, and quaking aspen.	Center of marsh: Sphagnum moss, roots, and muck (0–1). Dark rust-colored peat, some wood (1–5). Yellow-brown reed-sedge peat (5–11). Light-gray clay containing silt, sand, and gravel (11–13+).	5	4.5	B2

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				SUSQUEHANNA COUNTY—Continued				
				Lenoxville quadrangle—Continued				
20	At Robinson Lake	90	10	Ash, hemlock, and yellow birch; shrubs include wild azalea.	125 ft east of center of west edge of swamp, north of Robinson Lake: Muck (0–1). Reed-sedge peat (1–18). Peaty clay (18–22). Clay (22+).	5–9	5.5	A3
21	Tamarack Swamp	20	18	Hemlock, yellow birch, maple forest; rhododendron belt begins about 300 ft from margin of bog and spreads towards center.	Center of swamp: Muck (0–1). Reed-sedge peat (1–21). Peaty clay (21–23). Clayey peat and peaty clay (23–26). Light-gray sandy clay (36+).	10	18.0	A3
22	At Tea Pond	20	12	Sphagnum moss with pitcher plants; few low shrubs.	East-southeast edge of pond. Sphagnum moss over reed-sedge peat (0–15). Black muck (15–23). Light-gray clay, soft (23–29). Compact gray clay and fine sand (29+).	7–9	5.0	A3
23	1.5 miles west of Hartley Pond.	15	15	Pond with dead trees; water level raised by beaver dam.	200 ft from center of east edge of pond: Muck and water (0–1). Reed-sedge peat (1–17).	----	----	A2

				Clayey peat (17–24). **Black clay; soapy texture (24–29).** Gray clay, soft (29–30). Gray clay, compact (30+).			
24___0.65 mile east of Hartley Pond.	10	8	Pond with dead trees caused by artificial dam.	225 ft south of north edge of pond: Water (0–4). Clay (4–5). Reed-sedge peat (5–13). Blue-gray clay (13–14). Sandy silt (14+).	----	----	A3
Clifford quadrangle							
25___0.85 mile west of North Knob.	40	10	Pond covers most of swamp.	200 ft west of center of swamp: Water (0–2). Woody muck (2–3). Reed-sedge and woody peat, partly decomposed (3–10). Reed-sedge peat with a little clay, gray brown with green cast (10–14). Peaty clay (14–15). Peat and green clay, layered (15–28+).	11	8.0	A3
WAYNE COUNTY **Forest City quadrangle**							
26___0.4 mile south of White Oak Pond.	30	8	Tall forest of maple, hemlock, and white pine; rhododendron. Tamarack-bordered marsh near Mud Pond.	South center of swamp: Reed-sedge peat (0–12). Peaty clay (12–13). Gray clay (13+).	5–9	6.0	A1

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				WAYNE COUNTY—Continued **Aldenville quadrangle**				
27	1.4 miles northwest of Miller Pond.	15	7	Water, dead trees, and shrubs as result of ponding by beaver.	200 ft west of center of east edge of swamp: Water and muck (0–1). Reed-sedge peat; some wood layers (1–7). Peaty clay (7–8). Gray clay (8+).	5	2.8	B1
28	0.8 mile north of Miller Pond.	20	10	Water and dead trees as result of artificial ponding.	South center of swamp: Water and muck (0–4). Woody peat (4–9). Reed-sedge peat (9–16). Peaty clay (16–18). Gray clay, gravel (18–22+).	9–13	13.3	B1
29	0.5 mile southeast of Miller Pond.	15	10	Alder, maple, yellow birch, and ash.	Center of swamp: Muck (0–1). Woody peat (1–5). Reed-sedge peat (5–12). Peaty clay (12–14). Clayey peat (14–18). Soft gray clay (18–26.5). Clay (26.5+).	9	11	B2
30	Southeast of Mud Pond.	80	5	Tall forest of maple, white pine, and hemlock; rhododendron.	Center of swamp: Muck (0–1). Reed-sedge peat (1–21). Peaty clay (21–22). Light-gray clay (22+).	5–9	3.3	A2

31...East of Glass Pond 3	50	10	Dense growth of rhododendron; maple and hemlock; water and dead trees in south part.	200 ft from west edge of swamp and 1,500 ft from north outlet: Muck (0–1). Reed-sedge peat (1–11). Peaty clay (11–12). Clay (12+).	5–6	7.0	A2
Waymart quadrangle							
32...0.75 mile north of South Clinton.	45	15	Tall maple forest; some spruce and white pine.	Center of swamp: Muck (0–1). Reed-sedge peat, woody layers (1–20). Clayey peat (20–24). Peaty clay (24–30). Pink clay (30–33+).	13	10.0	B1
33...Just north of South Canaan.	50	10	Forest of yellow birch, maple, and ash.	Center of south end of swamp: Muck (0–1). Woody Peat (1–5). Reed-sedge peat (5–12). Clayey peat (12–18). Peaty Clay (18–20). Gray clay (20–21.5+).	9	6.1	B1
Honesdale quadrangle							
34...Bear Swamp	80	10	Forest of maple, yellow birch, and ash.	Center of swamp: Muck (0–1). Reed-sedge peat (1–10). Peaty clay (10–11). Compact gray clay (11–12).	5–9	4.0	A1

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				WAYNE COUNTY—Continued **Lake Ariel quadrangle**				
35	0.9 mile south of Lake Ariel.	20	5	Swamp has been cleared of trees.	Center of swamp: Muck (0–0.5). Reed-sedge peat (0.5–17). Clayey peat (17–21). Gray clay (21–29).	5–6	8.0	A3
				Sterling quadrangle				
36	Thousand Acre Swamp	50	10	A tangle of rhododendron; high-bush blueberry, and viburnum; birch, maple, and tamarack are principle trees.	700 ft northwest of outlet: Reed-sedge peat (0–6). Bedrock (6+).	5	5.0	A1
37	1.0 mile southeast of Thousand Acre Swamp.	70	3	Sedge, grass, and low shrubs.	Center of marsh: Muck (0–0.5). Reed-sedge peat (0.5–3). Soft gray clay (3–17+).	5	5.4	A1
38	Big Sampson Swamp	85	5	Thick tangle of rhododendron, highbush blueberry, and viburnum; birch, maple, and tamarack are common trees.	Center of swamp: Muck (0–2). Reed-sedge peat (2–7). Gravel (7+).	3–5	3.3	A1

WYOMING COUNTY							
Jenningsville quadrangle							
39___On County line 0.3 mile southeast of Stowell Pond.	15	13	Dead trees, grass and sedge.	Center of marsh: Muck (0–1). Reed-sedge peat (1–16). Soft gray clay (16–17). Compact gray clay (17+).	3	9.5	B1
40___At head of Little Mehoopany Creek.	12	4	Dead trees and clearings.	Center of swamp: Black humus (0–2). Gray clay (2–4). Reed-sedge peat (4–9). Gray clay (9+).	5–6	22.3	A3
41___1.0 mile southeast of Stowell.	7	0	Alder and willow fringe, patch of cattail.	Center of marsh: Gray clay over till or bedrock (0–1+).	----	----	A3
Meshoppen quadrangle							
42___Head of Fox Hollow Creek.	45	0–1	Yellow birch, ash, maple, and hemlock forest.	Center of swamp: Silt, clay, and peat in thin layers (0–2). Reed-sedge peat (2–4). Black muck (4–5). Pink silty clay (5–6).	----	----	B1
Springville quadrangle							
43___0.8 mile west of Schlessers Corners.	30	12	White birch, ash, hemlock, black walnut, maple, aspen forest; alder and high-bush blueberry.	Center of swamp: Reed-sedge peat (0–17). Peaty clay (17–19). Soft blue-gray clay (19–21). Compact blue-gray clay (21+).	3	10.3	B1

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				WYOMING COUNTY—Continued				
				Hopbotton quadrangle				
44	Phelps Swamp	8	10	Cattail and low shrubs; trees mostly cleared.	Center of swamp: Muck (0–1). Reed-sedge peat with wood (1–13). Peat slightly decomposed (13–20). Peaty clay (20–27.5). Gray clay (27.5+).	7–9	8.5	A1
				Tunkhannock quadrangle				
45	Helman Swamp	18	25	Water and dead trees caused by beaver ponding.	Center of swamp: Water (0–1.5). Reed-sedge peat, woody (1.5–33). Peaty clay and gray clay (33–37+).	9–13	12.6	B1
				Factoryville quadrangle				
46	Stantontown Swamp	40	5	Hemlock and maple forest.	300 ft west of center of east edge of swamp against the steep hillside:	5	6.6	B1

				Muck (0–3). Reed-sedge peat (3–12). Peaty clay (12–13). Blue-gray clay (13+).			
47___Broadbent Swamp___	20	18	Hemlock, ash, yellow birch, white pine, maple, rhododendron.	200 ft west of center of east edge: Muck (0–0.6). Reed-sedge peat with wood (0.5–6). Reed-sedge peat (6–23). Peaty clay (23–29). Blue-gray clay (29–32).	3.5	6.7	A3
48___0.5 mile southwest of Factoryville.	12	0	Partly cleared of trees and shrubs.	Center of swamp: Peaty muck (0–2). Blue-gray clay (2+).	----	----	A2
49___0.5 mile north of Lake Sheridan.	18	6	Hemlock, ash, yellow birch, white pine, maple, rhododendron.	Center of swamp: Muck (0–1). Reed-sedge peat, slightly decomposed, with black clay (1–5). Reed-sedge peat with black clay near base (5–17). Black clay (17–19). Gray clay (19–20).	6	9.0	A3
Dutch Mountain quadrangle							
50___1.15 miles northeast of Crest of the Stack.	60	1	Thickets of high-bush blueberry at margin. Interior is open with scattered black spruce and small maple; sphagnum moss.	Center of marsh: Moss and reed-sedge peat (0–2). Peaty clay (2–4). Black clay (4–5).	----	----	A3

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				WYOMING COUNTY—Continued				
				Center Moreland quadrangle				
51	Along Marsh Creek south of Vernon.	80	10	Cattail and sedge; some maple and ash.	Center of swamp, 0.45 mile south of outlet: Muck (0–1). Reed-sedge peat (1–6). Reed-sedge peat with woody layer (6–9). Reed-sedge peat (9–15). Peaty clay (15–16). Soft blue-gray clay (16–17). Compact blue-gray clay (17+).	5	11.6	A1
52	0.75 mile north of Rymans Pond.	40	15	Yellow birch, maple, white pine, and hemlock.	Center of swamp, 0.45 mile south of outlet. Muck (0–1). Reed-sedge peat (5–15). Clayey peat (15–16). Light-gray clay (16–17). Very dark gray clay, soft (17–21). Compact gray clay (21–25+).	5	6.2	A3

LACKAWANNA COUNTY							
Lenoxville quadrangle							
53---0.1 mile southwest of Marshbrook.	18	10	Mostly dead birch and maple; cattails, bulrushes, and small shrubs.	Center of swamp, 500 ft southwest of outlet: Muck (0–3). Reed-sedge peat, woody layers (3–13). Peaty clay (13–15). Blue-gray clay (15–17).	5	12.5	A2
54---0.8 mile southwest of Marshbrook.	50	13	Dense forest of maple and hemlock.	Center of swamp: Muck (0–1). Reed-sedge peat (1–17). Peaty clay (17–20). Soft gray clay (20–21).	3	6.7	A2
55---0.65 mile southeast of Marshbrook.	9	6	White pine, yellow birch, and hemlock; high-bush blueberry a common shrub.	Center of swamp: Thick sphagnum moss (0–1). Reed-sedge peat (1–8). Gray clay (8–11). Sandy and gravely clay (11+).	5	2.0	A1
56---1.1 miles east-southeast of Marshbrook.	5	10	Tall maple and yellow birch forest; rhododendron.	Center of swamp: Muck (0–1). Reed-sedge peat (1–12). Gray clay (12–15).	7–9	5.0	A3
57---0.2 mile northeast of Finn Pond.	8	1	Deep woods of birch, hemlock, and maple; rhododendron throughout swamp.	Center of swamp: Black muck and decomposed peat (0–5). Reed-sedge peat (5–6). Blue-gray clay (6–7). Gravel (7+).	----	----	B2

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				LACKAWANNA COUNTY—Continued				
				Lenoxville quadrangle—Continued				
58	0.2 mile southeast of Finn Pond.	10	0	Deep woods of birch, hemlock, and maple; rhododendron throughout swamp.	North center of swamp: Black peaty muck (0–5). Gravel (5+).	----	----	B2
59	0.75 miles east of Finn Pond.	15	0	do	Center of swamp: Black peaty muck (0–5). Gravel (5+).	----	----	B2
				Dalton quadrangle				
60	0.65 mile northwest of Kochners Corner and 0.2 mile west of highway 407.	40	18	Ash, maple, hemlock, white pine, black spruce, and rhododendron.	300 ft northwest of center of east edge of swamp: Muck (0–1). Woody peat (1–6). Reed-sedge peat (6–21). Peaty clay (21–25). Light-blue-gray clay (25+).	9–13	4.5	A3
61	0.7 mile north-northeast of Kochners Corner.	15	18	Hemlock, birch, and maple forest.	Center of swamp: Peaty muck (0–2.5). Peat with stumps and logs (2.5–7). Reed-sedge peat (7–20). Clay peat (20–21). Light-blue-gray clay (21+).	13	13.7	A3

62...0.45 mile east of Kochners Corner.	12	15	Deep forest of hemlock, ash, birch, and maple.	Center of swamp: Peaty muck (0–1). Reed-sedge peat, woody (1–9). Reed-sedge peat (9–19). Peaty clay (19–21). Blue-gray clay (21+).	3.5	13.5	A3
63...0.6 mile southeast of Handsome Pond.	15	0	Dead trees due to ponding by beaver.	Center of swamp: Gray sandy silt (0–6). Gray clay (6+).	----	----	A2
64...At Davidson Corners.	25	0	Pasture; sedge and bulrush marsh.	Center of marsh, 1,000 ft from outlet: Gray sandy silt and wood. (0–2). Gravel (2+).	----	----	A3
65...0.7 mile northwest of Edella.	20	15	Deep forest of hemlock, white pine, elm, and maple.	Center of swamp: Peaty muck (0–1). Woody peat (1–5). Reed-sedge peat (5–13). Brown woody peat (13–17). Reed-sedge peat (17–24). Clayey peat (24–26). Peaty clay (26–29). Gray clay (29+).	9	11.0	A3
66...Carpenter Swamp...	40	6	High-bush blueberry, maple, button bush, and other low shrubs.	Center of swamp, 1,000 ft from outlet: Muck and wood (0–3). Reddish reed-sedge peat (3–4). Light-brown reed-sedge peat (4–9). Peaty clay (9–12). Blue-gray clay (12–13).	4.5	4.4	A3

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of deposit peat (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				LACKAWANNA COUNTY—Continued				
				Carbondale quadrangle				
67	0.3 mile south of Mud Pond.	20	10	Hemlock, maple, ash, and yellow birch forest.	Center of swamp: Muck (0–1). Reed-sedge peat with wood in upper 5 ft (1–13). Brown woody peat (13–17). Reed-sedge peat (17–24). Peaty clay (24–26). Light-gray clay (26–29+).	9	10	A1
68	1.0 mile north of Fall Brook Reservoir.	20	8	Hemlock, maple, and ash forest; rhododendron belt extends to center of swamp.	Center of swamp: Muck (0–1). Reed-sedge peat (1–13). Clayey peat and peaty clay (13–19). Soft pink clay (19–22). Light-gray clay (22+).	9	6.6	A1
				Factoryville quadrangle				
69	0.9 mile south-southeast of Keystone College near Factoryville.	30	11	Pond near south outlet caused by small dam used as cattle pass; elsewhere deep forest of maple, birch, and hemlock.	Center of swamp: Muck (0–1). Reed-sedge peat (1–17). Peat mixed with clay (17+).	4	5.2	A3

70...Northeast of Wilber Hill.	7	2	Cattail, reed, and sedge	Center of southeast end of marsh: Gray clay (0–2). Reed-sedge peat, shaly sandstone (2–5+).	3	33.0	A3
71...0.8 mile east-southeast of Walls Corners.	20	15	Cattail ----------------	Center of marsh: Muck (0–2). Blue-gray clay (2–15). Reed-sedge peat (15–32). Gravel (32+).	----	----	A1
Ransom quadrangle							
72...0.65 mile southwest of Scranton Airport.	15	8	Mostly a maple forest; some yellow birch and a few rhododendron.	North center of swamp: Muck (0–1.3). Reed-sedge peat (1.3–8). Clayey peat and peaty clay (8–9). Soft blue-gray clay (9–13.5). Compact blue-gray clay (13.5+).	5	5.7	A1
73...1.1 miles north of Falling Spring Reservoir.	21	15	Dead trees standing in water as result of ponding.	200 ft south-southeast of center of north edge of swamp: Water and muck (0–1). Reed-sedge peat (1–12). Peaty clay (12–15). Blue-gray clay (15–19). Clay (19+).	5	6.3	A1

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality Description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				LACKAWANNA COUNTY—Continued				
				Olyphant quadrangle				
74	1.0 mile east of Lake Scranton.	40	4	Moss, grass, and sedge, bordered by alder.	200 ft west of southeast edge of marsh and 700 ft north of outlet: Reed-sedge peat (0–4). Clayey peat over peaty clay (4–6). Brown clay (6–7). Brown sandy clay (7+).	5	13.5	B1
75	At Moosic Lakes 0.7 mile north of West Branch of Wallenpaupack Creek.	18	5	Thick grass and sedge among dead evergreen trees and dead shrubs.	Center of marsh: Reed-sedge peat (0–9). Peaty clay (9–11). Pinkish gray clay (11–17).	5	7.6	B2
76	0.4 mile north of Curtis Reservoir.	20	9	Artificial pond	North Center of pond: Water and mud (0–2). Reed-sedge peat (2–10). Clayey peat and peaty clay (10–15). Pink clay (15–16). Gray clay (16+).	----	----	A1
				Sterling quadrangle				
77	0.2 mile east of Madisonville.	30	0	Maple, aspen, beech, shadbush, and rhododendron.	Center of swamp: Black muck (0–1). Blue-gray silt (1–4).	----	----	B1

Moscow quadrangle							
78...Bear Swamp	50	0	Beech, maple, and hemlock forest; rhododendron throughout swamp.	Center of swamp: 1 foot of peaty muck over sandstone and clay.	----	----	A3
79...1.5 miles west of Fells Corners.	50	9	Tall maple and black spruce trees; shadbush, aspen, and high-bush blueberry; rhododendron belt 100 ft wide in margin of swamp.	Center of swamp: Peaty muck (0–1). Reed-sedge peat (1–11). Peaty clay, sandy (11–12). Gravel (12+).	5–9	4.6	A1
80...1.25 miles southeast of Fells Corners and south of State Route 307.	30	0	Black spruce, maple forest, alder, and high-bush blueberry; many dead trees as result of recent ponding.	Center of swamp: Black muck (0–2). Peat, clayey peat, and peaty clay (2–5).	----	----	A3
81...0.5 mile south of Daleville.	50	10	Tamarack, maple, and white birch forest; high-bush blueberry.	Center of northeast quadrant of swamp: Muck (0–1). Woody peat (1–5). Reed-sedge peat (5–15). Peaty clay (15–17). Gray clay (17+).	9–13	3.5	B2
82...0.1 mile north of Fells Corners.	9	2	Cattail and bulrush marsh with fringe of alder and high-bush blueberry.	Center of marsh: Black muck (0–2). Reed-sedge peat (2–5). Light-gray clay (5–6).	----	----	A3

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
LACKAWANNA COUNTY—Continued								
Moscow quadrangle—Continued								
83	3.0 miles southwest of Daleville.	25	15	Thick tangle of rhododendron and highbush blueberry; chief trees include maple, yellow birch, hemlock, black spruce, and shadbush.	North center of swamp: Muck (0–1). Reed-sedge peat with some wood layers (1–25). Clayey peat (25–28). Soft gray clay (28–30). Compact gray clay (30+).	5	6.8	A1
Avoca quadrangle								
84	At border of Luzerne County southeast of Big Shiney Mountain.	30	10	Open sphagnum bog with low shrubs grading toward outer margin to deep forest of maple and black spruce; highbush blueberry, rhododendron.	Near tiny pond in center: Sphagnum moss (0–17). Alternating reed-sedge peat and clayey peat (17–26). Black organic clay (26–30). Gray clay (30–38).	5–6	4.0	B1
PIKE COUNTY								
Shohola quadrangle								
85	2.2 miles south of Shohola.	50	12	Sphagnum moss; tamarack, gum, white pine; some maple	North center of swamp: Mostly sphagnum moss peat (0–13).	3	4.8	A1

			and rhododendron.	Slightly decomposed or clayey peat (13–22). Peaty clay (22–34). Blue-gray clay (34+).			
Newfoundland quadrangle							
86___0.8 mile east of Simonstown School.	60	9	An artificial dam has created a pond over part of tree-covered swamp.	Center of north edge of pond: Water and mud (0–1). Reed-sedge peat (1–9). Clayey peat (9–10). Gray clay (10–16). Pink clay (16+).	6	5.3	A3
87___1 mile southeast of Simonstown School.	30	0	Rhododendron, yellow birch, maple, and hemlock forest.	Center of swamp: Muck (0–1). Fine silty sand (1+).	----	----	A3
88___0.8 mile southeast of German Valley School.	50	10	Yellow birch, maple, hemlock, and ash; thick belt of rhododendron at margin of swamp.	Center of swamp: Muck (0–1). Reed-sedge peat (1–9). Clay mixed with peat (9–10). Reed-sedge peat (10–13). Gray silty sand (13+).	5	----	A1
Promised Land quadrangle							
89___Balsam Swamp ______	240	12	Artificial lake and dead trees.	Near south end of lake: Water and muck (0–2). Reed-sedge peat (2–12). Peaty clay (12–13). Clay (13+).	6–9	3.7	A1

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				PIKE COUNTY—Continued				
				Rowland quadrangle				
90	Smiths Swamp	120	6	Forest of black spruce, hemlock, white pine, maple, and yellow birch; rhododendron and older, chief shrubs.	200 ft west of center of swamp: Reed-sedge peat (0–9). Peaty clay (9–10). Clay (10+).	6	5.6	A1
				Pecks Pond quadrangle				
91	Ben Bush Swamp	80	0	Alder, hemlock, maple, and yellow birch.	Center of the narrow strip between the two broad parts of swamp: Muck (0–5). Sand (5+).	----	----	B2
				Edgemere quadrangle				
92	Bald Hill Swamp	160	9	Hemlock, black spruce, yellow birch, maple, alder, and high-bush blueberry and rhododendron.	Center of swamp, northeast of outlet stream: Reed-sedge peat, woody layers (0–10). Mixed clay and reed-sedge peat (10–11). Light-blue-gray clay (11–13+).	10	3.4	A2

Twelvemile Pond quadrangle							
93___0.4 mile east of top of Bald Barren.	20	8	Black spruce, maple, gum, alder, and high-bush blueberry.	100 ft west of center, edge of swamp: Reed-sedge peat (0–12). Blue-gray clay (12–13).	9	4.7	A2
94___0.8 mile west of Pine Flats.	45	7	Black spruce, maple, and high-bush blueberry; ground covered with sphagnum moss and fern.	600 ft south of east-west outlet stream: Reed-sedge peat (0–9). Peaty clay and gray clay (9–10). Gravel (10+).	5	4.4	B2
95___0.55 mile north of Lake Minisink.	100	10	Black spruce, gum, maple, alder, and high-bush blueberry.	300 ft north of center of south edge of swamp: Muck (0–1). Reed-sedge peat (1–14). Light-gray sand (14+).	9	4.3	A2
96___Between Inlet and Painter Swamps.	30	10	Black spruce, maple, gum, alder, and high-bush blueberry.	200 ft northwest of southeast corner of swamp: Muck (0–1). Reed-sedge peat (1–16). Clayey peat (16–17). Peaty clay and blue-gray clay (17+).	9	6.0	A2
97___Nebo Swamp _______	170	5	Maple, hemlock, and high-bush blueberry.	200 ft south of northeast edge of swamp: Silty peat (0–1). Reed-sedge peat (1–9). Blue-gray clay (9+).	5	5.8	B2

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of (depth range in feet given in parentheses) given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				PIKE COUNTY—Continued				
				Twelvemile Pond quadrangle—Continued				
98	Big Swamp, within the 1,200-ft contour.	160	15	Tamarack-black spruce swamp with maple and shadbush.	400 ft west of east edge of swamp at foot of ridge: Silt and muck (0–1). Reed-sedge peat, wood in upper 5 ft (1–13). Reed-sedge peat mixed with some silt (13–15). Reed-sedge peat (15–20). Peaty clay (20–21). Clay (21+).	9	3.3	A2
99	Elbow Swamp	90	0	Black spruce, hemlock, maple forest, alder, and high-bush blueberry.	Center of swamp: Muck (0–5). Sandy silt (5+).	----	----	B1
100	Turner Swamp	45	0	do	300 ft from center of northernmost edge of swamp: Black muck (0–5). Gravel (5+).	----	----	B1
				Lake Maskenozha quadrangle				
101	Little Bear Swamp	30	10	Black spruce; few maple; high-bush blueberry near mar-	200 ft from center of south edge of swamp: Reed-sedge peat, woody	10	3.2	A3

			gin of swamp; becomes open toward center.	layers in upper 5 ft (0–12). Peaty clay (12–18). Gray clay (18–20+).			
102___Big Bear Swamp____	160	10	Black spruce, maple, gum, high-bush blueberry and alder.	400 ft south of center of north edge of swamp: Muck (0–1). Reed-sedge peat, woody layers (1–14). Clayey peat (14–15). Gray clay (15–20+).	10–11	3.2	A3
Bushkill quadrangle							
103___1.0 mile northwest of Bushkill.	10	8	Black spruce, maple, high-bush blueberry.	Center of swamp: Muck (0–1). Reed-sedge peat (1–12). Gray clay (12–14+).	7	6.0	A2
LUZERNE COUNTY **Harveys Lake quadrangle**							
104___0.6 mile northwest of Loyalville.	30	5	Moss, grass, bulrush, sedge, and cattail; alder at margin.	Center of marsh: Living moss and roots of reed and sedge (0–1). Clay (1–2). Reed-sedge peat (2–7). Peaty sandy clay (7–9). Blue-gray clay, soft (9–11). Blue-gray clay (11+).	5	10.8	B2

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
LUZERNE COUNTY—Continued								
Kingston and Center Moreland quadrangles								
105	0.6 mile southwest of Demunds Corners.	25	15	High forest of maple, ash, and yellow birch.	Center of swamp: Muck (0–1). Reed-sedge peat with logs (1–7). Reed-sedge peat (7–17). Peat slightly disintegrated 17–25 Clayey peat (25–33). Peaty clay (33–35). Light-blue-gray clay (35–37+).	7–9	4.7	A1
106	0.45 mile northwest Green Pond, east of Dallas.	40	8	Yellow birch, maple, ash, and hemlock forest; partly cleared.	200 ft west of east edge of swamp and 700 ft south of outlet: Muck (0–1). Reed-sedge peat (1–7). Soft gray clay (7–9+).	5	4.7	B2
Pittston quadrangle								
107	0.8 mile north of Wyoming Camp Ground.	28	12	Hemlock, birch, and maple forest.	200 ft east of west edge and 500 ft north of south edge of swamp: Muck (0–1).	9	7.5	A1

				Reed-sedge peat and logs (1–19). Peaty clay (19–21). Soft gray clay (21–29). Compact gray clay (29+).			
Avoca quadrangle							
108___0.6 mile south-southeast of **Big Shiney** Mountain lookout tower.	40	5	Tamarack, black spruce, maple and white birch forest; high-bush blueberry.	300 ft west of center of east edge of swamp: Reed-sedge peat (0–7). Light-blue-gray clay (7+).	6.5	3.0	A3
Stillwater quadrangle							
109___Bear Swamp _______	23	0	Tall maple, hemlock, and white pine forest.	Center of swamp: Black muck over gravel and boulders (0–1). Glacial drift (1+).	----	----	B2
Sweet Valley quadrangle							
110___Bear Swamp _______	20	6	High-bush blueberry with scattered spruce and white pine.	300 ft from center of north edge of swamp: Muck (0–1). Reed-sedge peat (1–8). Tan peaty clay (8–9). Soft light-gray clay (9–13). Pink sandy clay (13–15).	5	4.3	A1

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				LUZERNE COUNTY—Continued				
				Sweet Valley quadrangle—Continued				
111	0.7 mile east of Bear Swamp.	40	10	Tangle of shrubs including high-bush blueberry and poison sumac; maple, birch, ash, and scattered black spruce and white pine.	300 ft from center of west edge of swamp: Muck (0–1). Reed-sedge peat, woody (1–16). Peaty clay (16–20). Light gray clay (20–21). Pink sandy clay (21+).	9	3.8	A1
112	1.0 mile northwest of Sylvan Lake.	20	5	Cattail, grass, and sedge marsh with scattered high-bush blueberry.	Center of marsh: Muck (0–1). Reed-sedge peat (1–9). Soft light-gray clay (9–11). Pink compact clay (11+).	5	4.7	A1
113	0.3 mile north of Sylvan Lake.	40	10	Yellow birch, maple, and white pine forest; high-bush blueberry common, rhododendron scarce.	Center of swamp: Muck (0–1). Woody peat and reed-sedge peat (1–20). Peaty clay (20–22). Soft pink clay (22–25). Compact pink clay (25+).	9	6.6	A1

Shickshinny quadrangle							
114---0.6 mile southwest of Muhlenburg.	25	14	Tall forest of maple, yellow birch, hemlock, ash, elm, and white pine.	100 ft from center of east edge of swamp: Muck (0–1). Reed-sedge peat (1–16). Peaty clay (16–17). Soft clay over compact gray clay (17+).	5	5.5	A3
115---0.4 mile east of Town Line.	12	1	High-bush blueberry--	Center of swamp: Black muck (0–1). Reed-sedge peat (1–3). Peaty clay (1–5.5). Compact gray clay (5.5+).	----	----	B1
116---0.8 mile south of Town Line.	30	0	Tall forest of yellow birch, maple, and white pine.	Center of swamp: Black muck (0–1.5). Compact gray clay (1.5+).	----	----	B1
Nanticoke quadrangle							
117---At Cranberry Pond-	100	10	Sphagnum moss with pitcher plant; low brush.	South center edge of cranberry pond: Sphagnum moss (0–0.5). Sphagnum peat (0.5–14). Dark clayey peat (14–22). Dark-gray clay (22–25+).	7–9	6.4	A3
118---1.2 miles northwest of Stairville.	50	10	Predominantly maple forest with some white pine.	Center of swamp: Muck (0–1). Reed-sedge peat (1–13). Clayey peat (13–14). Gray clay becoming pinkish (14–26+).	7–9	16	A3

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				LUZERNE COUNTY—Continued				
				Wilkes-Barre West quadrangle				
119	0.3 mile west of Nuangola.	15	10	A skunk cabbage swamp; maple and ash, chief trees.	Center of swamp: Muck (0–1). Reed-sedge peat, woody (1–11). Reed-sedge peat, clayey (11–12).	5–9	3.6	A1
120	0.6 mile south of Lake Nuangola, Turner Swamp.	30	9	Sphagnum moss under maple and ash trees.	275 ft north of south end of swamp: Reed-sedge peat (0–12). Peat and silt layers (12–13). Pinkish-gray clay (13–24+).	9	4.8	A1
121	Pole Bridge Swamp	40	6	Yellow birch, ash, maple, hemlock, white pine, and alder; reeds and sedge at southern end.	North center of swamp: Muck (0–1). Woody peat (1–5). Reed-sedge peat (5–12). Gravel (12+).	7–9	2.7	A1
				Wilkes-Barre East quadrangle				
122	0.7 mile northwest of Behren Pond.	40	0	Tall forest of maple, ash, and yellow birch.	150 ft north of center of south edge of swamp: Black muck (0–3). Gravel (3+).	----	----	A2

Sybertsville quadrangle							
123___2.2 miles southwest of Dorrance.	5	10	Thicket of high-bush blueberry; maple is predominate tree; some yellow birch.	70 ft southeast of northwest edge of swamp: Black peaty muck (0–1.5). Reed-sedge peat (1.5–6). Clayey peat (6–7). Light-gray clay (7–10).	4	10	B2
124___0.2 mile west of Dorrance.	6	1	Tangle of poison sumac, young maple, and alder; patches of cattail and bulrush.	Center of swamp: Silt and muck (0–1.5). Reed-sedge peat (1.5–4). Clayey peat (4–5). Sand and gravel (5+).	----	----	B2
MONROE COUNTY							
Tobyhanna quadrangle							
125___1.1 miles northwest of Tobyhanna.	160	5	Black spruce and hemlock forest with rhododendron and high-bush blueberry in marginal area.	200 ft west of southeast edge of swamp; 1,500 ft from the road crossing swamp: Muck (0–1). Reed-sedge peat (1–9). Clayey peat (9–9.5). Gray clay (9.5–10). Gravel (10+).	6–8	2.6	A2
Skytop quadrangle							
126___0.3 mile east of Mountain Lake.	15	10	High-bush blueberry and other shrubs including rhododendron; black spruce and hemlock forest.	400 ft north of south end of swamp: Brown silty peat (0–5). Reed-sedge peat (5–10). Peaty clay (10–13). Gray clay (13+).	5	2.0	A1

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface area of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growing above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				MONROE COUNTY—Continued				
				Skytop quadrangle—Continued				
127	0.7 mile northeast of Mountain Lake.	40	10	Black spruce, gum, maple, rhododendron, viburnum, alder, azalea, high-bush blueberry.	Center, west of small pond: Muck (0–1). Reed-sedge peat with wood layers in upper 11 feet (1–20). Peaty muck (20–28). Sand and gravel (28+).	9	7.0	A2
128	South part of Kintx Swamp.	15	15	Tamarack and black spruce swamp; sphagnum moss and high-bush blueberry.	Center of swamp: Reed-sedge peat (0–14). Peaty clay (14–17). Gray clay (17–20).	5–9	15.0	A1
129	Bloomer Swamp	25	6	do	Center of swamp: Muck (0–2). Reed-sedge peat (2–11). Peaty clay (11–13). Fine sand (13–16+).	9	3.4	A1
				Blakeslee quadrangle				
130	1.7 miles northeast of Blakeslee.	200	2	Spruce, white pine, hemlock, maple, and shadbush forest; rhododendron.	Southwest center of swamp: Reed-sedge peat (0–4). Clayey peat (4–5+).	----	----	A3

131---0.7 mile southwest of Pocono Lake.	160	1	Spruce, white pine, hemlock, maple, and shadbush forest; rhododendron throughout swamp.	Center of southwest end near pipeline clearing: Black peaty (0–1.3). Reed-sedge (1.3–3.8). Peaty clay (3.8–4). Silty clay, pink (4–9). Light gray clay (9–13.5). Gravel (13.5+).	----	----	A3
East Stroudsburg quadrangle							
132---1.5 miles southeast of Manzanedo Lake.-	20	10	Maple, white pine, and black spruce forest; high-bush blueberry and rhododendron.--	Southeast center of swamp: Muck (0–1). Reddish reed-sedge peat with woody zones (13–17). Partly disintegrated reed-sedge peat (17–21). Soft blue-gray clay (21–23). Compact clay (23+).	7–9	6.4	B1
133---0.35 mile northwest of Analomink. -----	12	12	Bulrush and cattail marsh; dry because a beaver dam has recently been breeched ----------	West center of marsh: Muck (0–1). Reed-sedge peat (1–8). Clayey peat (8–10). Reed-sedge peat (10–17). Gray clay (17–18+).	6–7	5.0	B1
Bushkill quadrangle							
134---0.35 mile east-northeast of Lake Monroe (in the East Stroudsburg quadrangle). ---------	30	17	Alder, maple, ash, and hemlock -----------	Center of swamp: Reed-sedge peat, wood layers (0–25). Peaty clay (25–29). Soft light-gray clay (29–33.5+).	13	4.0	A2

TABLE 1.—*Location, estimated extent, and description of peat deposits in northeastern Pennsylvania*—Continued

No. in fig. 2	Locality description	Surface are of peat deposit (acres)	Average thickness of peat (feet)	Major vegetation now growilng above peat deposit	Location and stratigraphy of representative core hole (depth range in feet given in parentheses)	Depth of sample [1] (feet)	Local drainage basin ratio [2]	Geologic setting [3] (class)
				MONROE COUNTY—Continued				
				Bushkill quadrangle—Continued				
135	0.9 mile north of Poplar Bridge.	10	8	Yellow and white birch, maple, azalea, and high-bush blueberry	Center of swamp: Muck (0–3). Reed-sedge peat (3–9). Gravel (9+).	5–9	4.0	A2
				Twelvemile Pond quadrangle				
136	Tims Swamp	20	10	Tamarack and black spruce forest with high-bush blueberry.	North center of swamp 300 ft from edge of widest part: Reed-sedge peat (0–11). Clayey peat (11–12). Gravel (12+).	6	3.7	B2

[1] Data on physical properties and pH of samples from indicated depth are given in table 2.

[2] Effective sediment-contributing area relative to size of peat deposit area.

[3] The geologic settings of the basins of accumulation of the deposits are grouped into the following classes:

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.

TABLE 2.—*Analytical data (physical properties) for representative peat samples from selected deposits in northeastern Pennsylvania*

[Analyses by C. L. Burton, Grafton Daniels, and P. J. Aruscavage, U.S. Geol. Survey. Data in percent except as indicated]

Locality (fig. 2 and table 1)	Organic content	Water-holding capacity	Fiber longer than 0.15 mm	Hydrogen ion concentration (pH)
1	97.1	1,143	34.3	4.51
2	90.8	1,181	44.8	5.79
3	73.0	1,114	21.7	6.31
4	55.1	744	22.6	6.34
18	83.3	1,413	32.7	5.9
19	61.4	1,019	23.7	5.93
20	95.2	1,035	47.0	6.0
21	84.7	1,567	49.3	5.9
22	64.3	1,057	32.6	5.6
25	42.3	463	21.6	5.6
26	90.9	1,290	36.1	5.9
27	85.3	951	36.9	5.85
28	73.1	1,024	36.6	6.54
29	56.8	1,051	19.5	6.18
30	90.8	1,077	36.1	5.9
31	56.2	605	37.0	5.5
32	92.7	2,152	47.5	6.68
33	95.4	2,065	49.5	6.1
34	97.6	1,155	43.2	5.9
35	70.1	902	60.6	5.7
36	96.2	1,499	56.7	5.4
37	48.2	833	58.5	5.4
38	87.8	960	26.0	4.85
39	80.7	727	31.3	6.42
40	75.0	1,118	49.0	5.99
43	82.7	876	39.5	6.03
44	91.8	1,893	44.6	6.64
45	89.5	1,314	48.7	6.11
46	92.5	1,444	56.9	5.61
47	89.4	957	49.9	6.15
49	89.8	2,299	41.6	6.48
51	92.4	1,116	34.1	5.85
52	43.5	664	18.3	6.55
53	89.7	1,258	53.1	6.02
54	91.6	871	45.2	5.71
55	81.7	1,755	40.0	6.15
56	55.6	1,012	28.9	6.25
60	90.9	2,019	37.1	6.40
61	93.5	1,765	48.7	6.41
62	83.3	855	33.4	6.08
65	95.8	2,417	48.4	6.22
66	94.5	1,921	44.9	4.85
67	93.2	2,216	44.6	6.38
68	41.0	578	15.8	6.55
69	94.5	1,296	53.4	5.65
70	35.4	314	26.2	5.49
72	78.9	1,417	35.0	6.43
73	93.4	1,957	50.5	5.79
74	78.7	839	58.9	5.4
75	48.7	585	24.5	5.6
79	91.7	2,339	24.5	6.12
81	61.2	1,162	30.7	6.43
83	90.6	2,085	44.7	6.02
84	79.0	1,752	54.2	5.75
85	96.6	3,374	56.9	4.3

TABLE 2.—*Analytical data (physical properties) for representative peat samples from selected deposits in northeastern Pennsylvania*—Continued

Locality (fig. 2 and table 1)	Organic content	Water-holding capacity	Fiber longer than 0.15 mm	Hydrogen ion concentration (pH)
86	90.6	1,923	44.8	6.0
88	93.6	1,082	57.8	5.8
89	74.7	1,012	42.6	5.8
90	94.9	1,826	49.9	5.6
92	46.2	570	26.1	5.2
93	58.8	1,175	41.6	5.2
94	93.9	1,914	48.0	5.8
95	61.9	1,244	31.2	5.4
96	99.8	2.552	71.2	5.6
97	91.5	1,510	52.5	5.8
98	95.5	2,084	51.6	6.0
101	80.9	2,170	34.1	6.05
102	94.3	2,086	56.0	6.45
103	47.3	861	9.5	5.83
104	74.1	1,170	27.9	5.95
105	90.2	2,055	39.8	6.41
106	51.3	738	24.5	5.85
107	92.2	1,360	49.1	6.68
108	37.5	1,552	30.1	5.72
110	90.8	1,312	46.0	5.75
111	93.6	1,254	34.5	6.75
112	43.6	1,194	31.3	5.80
113	95.1	1,844	46.8	6.10
114	94.6	2,372	50.8	5.84
117	92.2	1,822	45.5	6.28
118	75.3	1,833	32.0	6.10
119	66.7	1,240	41.1	5.2
120	88.9	1,958	41.2	5.5
121	42.3	565	31.8	6.32
123	69.5	1,269	18.7	4.25
125	58.0	909	25.6	5.95
126	86.8	1,547	43.4	5.7
127	95.7	1,970	56.4	5.75
128	90.5	1,337	52.2	5.51
129	94.3	1,550	52.2	5.6
132	93.6	1,514	44.8	6.38
133	58.7	497	9.0	6.12
134	54.2	1,824	44.4	6.59
135	28.7	607	17.1	5.79
136	95.5	1,539	55.8	5.65

TABLE 3.—*Pertinent drainage and ground-condition information about 15 peat deposits in northeastern Pennsylvania*

Locality (fig. 2; tables 1, 2)	Class of geologic setting	Remarks
20	A3	15–20 ft of clayey peat and soft clay under the peat deposit afford very unstable foundation for excavating machinery. Establishment of artificial drainage would be difficult because of the slight gradient of the outlet stream to Bushkill Creek. Gentle slopes, less than 10 percent on firm ground at margin of swamp, would facilitate construction of operation roads.
36	A1	Artificial drainage of peat deposit would be easy to establish; outlet stream flows over bedrock at gradient of 528 ft to more than 2,112 ft per mile. Firm ground at south end of swamp near access road, where slopes are 2–4 percent, favor plant construction.
46	A1	Artificial drainage of peat deposit would be easy to establish; gradient of outlet stream is about 130 ft per mile. Drainage-basin walls slope 4–20 percent and are gentle at south end where firm ground is suitable for construction of buildings.
54	A2	Artificial lowering of water table may be difficult to establish. Outlet gradient is very gentle. Gentle drainage-basin slopes (as much as 6 percent) on firm ground at the west side of the deposit would facilitate plant and road construction.
60	A3	Artificial drainage would be easy to establish; outlet stream has gradient of 200–300 ft per mile. Edges of swamp are firm. Drainage-basin slopes of 4–6 percent facilitate construction of operation roads.
83	A1	Lowering water table in peat deposit would require draining an artificial pond that has an outlet with gradient of about 210 ft per mile. Gentle drainage-basin slopes (as much as 10 percent) on firm ground at west side of swamp facilitate construction of operation roads.
84	B1	Artificial drainage may be achieved by ditching short distance to deep valley from the northeast end of swamp. Excavation equipment will mire in deposit in vicinity of pond, but ground with slopes as much as 2 percent is firm at west margin of swamp.
90	A1	Swamp is without outlet; natural drainage of 1-percent gradient is through till from southeast arm of deposit to artificial pond at a distance of about 2,000 ft. East and west sandstone drainage-basin walls slope 16–20 percent. Slopes at either end of deposit are as much as 6 percent on till.
97	B2	Natural drainage is through seepage to Painter Swamp Creek, thence to Little Bush Kill Creek. Artificial drainage would be difficult to achieve because the elevation of the creek is very nearly the same elevation as the surface of the peat deposit.
98	A2	Artificial drainage to depths greater than 15 ft may be difficult; Twelvemile Pond, 0.4 mile south of deposit, is only 19 ft below the surface of the peat, and Spruce Run, 1.2 miles west, is 80 ft below the surface of the peat deposit. Broad areas of level firm ground are near the south and west margins of the deposit.

TABLE 3.—*Pertinent drainage and ground-condition information about 15 peat deposits in northeastern Pennsylvania*—Continued

Locality (fig. 2; tables 1, 2)	Class of geologic setting	Remarks
102	A3	Establishment of artificial drainage to Bushkill Creek would be difficult because of very low relief. 15–20 ft of soft peaty clay and soft clay under exploitable deposit would cause excavating equipment to mire; however gentle slopes on firm ground at margin of deposit would facilitate construction of operation roads.
105	A1	Gradient of outlet stream ranges from 50 to 210 ft per mile. Firm ground sloping less than 4 percent at southeast margin of deposit is suitable for plant construction.
111	A1	Artificial lowering of water table in peat deposit may be accomplished by ditching northward toward Huntington Creek 0.4 mile distant and at an elevation of more than 300 ft lower than surface of deposit. Firm ground at south end of swamp sloping less than 4 percent is suitable for plant construction.
117	A3	Low relief makes artificial lowering of water table difficult. The flattest area of firm ground it at the northeast end.
118	A3	Surface of Cranberry Pond within the peat deposit is higher than the margin of the deposit. Artificial lowering of water table could best be achieved across low divide 0.5 mile west of Mount Zion Church. Firm ground at southwest end of marsh containing peat deposit slopes 6–8 percent.

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[Italic numbers indicate principal references]

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