A Classification of Peats

The increasing interest in peat for soil improvement during recent years has led to the utilization of numerous deposits in different parts of the country. Golf clubs which contemplate purchasing peat find that there are numerous kinds of peats sold under various names which are decidedly confusing. Claims of superiority are made for many of these special kinds of peat and the consumer has had little information to indicate to him the relative merits of the different types of peats. The new Circular No. 290 issued by the United States Department of Agriculture contains a description of different types of peat. Since this circular should be of interest to all clubs that plan the purchase of peats, we are extracting freely from it such parts as are of chief concern to golf clubs.

It is pointed out in the Circular that the peat importations from Europe are increasing and now reach an annual value of nearly $1,000,000, while the domestic production in 17 states is reported to be greater than the imports. This estimate does not include the large amounts of peat and muck that are obtained and used locally on golf courses or similar areas wherever small deposits of this material occur on the property or nearby.

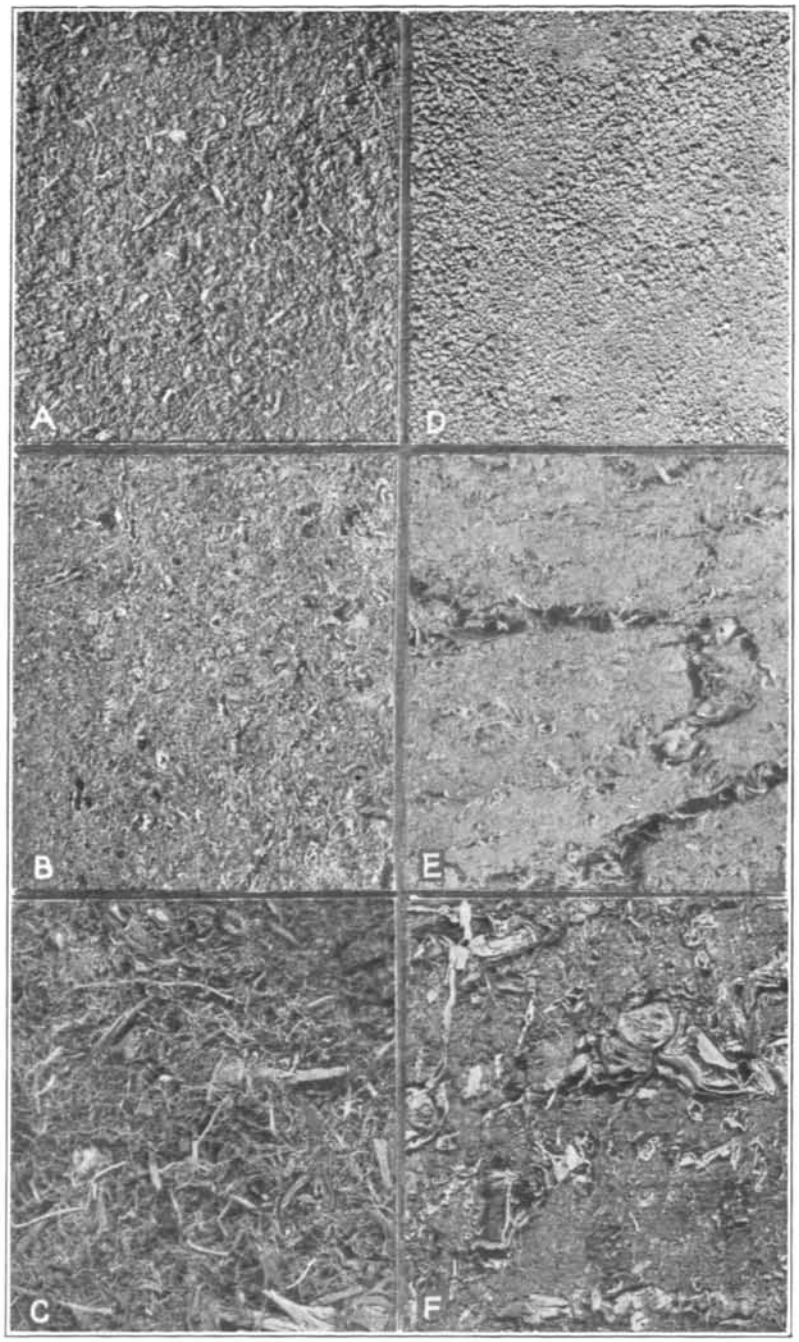
Under natural conditions peat deposits as a rule consist of different layers of peat which vary in composition.

"Areas of peat represent different stages in a process of development which in many instances has proceeded since the close of the ice age and is still in progress. They vary in size and depth, in the number and thickness of layers, and in such characteristics as color, reaction, height of water level, and the features with which each layer is preserved, making identification possible."

Distribution of Peat Deposits in the United States

Peat and muck deposits are found widely distributed in the United States. "The peat deposits of the United States have been broadly divided into three major groups, differing in important characteristics and regional relationships to surface vegetation, climatic conditions, and time relations. The geographic limits established for each group must necessarily be arbitrary, and each group unit includes areas of peat of a transitional character."

"The first main group comprises areas that contain a surface layer of moss peat varying greatly in thickness and in amount of woody material. It includes flat and raised bogs, heaths, and coniferous swamp forests, as well as peat areas of an intermediate character. The deposits are generally acid in reaction, more or less poorly decomposed, and deficient in plant nutrients. The group is confined chiefly to the cool and humid northern portion of the New England and the Great Lakes States and along the Pacific coast from northern Washington into Alaska. The peat materials are more or less leached, lack available nitrogen and mineral salts, notably lime, but have a moderately high content of decomposable organic matter. They are of relatively recent origin and do not appear to have undergone decomposition to so great a degree or to so great a depth as in the more southern states.



Varieties of Sedge and Reed Peat

(A) sedge muck; (B) radicellate sedge peat; (C) coarsely fibrous sedge peat; (D) reed muck; (E) partly fibrous reed peat; (F) coarsely fibrous reed peat. Each variety is shown here in natural size from air-dry sample. (From Bulletin 1419, U. S. Dept. Agriculture)

"The second major group includes areas of peat from New Jersey westward to Ohio and toward South Dakota. It comprises continental deposits that have a more or less complex structural development. The various layers consist of fibrous peat derived from reed and sedge marshes and of woody materials from swamp forests of mixed conifers and hardwoods. Some of the layers of peat are darker in color and partly decomposed. Lime, phosphorus, and nitrogen may be present in varying quantities owing to the greater depth at which decomposition has taken place favored by a modifying influence from the underlying mineral soils of the region, by evaporation and warm summers. A belt of peat deposits, represented by the Dismal Swamps along the Atlantic Coastal Plain from Virginia to Georgia, has been included in this main group. These peat areas are predominantly woody and acid in reaction. Their relationships and possible uses are not well known, but their basic economic utility is that of timber production.

"The third major group consists of deposits of peat containing fibrous material derived from saw grass, cane, tule, and other marsh vegetation subject to periodic flooding. They are generally neutral to alkaline in reaction and show varying degrees of decomposition. Outstanding members of this group are the subtropical Everglades of Florida, the areas of peat in the valley of Mississippi River, the semiarid peat lands of California, and the deposits in the valleys of the Klamath and Willamette Rivers in Oregon."

Principle Classes of Peat

Peat deposits have in the past been classified in several different ways. Like all classifications these have had certain advantages and disadvantages. The chief classes now used by the Department of Agriculture are based largely on the origin of peat.

Sedementary Peat.—"In any shallow lake or pond, such as may be seen rather generally in the Northern and Central States, the history of a peat deposit begins with a stage of vegetation associated with the open water.

"It consists of microscopic organisms, submerged plants, pond weeds, waterlilies, and similar forms of plant life. The yearly addition of decaying bodies of such organisms, deposited in depressions and basins, accumulates in the form of a soft, oozy, structureless peat. It contains plant remains that are recognizable and material which has lost all traces of its origin and has become changed into an amorphous residue. With these variations are associated gases such as methane, hydrogen, carbon dioxide, and others produced by the activity of certain (anaerobic) microorganisms that decompose the organic matter.

"Sedimentary peat is fine-textured, plastic, and often gelatinous when wet, but hard and horny when dry. In some localities it occurs compacted into a dense, impervious organic sediment; in other places it contains bits of tissue from roots and leaves, a variety of seeds, wind-blown pollen, quantities of shells from mollusks, diatoms which have siliceous skeletons, or sand, silt, and clay. Some varieties of this organic material are nearly alkaline in reaction and comparatively high in lime but others range from acid to neutral.

"The significant feature of the organic content of sedimentary peat is that in a plastic colloidal state it performs the function of a

binding material with a soil. It is the seat of important chemical reactions and absorbs and exchanges dissolved substances from solution. When air-dried it shrinks greatly and becomes relatively inert. Owing to this tendency to unfavorable compaction and hardening, sedimentary peat with a high content of organic matter of the size of colloidal particles does not offer a satisfactory material for decreasing the cohesion or plasticity of certain soils when mixed with them. The evidence available at present indicates that, in general, the characteristics of sedimentary peat do not have the value for imparting changes in granulation, aeration, and other desirable properties."

Reed and Sedge Peat.—"The second stage in the development of a peat deposit is generally associated with the encroachment of marsh vegetation upon the lake or pond in which the free water surface is disappearing by the filling process of the aquatic plants. In this case the dominant vegetation consists either of sedges such as wire grass, saw grass, tule, rushes with cattail and others, or of reeds, canes, and reedlike grasses. The plants make little demand for nutrients. They can grow in water containing considerable proportions of mineral salts in solution, tolerate partial submergence, and root themselves into the soft, miry ooze. They possess a habit of excessive root growth, which in time builds up a firm, coarse-to-felty fibrous and porous peat layer, made of an interwoven network of underground stems and roots. The plant remains restrict the movement of water, and this in turn raises the water level, excludes air to a large extent, prevents oxidation, reduces microbial activity, and thus preserves the accumulation of roots, rhizomes and residue.

"Poorly decomposed plant remains generally form a considerable proportion of the fibrous layer; but in certain cases it may contain dark-colored, structureless residue, derived from more easily decomposing leafy tissue by a complex series of microbiological and chemical changes. Fibrous types of peat are often designated as fen peat, low-moore peat, and high-lime peat. They are here separated and classified either as sedge or reed peat, depending on the nature of the flattened rootstocks that predominate in the organic material, and can be recognized by the eye or under the microscope.

"Characteristics which meet the requirements of a good grade of reed or sedge peat are based on degree of decomposition, color, reaction, low ash content, and absence of objectionable matter such as coarse woody fragments and injurious mineral salts of iron and sulphur.

"A poorly decomposed grade of reed or sedge peat is reddish to yellowish brown in color, acid or neutral to slightly alkaline in reaction, and distinguished by its more or less porous, coarse-to-finely fibrous structure. When air-dried, the mass is brittle and the finer root material tends to break into powdery particles that absorb air and become almost impervious to water. Under moderately moist or drained conditions reed and sedge peat favor the activity of an appreciable number of micro-organisms, especially fungi. They decompose more or less rapidly when their moisture content is favorable, and the recognized nutrient deficiencies are remedied by the addition of potash and phosphate fertilizers. Applications of nitrogen and lime are not always required, but should vary according to climatic conditions and soils.

"When reed or sedge peat is in a moderately advanced state of decomposition or has undergone cultivation, the material is partly fibrous, and the residual organic matter is dark brown to black in color, fine-grained in texture, and slightly acid to neutral in reaction. This grade crumbles easily and is generally referred to as reed or sedge 'muck.' It shows marked transformations in comparison with the original parent material. The changes are characterized by an increase in the content of ash and organic complexes that are more or less resistant to further decomposition. There is present also a higher content of nitrogen, mainly as a result of the activity of microorganisms, but phosphorus and potassium are found in small amounts and should be reinforced by the use of commercial fertilizers.

"Fairly definite inferences may be derived from the information presented above. Grades of reed or sedge peat that are fibrous and poorly decomposed, when prepared by shredding and sieving, and well mixed with a mineral soil, may be expected to improve the moisture relations, to be more effective as a source of organic matter for microbiological processes, and to develop an organic complex that possesses the characteristics of soil humus. They may thus render possible the development of a crumbly structure in sticky or hard-packed, clayey soils and to that extent exert desirable physical influences. On the other hand, partially decomposed and cultivated grades of reed or sedge peat should be valuable primarily for supplying a relatively inert, organic residue; they may be used more effectively for improving the physical condition of any mineral soil in need of structural changes."

Woody Peat.—"The final stage of native vegetation that establishes itself upon a layer of reed or sedge peat under natural conditions is a swamp forest of conifers, together with deciduous trees. The gradual accumulation of peat above the water level of the original lake, moderate aeration, and a vigorously active population of microorganisms, as well as differences in evaporation and shading through tree growth, modify the character of the surface of the marsh and eventually result in new peat-soil features.

"The invasion of shrubs and trees into a marsh reaches its greatest development with the subsequent segregation of the swamp forest vegetation into dominant deciduous trees and subdominant trees of conifers, a diversified undergrowth of shrubs, and a ground cover of perennial herbs, ferns, some mosses, wood-destroying fungi, and the like.

"Under forest conditions the principal source of organic matter is an accumulation from fallen logs, branches, and roots varying in size and degree of decomposition. Additional marked effects of the influence of a swamp forest are indicated by the litter from leaves and needles, by a considerable contribution of bits of twigs, bark, cones, and fruiting bodies, and by an appreciable amount of crumbly, granular residue (duff or leaf mold) matted together by a meshwork of roots and the mycelium of fungi. This type of organic mixture is classified as woody peat.

"Coniferous woody peat derived from spruce, tamarack, cedar, evergreen shrubs, and others has a marked acid reaction, and transformation of the organic matter is very slow. Decomposition changes are mainly the work of fungi, and the peat material remains as a more or less sharply defined, coarse, woody layer, brown or dark brown in color, correspondingly poor in mineral nutrients and basic

constituents. In the presence of a sufficient supply of lime and other mineral bases to maintain a neutral to slightly alkaline reaction, changes result mainly through the agency of bacteria, earthworms, and similar organisms. The dark-colored, granular woody residue may extend to considerable depth, and the peat deposit is then in its final phase, in which the principal trees are maple, ash, elm, and to a less extent conifers such as tamarack and cedar.

"Because of the presence of tree stumps and many coarse, woody fragments, and the practical difficulty involved in separating the variable quantity of granular residue, woody peat does not constitute a suitable source of organic matter for soil improvement. The chief value of swamp forests and their woody peat seems to be in the tree growth which they are capable of producing."

Moss Peat.—"Many of the deposits from Maine to Minnesota illustrate a more northern type of peat, which differs markedly in character and composition from the kinds of peat previously described. It is formed predominantly by the small stems and leaves of sphagnum mosses.

"Layers of moss peat of varying thickness occur most commonly in the cool and moist northern region of the United States. Some of the peat areas are flat heath bogs, while others, especially those of northeastern coastal Maine, have a surface which rises from the margin of the deposit to the center, and on that account are known as 'high moors.' The native surface vegetation is made up largely of various species of Sphagnum and a scattered growth of sedges and small heath shrubs, principally leatherleaf, Labrador tea, laurel, blueberries, together with scrubby, dwarfed black spruce and tamarack. There is not much timber growth, owing to the very low amount of soluble mineral and organic constituents in the water retained by the mosses. A layer of moss peat generally overlies a layer of woody peat, but it may occur superimposed upon sedge and reed peat.

"The reaction of moss peat is strongly acid. The material is, as a rule, poorly decomposed, spongy-fibrous, light yellowish brown in color, and consists mainly of the remains of sphagnum mosses. It has a uniformly low content of mineral matter and nitrogen and supports a very limited population of fungi and other microorganisms. This is due in part to the high capacity of the tissue of stems and leaves of mosses to conduct and retain water in the meshwork of elongated, absorbing capillary cells.

"The chemical composition of these cells does not offer a favorable organic material to microbial activity. It cannot be utilized by them in the absence of oxygen and in a cold, acid, water-logged environment. These conditions account also for the heavy expense involved in reducing the moisture content of moss peat by artificial means. Similar considerations apply to the decomposition of the material when intermixed with a mineral soil. The rate of change is very slow unless the acid reaction is corrected by the use of lime, and its nutrient deficiencies are remedied by an application of nitrogen in an available form or by the use of a complete commercial fertilizer.

"Coarse-textured fibrous moss peat is supplied to the trade in several grades based mainly on the degree of fineness of shredding the material. It is customary to make a separation of the mechanically shredded moss peat by sieving. Moss peat for stable bedding

and poultry litter is relatively coarse and lumpy, while particles of smaller size serve horticultural uses. The finely shredded fraction affords a more satisfactory material for soil improvement because it exhibits certain well-defined properties of organic matter that are most important from a soil standpoint.

"Moss peat which has undergone a moderate degree of decomposition is brown in color, partly fibrous, contains an appreciable quantity of dark-colored residue, small woody fragments, and coarse fibers from cotton grass; it is considerably more resistant to further decomposition than the less altered, younger material."

Classification According to Degree of Decomposition

Any of the above classes of peats may show considerable variation due to their stage of decomposition.

"To express the degree of decomposition that has taken place, it has been found practical to employ an arbitrary scale of five divisions. These represent certain more or less definite values to indicate grades of (1) poorly decomposed peat, (2) slightly decomposed peat, and (3) partly decomposed peat, and grades of (4) largely decomposed muck to (5) well-decomposed muck.

"Color is one of the important aids to the recognition and description of different grades of peat. There is generally a progressive darkening in color as peat material decomposes to muck. This can be well illustrated by comparing the material of a peat deposit exposed in an old open ditch with a freshly cut vertical section, or by examining portions of a peat area that have been under cultivation for different periods of time.

"The natural color of a peat material is a characteristic which assists judgment of quality and value. Light reddish- and yellowish-brown colors almost invariably predominate in poorly and slightly decomposed peat materials. These colors characterize grades that have a relatively low content of mineral matter and tend toward an acid reaction. Mottled yellow and red colors are indications of differences in plant remains and in the rate at which decomposable substances are developing a residue under fluctuations of water content. Mottling is rarely due to the presence of minerals such as iron or its oxidation products.

"Partially decomposed grades of peat are usually slightly acid to neutral in reaction, and brown. A shade of gray deserves closer consideration. A grayish tint indicates as a rule the prevalence of mineral matter and to a certain extent the presence of soluble salts. Black tints originate naturally from residual organic matter, but in some cases they are produced by anaerobic conditions and hydrogen sulphide.

"Very dark brown and black colors serve as the general basis for estimating grades of largely decomposed to well-decayed plant remains. They are the result of active oxidation of a high proportion of residual material contributed chiefly by the activity of microorganisms.

"Greenish colors may be attributed to the presence of compounds of sulphur and iron, such as marcasite, while a bluish color may be due to vivianite (phosphate of iron). Red colors may also occur in peat and muck containing varying proportions of iron compounds.

"Broadly speaking, it may be said that the most marked changes

from dark to light colors are found in the peat material nearest the surface of a deposit. The differences in color are much less distinct in areas which have been subjected to drainage and in peat deposits of relatively greater age. The colors stand out sharply and are more strongly contrasted in deposits that are of recent origin or are water-logged and in which the active agents remove oxygen from the organic material."

QUESTIONS AND ANSWERS

All questions sent to the Green Section will be answered in a letter to the writer as promptly as possible. The more interesting of these questions, with concise answers, will appear in this column. If your experience leads you to disagree with any answer here given it is your privilege and duty to write to the Green Section. While most of the answers are of general application, it must be borne in mind that each recommendation is intended specifically for the locality designated at the end of the question.

Preparing putting green beds for spring planting.—The beds for our greens are now (November) plowed. What time in spring is best to start planting? Will it help to apply fertilizer in November? Our soil is black and heavy. (Vermont)

ANSWER.—Late summer or fall is the best time to plant putting greens. Frequently there is considerable trouble from weeds in connection with spring planting. For that reason you should apply fertilizer just previously to planting so that the seed or stolons may get a vigorous start and thus be able to compete better with the weeds. Since your soil is heavy it would be well to apply lime during winter, broadcasting it at the rate of 50 to 100 pounds to 1,000 square feet. If you can obtain some coarse sand it would also be well to disk that in during winter. Do not work the soil until it is free from moisture in the spring, and then apply 50 pounds of some good organic nitrogen carrier to each 1,000 square feet, raking it into the soil just before planting. Pulverized poultry manure, activated sludge, and bone meal are good fertilizers to use at the time of construction.

Injurious layers resulting from top-dressing with pure materials.—In planting our putting greens with stolons of the Washington strain of creeping bent we covered the stolons with about ½ inch of good soil, and when they began to come through the soil we covered them with ¼ inch of sharp sand. Is this a sufficient covering of sand? (Indiana.)

ANSWER.—The quantity of sand you have applied is too much for one application. Layers of pure sand or pure organic materials like peat and muck on putting greens are liable to cause injury in after years. In your further use of sand for top-dressing it should be mixed with sufficient soil to make a material having the consistency of a sandy loam.