value. Well-rotted manure serves the same purpose, but in addition to its humus content manure also contains certain fertilizing elements and beneficial bacteria. Peat moss is now being extensively used as stable bedding or for poultry-house litter, and when combined with manure in this manner it forms an excellent ingredient of top-dressing.

Some of the heavy peats have a relatively high nitrogen content; but this is not considered important, since this nitrogen is available to the plants only after a slow process of disintegration. Some mucks and dark-colored peats may contain such large amounts of sulphur and iron as to be poisonous to plants under certain conditions. Such material should be avoided in turf work. Some muck contains so much clay and silt that it is undesirable for golf course use due to its tendency to form a hard crust in dry weather.

It is sometimes claimed that the undecomposed portion of the organic material in peat may have a beneficial influence on the soil. It is believed that a soil well supplied with such material will produce a turf which will remain more resilient than one deficient in it. There have been no adequate tests made to definitely support this claim that the portion which is not broken down can be of much value, but it is well known that the portion which is changed to humus greatly improves soil texture.

Peat and Muck

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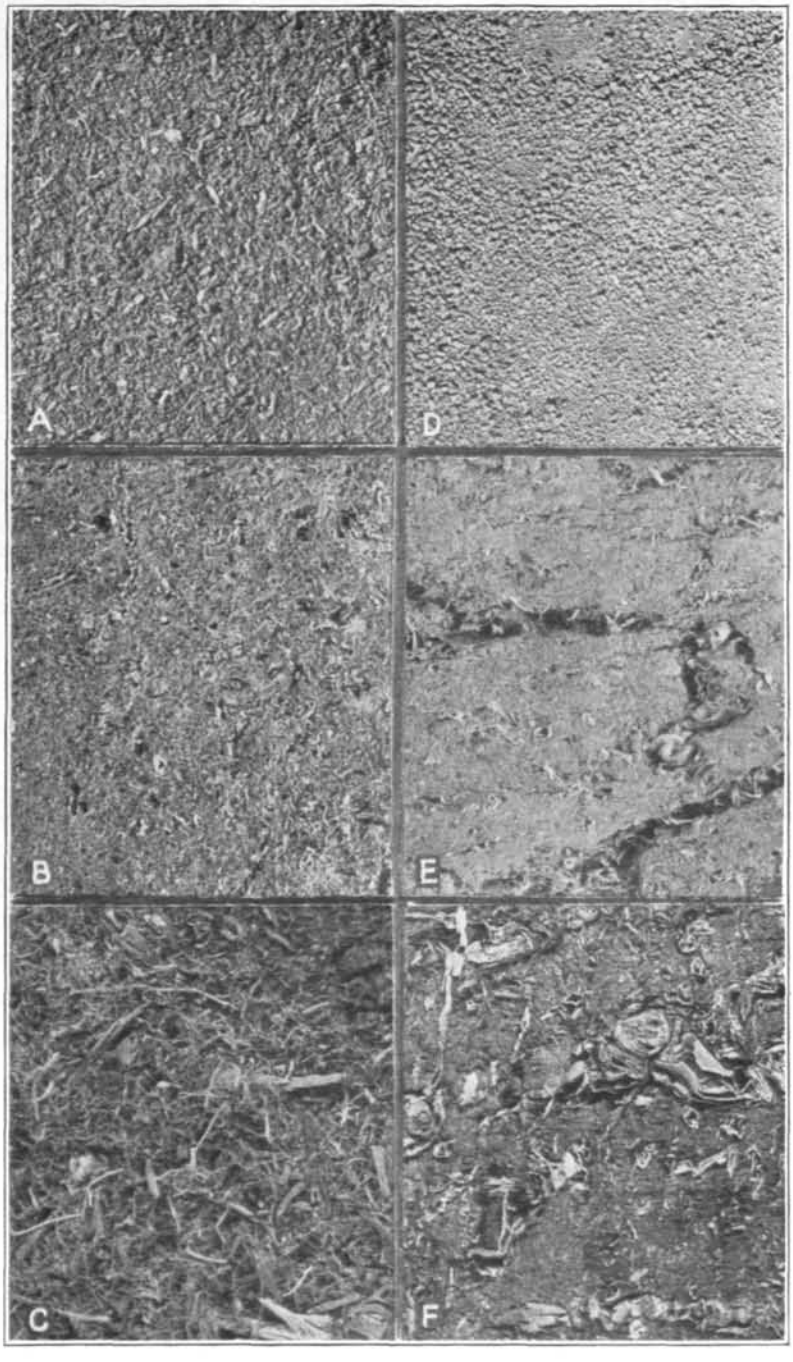
Many inquiries are received and considerable interest is shown concerning the agricultural uses of peat and muck and the conversion of these materials into organic manures and fertilizers. What is peat and what is muck? Where are the areas in which they are to be found? What can be done with them? These are questions which grow constantly more urgent, and they are difficult to answer briefly.

The aggregate area of peat and muck in the United States is approximately 100,000,000 acres. These deposits constitute not only one of the great resources of organic raw material and undeveloped land, but they also present an invaluable record of the history of plant life and changes in environment.

The visual differences between peat and muck have been pointed out in an illustration (plate 5) shown in Bulletin 1419* of the United States Department of Agriculture. The illustration is here reproduced. Reed muck, for example, is a well-decomposed granular residue derived from the plant remains of reed-like grasses; its existing characteristics are the result of many years of cultivation and cropping as well as weathering, oxidation, and the activities of micro-organisms at the surface and above the water level. The untilled and unaltered parent peat material below the surface is a brown, fibrous to felty network of rootlets and underground stems that are susceptible of botanical identification. Saturation with water had prevented access of air and stopped their decay.

*All the publications referred to throughout this article are publications of the United States Department of Agriculture. They are no longer available for free distribution, but may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C.



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)

Different kinds of peat and muck are described and classified in Bulletin 802 of the United States Department of Agriculture. The most important types of peat in the sedimentary class are finely divided plant remains derived from soft herbaceous and aquatic plants, and the jelly-like material formed from organic suspensions in lakes and ponds. The fibrous class comprises the resistant material derived from roots and rootstocks of sawgrass, tule, rushes, and sedges, and from the leaves of various mosses. The woody class of peat has been formed from disintegrating shrubs and timbers of forests.

The physical and chemical properties of several distinct types of peat are to be found in Tables I and II of Bulletin 802. The organic constituents, such as waxes, resins, oils, crude fiber including celluloses and lignins, and nitrogenous and other substances of various peats from different States, are reported in a paper in the *Journal of Agricultural Research* (29:69-83, 1924), also published by the Department of Agriculture.

The inherent structural differences between areas of peat in the United States are pointed out in Bulletin 1419. The character, number, and sequence of the chief layers of peat of which they are composed greatly modify the practices and purposes of peatland agriculture. The bulletin contains descriptions of the more common profiles which constitute series of peat soils, and the factors involved in a proper selection of peatlands are discussed. It draws attention to the difficulties encountered in their utilization, and emphasizes their principal uses for the production of forage crops and timber and for the regulation of stream flow and water supplies. In Circular 252 of the Department, an account is given of different methods employed for excavating and handling peat and for preparing peat composts. Profitable methods of farming have been described in Farmers' Bulletin 761, and some of the crops adapted to peat soils are listed in Bulletin 6.

The location and acreage of peat and muck in the United States are shown on maps of the Soil Survey, United States Department of Agriculture. In order to correlate and coordinate field and laboratory work, the peatlands of this country have been broadly divided into three main regions. They differ in surface vegetation, structural framework, and climatic conditions. These regions are described as follows:

The first main region consists of areas whose characteristic peat layers are derived from sedges, reeds, and similar vegetation. The group is technically designated as eutrophic, because the peatlands have an abundance of mineral salts and are neutral to alkaline in reaction. Outstanding members of this region are the sub-tropical Everglades of Florida, the semi-arid Delta peatlands of California, the valley peatlands of the Klamath and Willamette Rivers in Oregon, and the areas of peat in the valley of the Mississippi River.

The second main region comprises the group of peat areas deficient in plant nutrients (oligotrophic). It is chiefly confined to the northern portion of the New England and the Great Lakes States, and includes a belt of domeshaped, raised moors in Maine and Minnesota. The "high moors" in Maine contain moss peat up to 10 feet in thickness. The surface peat soils are usually acid in reaction, lack available nitrogen and mineral salts, notably lime, but have a

relatively high content of decomposable fiber. However, the cool soil temperature during the growing season is not conducive to the activity of micro-organisms that ordinarily bring about decomposition and the availability of mineral plant food constituents.

The third main region includes peat lands from New Jersey westward to the southernmost boundary of the glacial drift toward South Dakota. These areas of peat have a more or less complex structural framework and are designated as the mesotrophic group. Lime, phosphates, and nitrogen may be present in the surface peat soil owing to the greater depth at which decomposition, favored by evaporation and warm summers, releases soluble plant food constituents.

A belt of peatland represented by the Dismal Swamps along the Atlantic coastal plain from Virginia to Georgia has been included, for the present, in this third main group. They are predominantly woody and acid in reaction. Their relationships and uses are not well established.

Little is known regarding the characteristics of muck and humus derived from various peats, how they are formed, and the nature of the chemical compounds of the residual material in different regions and climates. Reed and sedge peats appear to give a larger fraction of nonfibrous soluble constituents, and to yield more rapidly available nitrogen and mineral matter. On the other hand, moss peat, for example that from Maine, offers a "crude fiber" with a higher cellulose content, but its utilization as a food supply and an available source of energy for micro-organisms must be aided by the addition of liquid manure or a solution of some readily available nitrogen carrier such as nitrate of calcium; hence the greater demand for moss peat as an absorbent in stables, bedding for poultry, and for composting waste products of agriculture. Changes in water content, the action of freezing, leaching, the growth of plant roots, the presence of iron, sulphur, and other salts, and various micro-organisms, all play a part in the process of decomposition. The forces that are active in the transformation of peat into muck and humus are, therefore, mechanical, chemical, biological, and climatic as well.

The formation of muck from peat of different kinds is accelerated by factors which are within the control of man. It is favored by the addition of manure and fertilizers, and by the application of lime, especially in States of the eastern humid belt. Peatlands pass more or less slowly from the natural state of well-preserved plant remains, through the muck stage, to the final transformation into humified organic matter. After that period has been reached, there remains a black soil with a high humus content to suggest the former location of the areas of peat. Since the settlement of the States, many extensive shallow deposits of peat which had once been under cultivation have disappeared. Today they constitute more properly a mineral soil type in the respective localities, with characteristic requirements and crop adaptations quite different from those of the original organic material.

Birds are the greenkeeper's friends. It is rare that they are destructive to turf, and the quantities of earthworms, ants, and grubs which they dig out of or pick off the turf is scarcely appreciated. They can be attracted to a golf course by planting fruit-bearing shrubs and providing bird houses.