John W. Bengtson, a former member, who is now specializing on turf for the U. S. Engineers at Mobile, Alabama.

It is fully recognized that past neglect in providing funds for a more critical study of turf culture leaves many problems for which no immediate solution is available. This failure, however, can in no way justify an additional failure to use to the best advantage the information and experienced personnel that is now available to most rapidly and efficiently provide the turf that is needed immediately and to rapidly improve present cultural methods.

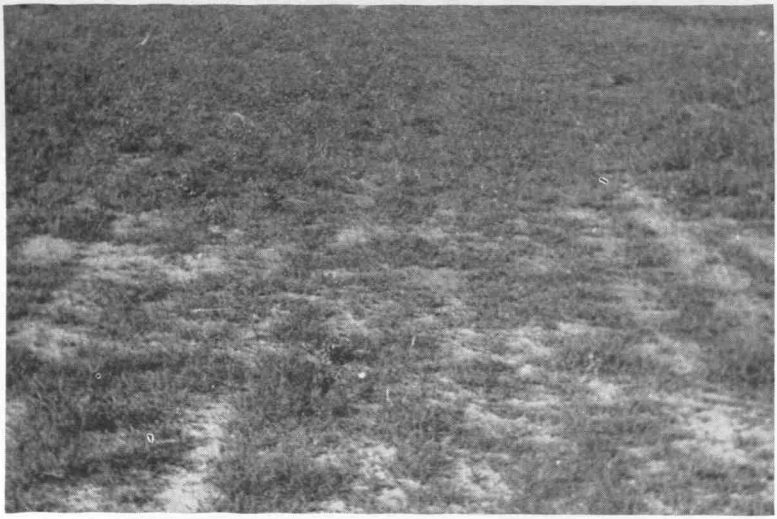
Soil

In preparing an area for turf one of the first problems which presents itself is whether or not to save the topsoil. The physical properties and plant food content of the topsoil in relation to the subsoil are the chief factors affecting the solution to this problem.

In many cases the practice has been to save the topsoil on areas requiring extensive grading. The saving and replacing of large quantities of topsoil involves considerable delay and expense. Assumption that this operation is an absolute necessity should be challenged in view of the fact that in some localities the subsoil is suitable from a physical standpoint and should produce a satisfactory turf provided enough plant food of the right kind is added. The advisability of saving topsoil is particularly questionable in much of the Bermuda grass region where the topsoil itself is poor. The cost of fertilizer represents only a small fraction of the cost involved in moving or saving the topsoil.

Freedom from competition by weeds is another point in favor of using subsoil exposed by grading operations. Topsoil which

is badly infested with weed seed becomes a serious handicap to the establishment of a good stand of grass. There are few viable weed seed on areas from which topsoil has been removed.



Bermuda grass turf which has been sprigged on an airfield. Foreground, on subsoil; background, on topsoil. The difference in amount of vegetation in the two areas is due to a larger number of annual weeds on the topsoil in the background rather than to a heavier stand of grass. Weeds retard the growth of grass and then die in late summer or early fall. A poor cover will remain on the area in the background after the weeds have died.

Soils on which turf must be grown may vary from heavy clays, to loose sands through wide variations in mixtures of sands, silts and clays. Soil mixtures which combine the sand, silt and clay in certain proportions are called loams. When, by fortunate accident, a sandy loam type of soil is present, it provides the most favorable physical condition for grass turf.

Soils on which establishment of turf is difficult because of unfavorable physical conditions can be corrected sometimes by

the addition of suitable soil amendments. Sandy soils may be improved by the addition of clay and possibly organic materials such as peat and muck. The important thing is to add sufficient fine mineral soil to stabilize the sand and retain moisture for plant growth. On the other hand, the addition of sand may help to prevent the development of dangerous slick surfaces on heavy clay soils.

Variation of physical properties of soils is so great in many places that soils ranging from heavy clays to loose sands exist on the same project. Where a great deal of cutting and filling is being done on projects having a considerable range of soil types it may be feasible to use a mixture of light and heavy soils for the top 4-to-8-inch layer of the fill.

Detailed information on soil stabilization studies is available in "Classification of Soils and Control Procedures Used in Construction of Embankments," *Public Roads*, Vol. 22, No. 12, February, 1942. Therefore, the subject will not be discussed here. In general, the improvement of soils from the physical standpoint will help in the establishment of turf provided similar careful consideration is given to the improvement of soil fertility.

Mucking

The term "mucking" is commonly used, particularly in the South, to designate the process of incorporating muck into sandy soil or simply the spreading of it on the surface. The significance of the mucking operation naturally hinges on what is meant by muck.

Loose usage of the word "muck" has given it a variety of meanings which have led to misunderstandings and misinter-

Trench 10 feet wide at the edge of an airfield runway excavated in preparation for "mucking." A 4 to 6-inch layer of muck is used to fill the trench. Natural vegetation growing in the muck is expected to produce a dense cover along the edge of the runway. The muck has already been placed in the trench in the background.

pretations. As the word is often carelessly used, it applies to almost any kind of soil or related material which is black or very dark in color, occurring in poorly drained areas. Due to this incorrect use, the word may include a dark clay or silt material which is essentially a sticky mud with little organic matter, or at the other extreme it may include a well-preserved peat containing practically no clay or silt.

Technically the term "muck" ordinarily is limited to organic matter, dark in color, granular in structure, and in such an advanced stage of decomposition that the original plant remains are no longer recognizable. The commercial mucks ordinarily used for modifying soil contain less than 15 percent mineral matter, but the mineral fraction may reach 50 percent and the material still be called muck. When above 50 percent it is classed as a mineral soil of high organic content.

A true muck therefore falls in Group 8 in the Public Roads Administration's booklet, referred to under "Soil." In this

Ten-foot strip of muck which has been in place along edge of airfield runway approximately one year. Note the dense growth of natural vegetation on this strip which prevents soil from washing onto the runway. Often the vegetation obtained in this way will not survive the dry conditions on airfields since it is usually brought in from low swampy areas.

booklet the "general stability properties" of peat and muck are classified as being "incapable of support."

For airfields and roadsides where load-bearing capacity is important, muck, or peat which is often erroneously classed as muck, is of little permanent value on sandy soils unless combined with marl or other suitable mineral soils which will serve to stabilize the sand. The organic matter will soon decompose when spread out on the surface or worked into the soil. The decay will be hastened if fertilizer is applied. Marl or mineral soils found in many hammock areas in the South or clay or loam soils elsewhere are far more beneficial than muck. Likewise clay and silt soils containing moderate amounts of organic

matter, which are frequently erroneously called muck, are superior to the true muck for improving sandy soils for airfields and similar purposes. The fine soil particles they contain in abundance have a permanent stabilizing effect on the sand and improve the water-retention qualities of the sand throughout the years.

When establishing turf on areas such as lawns for housing projects some classes of muck are helpful. Such materials should be free from sticky plastic residues which harden upon drying. Where muck is incorporated into sand before planting grass it will encourage the growth of grass, particularly if it is reinforced with some fertilizer. On stiff clay soils muck may help in loosening the soil and its use in some instances may be justified for this purpose.

Mucking is also used in the establishment of vegetation by the process described elsewhere in this issue as topsoil planting. While good stands may be established in this manner, it should be remembered that the vegetation naturally growing in the swampy areas from which muck is obtained is usually not of the kind suitable for turf and is not likely to survive long under the drier conditions it will encounter in many places where muck is now being used extensively.

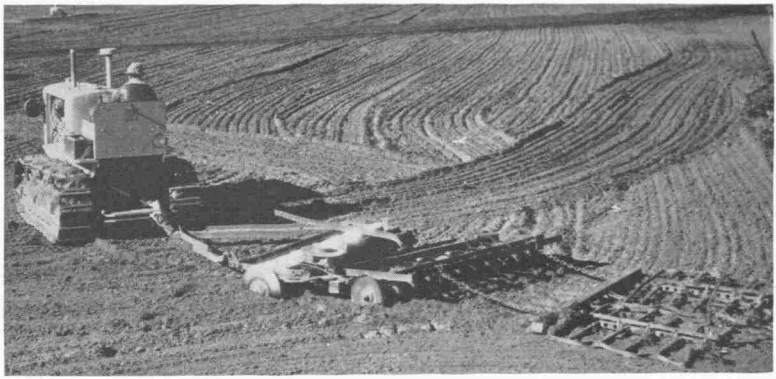
Drainage

No discussion of turf can be considered complete unless it points out the great importance of drainage in the establishment and maintenance of turf grasses. It is impractical, however, to discuss here the subject of drainage systems. It should be borne in mind that water drains more slowly from turf than from pavements and that, therefore, more pitch is required to remove water quickly from a turfed area than

from a concrete or asphalt surface. Poor drainage often unnecessarily delays the use of turf after rainy periods. Any irregularities in the surface, such as those caused by tires in wet weather, are more troublesome in flat areas than those with more pitch. Porous loams or mixtures of loam and clay soils with more than 50 percent of sand, are of great advantage in establishing turf from the standpoint of drainage.

Preparing the Seedbed

The purpose for which turf is to be planted, size of the area, and soil type are all factors which influence the methods to be



In preparing large areas for turf, a double disk may often be used to advantage. A machine such as this one, having a rear disk which throws the soil in only one direction opposite to the front disk, produces a level seedbed. The spike-tooth harrow dragged behind the disk helps to further pulverize and smooth the soil.

used in the preparation of a seedbed. On large areas such as airfields the preparation of soil for planting after the final grading has been done usually can be accomplished in one operation by the use of a disk. This operation may leave the