The Soil Profile

Characteristics of soil and their relation to drainage design as discussed by one of America's recognized experts

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IF ONE examines a freshly exposed vertical column of soil there are found various layers or horizons differing in their depth, thickness, color, texture, reaction and in other characteristics. This entire series of horizons is collectively known as the "Soil profile."

Soils show marked differences in the character of the horizons which make up their profiles. These differences are the result of different conditions of climate, of topography and of drainage during the formation of the soil from its parent material.

Consider the case of a soil adjacent to a stream subject to annual overflow; it receives yearly deposits of soil material dropped from the flood water. Before this deposited material has opportunity to undergo much change a fresh deposition is made. This continues from year to year. A soil formed under such conditions will show little variation from the surface downward. It may be almost entirely uniform to a depth of three feet or more.

In marked contrast is the soil on the upland far removed from any possible deposition by flood water. It has been in place for possibly thousands of years. Through all this long period of time it has been undergoing slow changes. The soil-forming processes have been continually remodeling it. Finally there results a soil in which there is a marked gradation in physical and chemical characteristics from the surface downward. A definite soil profile is developed in which there are several distinct layers of horizons differing in many ways, especially in thickness, textures and color, and often in reaction.

Upland Soils are Stratified

UPLAND soils of the humid regions generally tend to be somewhat stratified as to texture or size of particles. Their upper or surface horizons usually contain a greater proportion of larger particles than do the lower or sub-surface horizons. The process of leaching, especially in old soils, has tended to move the finer particles downward with the consequent formation of layers made up for the most part of very fine soil particles. Such layers offer considerable resistance to the flow of water through them. The opposite condition of sandy or gravelly layers in the subsoil, with consequent ease of water movement, is sometimes found.

It is seldom the case that the character of the surface soil furnishes a reliable clew to the kind of subsoil underneath. The drainage engineer is not so much concerned with the properties of the surface horizons as he is with those of the subsurface. It is particularly important to him to know whether or not any of the horizons of the subsoil are only slowly permeable to water. If they are, he desires to know the exact location of these impervious horizons with respect to their distance below the surface.

He also needs a clear picture of the nature and texture of the soil material in these impervious horizons in order to know how to proceed to overcome this condition. A lack of knowledge of these two points might result in so placing lines of tile in the sub-soil as to render them ineffective.

How Soil Texture is Defined

A DETERMINATION of the percentages of the various sized particles which constitute a soil defines its texture. Soil particles vary in size from mere specks, invisible with the most powerful microscope, to those which are large enough to be seen with the unaided eye. The physical properties of any soil horizon are determined largely by the size, arrangement and relative proportion of these different sized particles in it. Of particular interest to the drainage engineer is the amount of extremely fine or "colloidal" material present. He is especially interested in this because of its marked effect on the total surface area of the soil particles which in turn effects the movement of water through the soil.

As the number of fine particles in a given weight of soil is increased the combined surface area increases also, but not in the same proportion. If the size of particles is decreased to one tenth the previous size, the total number present in a given weight of soil is increased one thousand times. At the same time their total surface area is ten times as great. It is this latter which is of most significance from the drainage standpoint.

If all the particles contained in an acre of soil to plow depth had diameters of one-twenty-fifth of an inch the total internal surface area in the acre would be less than five hundred acres. On the other hand if the particles all had diameters of one-ten thousandth of this amount the total internal surface area in the acre would be five million acres. In this latter case the particles would tend to stick together with a consequent slowing up of the rate of movement of water through the soil. Many soils contain a considerable proportion of particles smaller than those last mentioned, especially in their subsoil horizons.

These fine colloidal particles tend to decrease the size of the drainage channels through the soil and cause them to offer great resistance to water percolation. Imperviousness is usually most highly developed in fine textured soils which necessarily have minute interspaces and hence high friction. This condition is usually intensified in the subsoil horizons.

The Meaning of Flocculation

IT IS well known that colloidal particles such as exist in soils, may be present either in a highly dispersed state where each particle acts as an entity, or, they may exist in clumps or masses made up of a number of individual particles. In this latter case they are said to be flocculated. A soil horizon in which the colloidal particles are flocculated is much more permeable to water than one in the deflocculated condition.

This condition of flocculation depends largely upon the reaction of the soil, an acid reaction causing dispersion or deflocculation. Flocculation may be caused to take place by decreasing the acidity by means of additions of limestone.

Obviously, the decision regarding the proper depth and spacing of drainage lines cannot be made arbitrarily; it must be decided entirely with reference to the character of the particular soil profile involved. The depth, thickness, texture, colloidal content and reaction of the various soil horizons must be taken into consideration. Each soil type has its own individual combination of these characteristics, and the depth and distance apart of the tile lines must be determined accordingly.

Minnesota Greenkeepers Assn.

THE young and thriving Greenkeepers' Association of Minnesota which was organized April 5 has already issued its booklet containing constitution and bylaws and other information.

The booklet states that there are twenty-six clubs in the Twin Cities district, which includes Saint Paul and Minneapolis. Seventeen of these clubs have already joined the association.

The object of the Minnesota Association shall be to advance the art and science of greenkeeping, to cement the greenkeepers of the state into a closer relationship with each other and the National Association, to collect and disseminate practical knowledge of the problems of greenkeeping with a view to more efficient and economical maintenance of golf courses.

Eliminating the Compost Pile

Many greenkeepers still wonder whether it is possible to get along without a compost pile. Quite a few others—greenkeepers not tied down by traditions anent the growing of grass, have discovered that it is not only possible to do away with a compost pile but that such procedure is the most effective method of producing a set of uniform, healthy, fine, thick turf greens of a rich shade.

The experience of Grange Alves, pro-greenkeeper at the Acacia Country Club, of the Cleveland, Ohio, district, ought to prove interesting. Alves has done away with the compost pile at Acacia.

All Alves used on the greens at Acacia is Lecco and sand. The sand, free of pebbles and sediment, was used as a topdressing. The sand is distributed with a Stumpp & Walter topdresser and rubbed into the turf with cocoanut mat. The Lecco is applied by hand. Alves has been applying sixty pounds of Lecco to a green of five thousand square feet. On a green of nine thousand square feet he has applied eighty pounds.

Another of the conservative greenkeepers, W. H. "Bertie" Way of the Mayfield Country Club, Cleveland, like Alves, has had little use for a compost pile this year. Way has applied fifteen tons of Lecco to the greens and fairways at Mayfield and the course was never in better condition. Mayfield has always been noted not only for its greens but fairways as well. Many give Way credit for being a past master when it comes to fertilization.

The most startling thing Way did was to give the No. 2 green, smallest on the course, one hundred and fifty pounds of Lecco in one hour. That was on July 5. The green at that time was brown in color and Way believed it had gone. In a little over a week this green had come back a richer green than ever. The blades of grass were noticeably finer and the grass in general denser over the whole green.

One of the clubs to discard its compost pile was the Kirtland Country Club, of Willoughby, Ohio. This course is in charge of Arthur Boggs. Like "Bertie" Way, Boggs uses only Lecco and a sandy loam as a topdressing on the greens at Kirtland. Boggs also uses Lecco on his fairways. Another club to eliminate their compost pile is the Pepper Pike Country Club, Cleveland, O.

Tournament Schedule

July 26-28—Annual Buckwood Trophy Tournament at the **Shawnee C. C.**, Shawnee-on-Delaware, Pa.

July 31-Aug. 5—Public Links Championship, **Cobbs Creek Course**, Philadelphia, Daniel Flaherty, Greenkeeper.

Aug. 15-18—Buffalo District Amateur Championship, **Cherry Hills Country Club**, Charles Behm, Greenkeeper.

August 27-Sept. 1—Western Golf Association Amateur Championship, **Bob O'Link Golf Club**, Chicago, Ben Freberg, Greenkeeper.

August 30-31—Walker Cup Matches, **Chicago Golf Club** Wheaton, Ill., John MacGregor, Greenkeeper.

September 10-15—National Amateur Championship, **Brae Burn C. C.**, West Newton, Mass., John Shanahan Greenkeeper.

September 24-29—Women's National Championship, **Virginia Hot Springs Golf and C. C.**, Virginia Hot Springs, Va.

October 5-6—Lesley Cup Matches, **Winged Foot Golf Club**, Mamaroneck, N. Y., John Elliffee, Greenkeeper.