Soils, Drainage and their Part in Profitable Operation

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(At N. A. G. A. Convention)

PROBABLY a better idea of the greenkeeper's work and importance would prevail were he to be known as the golf course manager. Greenkeepers are the men behind the guns of one of America's greatest and most rapidly growing industries. There are scores of men in the profession who are running million dollar factories to manufacture just one single identical product—pleasure.

The dividends you greenkeepers earn for your member stockholders are totaled up at the end of the year not as so many dollars and cents, but as so many good days of perfect golf.

Let's analyze this idea of the pleasure factory and see just who is the really important man in your company on whom depends the dividends your club will pay at the end of the year.

Every manufacturing concern when it gets into the big business class with $100,000 to a million or more dollars of invested capital, has a president, a secretary, a treasurer and a board of directors, but they do not really produce the manufactured product. They only direct the business. Out in the factory you will find the men behind the guns and the big boss here is the factory or works manager.

You greenkeepers are in identically the same relative position to your board of directors as is the works manager. You are the biggest single factor in the manufacturing of this thing called golfing pleasure.

When the works manager finds that the machinery which his board of directors have provided for him is getting obsolete, he does not wait for the board to ask him what is the trouble with his production. If he is a smart works manager, he is the one who is constantly plugging at the board to let him make improvements which will speed production, lower costs, or improve the product.

Demand Working Facilities.

The point I want to make here is that unless the greenkeeper himself demands of his club that he be provided with adequate drainage, irrigation, or maintenance equipment he is not likely to secure these benefits in time to save his job.

Economical maintenance, is entirely relative. What one club finds economical would, for another club, be a waste of resources. The perfect golf course from the standpoint of economical maintenance has never yet been built. There are always factors affecting the final cost of upkeep and consequent amount of income which can be improved. How many of these factors which affect profit and loss in the operation of your course and clubhouse can be traced back to the drainage of the grounds? Did it ever occur to you that the clubhouse manager may show a red ink figure all through the months of April, May, October and November because he has filled his ice box with perishable foods and a rainy Friday has kept his Saturday and Sunday patrons at home? If your course had the reputation for always being dry, regardless of the frequency and amount of rainfall, this loss would be largely eliminated, due to tile drainage.

Briefly stated, the following facts regarding tile under-drainage will all stand the searchlight of scientific investigation. Whether your course is flat, rolling, or hilly; of clay, loamy or sandy soil; uniform tile drainage from the tee through the green will pay dividends on the investment, both in cash and pleasure because:

Drainage reduces the cost of putting the course into condition in the spring by preventing winter kill, heaving of the grass and erosion of bunker slopes; by increasing the efficiency of labor due to good working conditions; by permitting the use of larger units of machinery without damage to the turf or soil.

Uniform drainage has lengthened the

playing season an average of two months in Chicago, Detroit, and Cleveland districts by permitting safe conditioning of courses for April first opening and December 15th closing.

The total number of rounds of golf played for the year will be greatly increased but the peaks on a curve showing daily number of players will be smoothed by increased numbers of players using the course early and late in the season and also by preventing the heavy drop in week-end attendance during mid-season caused by a wet course and the consequent jam on the following week-end. It costs little more to keep a course in condition for 200 than for 50 players.

Drainage Lowers Water Cost.

Thorough tile drainage reduces materially the amount of sprinkling water required to keep the turf in best playing condition, both as to amount of water and frequency of application. This statement is the one most likely to be doubted. Drainage, by causing a chain of physical changes to occur in the natural undrained soil, actually increases the absorption and moisture holding capacity of all types of soils. Thorough tile drainage increases the content of capillary moisture in the soil to such an extent that this factor alone is of enough value to make it a sound investment in reducing the cost of maintenance. Capillary moisture, the only form of soil moisture of value to plants, moves in all directions in the soil regardless of the force of gravity, but the rate of movement toward the surface is largely dependent upon the tilth of the surface layers of soil. Drainage keeps the soil mellow and open. In puddled soils, that is soils that have been compacted by rolling or trampling when full of free soil water, the capillary moisture supply and replacement is reduced to a minimum, hence more artificial sprinkling is required. Free soil water is absolutely detrimental. If saturation is maintained for more than a few days, air starvation will result in killing the turf.

Properly installed tile drainage produces and maintains the proper aeration of the soil. I wish I could tell the story of air in the soil. Let me tell just enough here to show its importance in economical maintenance. It is the benefit resulting from increased soil aeration which makes profitable tile drainage of sloping fairways where surface water never stands. Air and water cannot occupy the same space in the soil at the same time, hence, when the soil is full of free water, air is entirely excluded. When the free soil water is removed by run-off through tile drains, fresh air is pulled into the pores of the soil. The rapidity and frequency of this ventilation of the soil is a most important factor in determining the cost of growing good turf.

Soil Air Vital.

There is a universal law in organic life, be it plant or animal. Life, to be main tained, must have the right kind and amount of food, air, moisture, and warmth. If any of these are taken away, there is sickness. Soil air, the element generally lacking in the combination that constitutes the vital force in plant life, can be permanently and cheaply supplied by tile drainage. Nitrogen, purchased as ammonia in the fertilizer bag, and oxygen, so essential to soil fertility and plant life, are the two principal constituents of air, totaling nearly 98 per cent of the entire volume. Plants must get their oxygen through their roots as well as through their leaves.

Drainage is designed for two purposes. First, for the removal of all surface water and run-off from roofs, roads, and other areas. Secondly, the removal and control of soil water, whether resulting from rainfall, springs, or seepage from adjacent land.

The engineering data and experience is already at hand for the accuate and economical design of the drainage faculties required for the removal of surface run-off. The second purpose of drainage, that of soil water removal and control is the subject on which very little information is available except from the few engineers that have spent a lifetime on the subject. The mechanics of drainage construction and the hydraulic formulae for calculating the movement of water through pipes are an open book, but data on how fast water will seep into the ground and how fast it will run out is a major question that must be investigated on each individual golf course.

The determination of the drainage characteristics of each soil type on each golf course and the source of the ground water are, therefore, the major problems confronting the drainage engineer in planning a system.

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."

Wide Variations in Soil Profiles.

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 deposit 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 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 subsurface 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 clue to the kind of sub-soil 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 sub-soil are only slowly permeable to water. If they are, he must 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.

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 turf 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 of the soil particles increases also, but not in the same proportion. If the sizes 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 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 a six inch depth had diameters of one-twenty-fifth of an inch the total surface area of the soil particles 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 sub-soil horizons.

These fine colloidal particles tend to de crease the size of the drainage channels through the soil.