

## Drainage

By EDWARD B. DEARIE, JR.

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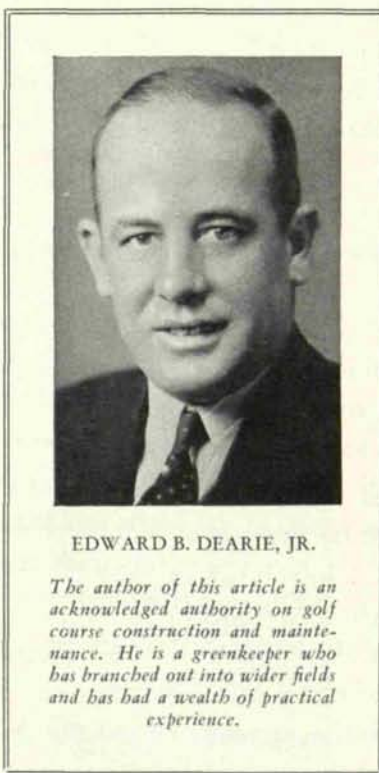
FIFTEEN years ago the problem of drainage on any golf course was not seriously considered. Today no golf club would attempt to build a course without the services of a qualified drainage engineer to render a complete and definite set of plans of uniform drainage. Experience is the greatest teacher and nearly every club has had more or less of that.

The cost of inadequate drainage to the clubs of the country cannot be estimated due to the lack of knowledge of the fundamentals of drainage. Tile lines were inadequate and undersize with no definite outlets, usually discharged into stone wells or open ditches with no permanent outlets.

Tile drainage was mostly installed by golf course labor with no idea of drainage work, as to depth and grades of ditches, the amount of water to be taken off a given area and the trunk line sizes necessary. No general plan of drainage was adhered to usually required for a complete golf course system.

### UNDERDRAINAGE REQUIRES ENGINEERING KNOWLEDGE

UNDERDRAINAGE requires not only a thorough knowledge of the principles of drainage engineering, but an extended practical experience in laying



EDWARD B. DEARIE, JR.

*The author of this article is an acknowledged authority on golf course construction and maintenance. He is a greenkeeper who has branched out into wider fields and has had a wealth of practical experience.*

out systems of drainage under varying conditions of different climates and soil conditions that demand a thorough knowledge of soil physics. The principles of land drainage must be clearly understood by those who are concerning themselves with the vast improvements in golf course perfection today.

The primary reason for complete and uniform drainage is the removal of storm water and excessive moisture in the ground as a result of spring thaws and rains, and, to prevent stagnation of the soil waters, which means to avoid the exhausting of O (oxygen) from the air in the soil water and in spaces not occupied by water. An abundance of free oxygen in the

soil is a fundamental necessity to turf growth. This is secured through drainage.

To germinate seeds we must have oxygen in the soil or they will rot. The roots of the plants must have it to enable them to do their work. And the vast army of soil bacteria which change the nitrogen of decaying organic matter into nitric acid which is the chief nitrogen supply for most higher plants, must have it or they cannot thrive.

Therefore the problem of acquiring and maintaining a good fairway playing surface at all times



during the season and especially the Spring, resolves itself to one thing—the removal of surface water or ground water or both.

The withdrawal of that water or part of such water that does not evaporate represents the problem of drainage. Therefore no attempt is made to enumerate the vast number of cultural principles and engineering problems involved in removing or conserving soil moisture for turf growth relative to golf courses due to varied climatic condition and the wide range of soils encountered in most drainage work through the country.

#### ALL LANDS REQUIRE DRAINAGE

**I**T MUST be kept in mind that all lands of whatever kind require drainage but it is extremely fortunate that for most lands this is done by natural methods of percolation and underflow of ground water.

The cases in which it becomes desirable to supplement the methods of natural drainage fall into four classes:

First: Those comparatively flat lands where surface waters from the surrounding higher land frequently collect.

Second: Areas bordering higher land whose structure is such as to permit the undertow of the ground water from adjacent regions to rise from beneath, thus keeping the soil too wet to play over.

Third: Lands regularly inundated by rise of tides or which would be if not shut off by dams or control means.

Fourth: Those extremely flat lands which are underlaid by considerable thickness of close, heavy clay or clay through which water does not readily percolate and which lies very close to the surface so that the clays become the sub-soil of the surface that is impossible for rain or water to penetrate.

Hence the problem of any golf course drainage is one of local conditions and the general condition existing, such as the laws governing the flow of water into the drains and ditches and how the surface of the water in the ground is related to that in the streams or lakes surrounding the property or which you continue to drain to.

An effort is made here to present in a broad, yet specific way the fundamental facts which underlie most drainage problems and the beneficial results usually obtained from proper drainage installation.

#### FACTS ABOUT DRAINAGE PROBLEMS

**T**HE great demand for irrigation today is too well known. This no doubt will have a material effect on drainage. Thorough tile drainage reduces materially the amount of sprinkling water required to keep the turf in the best playing condition both as to the amount of water and frequency of application. This fact may most likely be doubted.

Drainage, by causing a physical change 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 an asset to any club. Capillary moisture, the only form of soil moisture of value to plants, moves in all directions in soil, regardless of the force of gravity, but the rate of movement toward the surface is largely dependent upon the surface soil condition.

Drainage keeps the soil mellow and open: In puddled soils, that is, soils that have been compacted by heavy rolling when full of free soil water, the capillary moisture supply and replacement is reduced to a minimum, hence more watering or rain is required. Free soil water or gravitational water is absolutely detrimental and if saturation is maintained for more than a few days air starvation will result in killing the turf. Properly installed drainage produces and maintains the proper aeration of the soil.

Soil aeration is the benefit resulting from increased soil aeration which makes profitable tile drainage. Air and water cannot occupy the same space 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 the drains fresh air is pulled into the pores of the soil. The rapidity and frequency of this ventilation of the soil is the most important factor in growing good turf.

There is a universal law in organic life, be it plant or animal life, that if it be maintained it must have the right kind and amount of food, air, moisture and warmth. If any of these are taken away there is lack of growth. Soil air, the element generally lacking in the combination that constitutes the



vital forces in plant life, can be permanently and cheaply supplied by tile drainage.

Nitrogen and oxygen, so essential to soil fertility and plant life are the two principal constituents of air, totaling nearly 98% of the entire volume. Grass plants must get their oxygen through their roots as well as through their leaves. Grasses have no air circulatory system with which to pass air from the leaves down to the roots hence it follows that if the roots cannot get air from the soil they cannot get it at all. Heavy rolled, packed and puddled soils and soils saturated with free water can supply little or no air to the roots.

#### DRAINAGE SAVES MONEY ON FERTILIZING

**F**ERTILIZING of all fairway areas that are uniformly drained shows about ninety-five per cent efficiency as against about sixty-five per cent on undrained fairways. This holds equally true with new seeding or reseeding of fairways due to improved soil temperature.

Drainage reduces the cost of putting the course in condition in the spring by preventing heaving of the fairway surfaces which results in winter kill and root destruction of the grasses, making constant reseeding necessary.

Drainage permits the use of all course equipment much earlier without damage to the turf. Drainage reduces erosion and washouts of trap bunkers and embankments. Properly installed drainage in traps and pits is of vital importance. Tons of sand are wasted yearly on poorly installed drain lines in traps and pits.

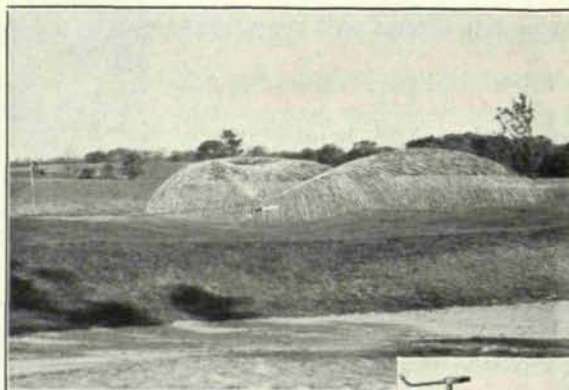
To install uniform drainage throughout from tee to green requires the services of a qualified drainage engineer to prepare plans covering the entire course area with a supplementary radius survey indicating or locating a definite and permanent outlet. The survey is usually taken in two hundred foot squares, co-ordinated alphabetically, the contour lines to be shown in two or five-foot intervals.

A topography map is indispensable in laying out a complete drainage system, and no club should attempt the planning of a system otherwise. Equally important is it necessary to have a soil plat showing the general geological formations to determine the sizes, depth, and spacings of the tile lines. This in-

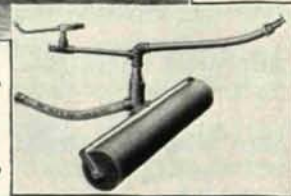
formation is the basis of arriving at the cost of a complete drainage installation.

Uniform drainage will lengthen the playing season of any golf course on an average of 35-50 days in a year, permitting play shortly after a heavy rainfall, whereas, undrained courses present a picture of lakes and pools all over the landscape and create an irritated membership who leave the course in disgust. Therefore drainage is the foundation of any course and the course without properly installed tile drainage can never be conditioned for championship play except at a great cost of upkeep and expense.

In conclusion of this article permit me to say that the purpose of drainage relative to golf courses is more than the mere idea of running a line of tile from one sand trap to the other or from one low spot to the other without any definite plan of outlet or understanding of functional principals of drainage. One must have an understanding of the various ramifications, and problems encountered by the elements of nature and man's attempt to control them.



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