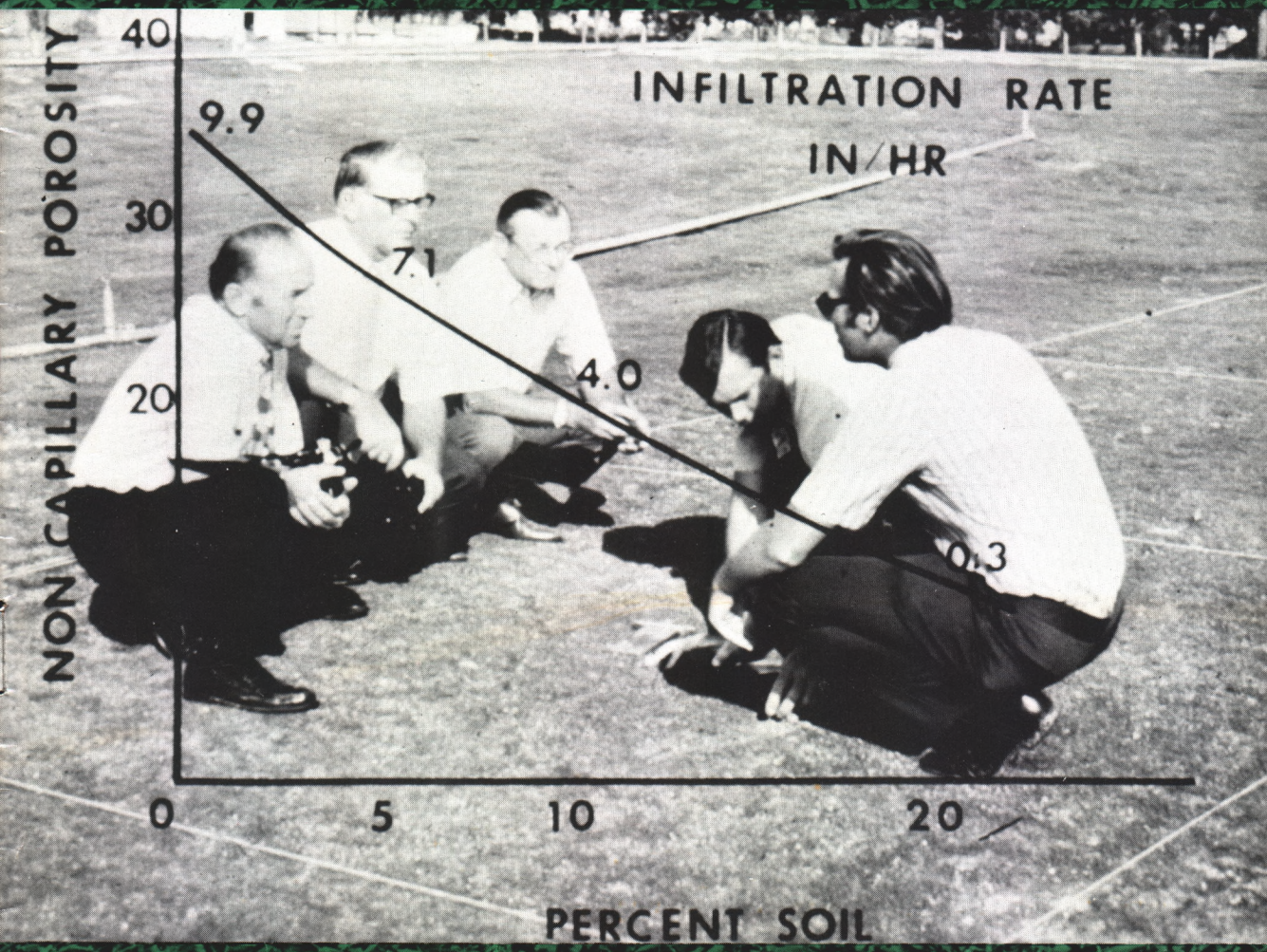
JANUARY 1975

USGA GREEN SECTION RECORD

A Publication on Turf Management
by the United States Golf Association



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VOL. 13, No. 1 **JANUARY 1975**

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A graph of water movement through soil being studied at Texas A&M University is superimposed on a picture of (left to right), Al Radko, James B. Moncrief, Dr. Marvin H. Ferguson of the USGA Green Section and Dr. Kirk Brown and Dr. Richard Duble of Texas A&M. Photo courtesy of Texas A&M University.

FUNCTIONS AND MOVEMENTS WITHIN PUTTING GREEN SOILS

by **HOLMAN M. GRIFFIN,** Mid-Atlantic Director, USGA Green Section

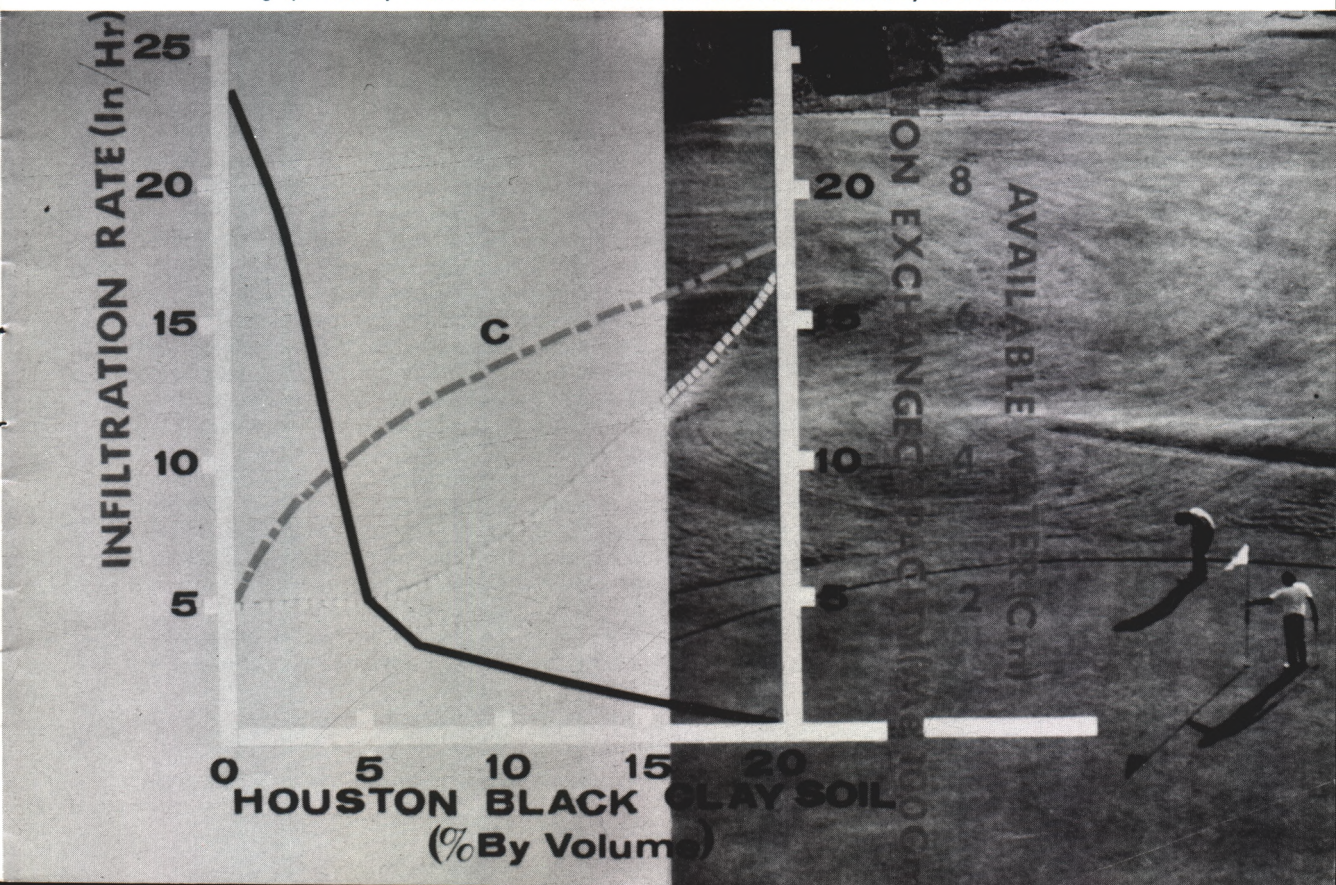
For many years now the Green Section has been studying putting green soils. First we sought to determine what comprises a suitable soil mix, and now, what goes on inside it. This latest study has taken on more importance in light of environmental concern and its residual regulations.

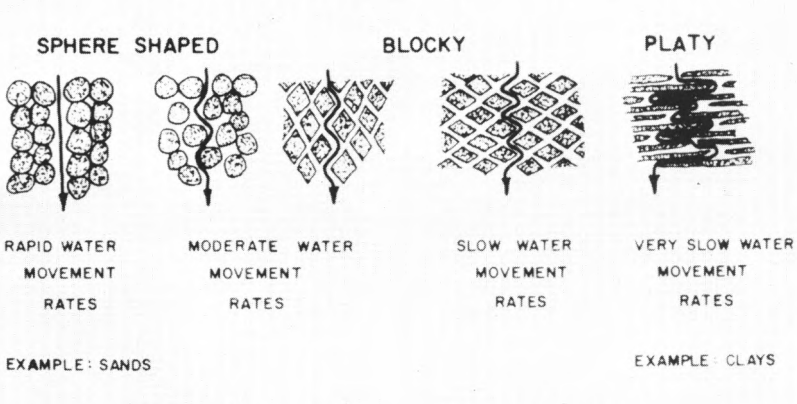
Functions within a soil in this instance refers to such things as biological activity, cation exchange capacity, root penetration, and the exchange of gases with the atmosphere and within the soil itself. These are functions of the soil *per se* or of agencies within the soil acting upon it.

Biological activity is probably least understood and an area in which our studies must overlap into the field of pure biology and bacteriology. My nephew pursued a post graduate degree in biological physics. He was so far inside the surface of plants and soils that his reports were akin to biological science fiction. Although not bodily transported, he nevertheless literally was being transported through plant parts and soil particles. The paper he sent me titled, "The Dimerization of Chlorophyll A,B,C and Bacterio-Chlorophyll' was of little practical value to my immediate interests in making grass turn green by applying nitrogen, but no doubt will someday be easy reading for turf students.

We should be concerned with the *biological activity* of soils on a practical level at this point,

Result of soil component and water movement studies at Texas A&M University show greatly reduced infiltration, an increase in cation exchange capacity, and greater moisture holding capacity as the clay content of a soil is increased. This graph clearly indicates the undesirable effect of too much clay in a soil mix.





The effect of soil particle size and shape has great influence on water movement.

however, because biology refers to life, and life within the soil has a tremendous influence on our success in growing turf. Hopefully we can find ways of increasing favorable biological activity and surpressing other forms.

The effects of pesticides on soil life have not been investigated extensively, but will no doubt be a fertile field for future study. The soil contains many organisms from microscopic bacteria to earthworms. The earthworm is a beneficial organism for the soil, but it is undesirable for golf greens because of their casts on the putting surface. Less desirable is the parasitic nematode, but even certain types of these microscopic animals can be beneficial in the soil. Most of the other soil bacteria and fungi is at least partly beneficial and concerned with such things as nitrogen fixation and the transformation of organic matter to humus. To aid the beneficial organisms in the soil, we should maintain a desirable soil pH, proper aeration and proper moisture.

Cation exchange capacity of a soil is a measure of the soil's ability to absorb, store and release nutrients. Some of the more recent methods of putting green construction advocate almost pure sand, which has a very low CEC (cation exchange capacity). I don't believe this is a really critical factor, however it has never been more important than now with limited or nonexistent fertilizer supplies at extremely inflated prices.

The USGA Green section has always thought that a putting green should have a small amount of soil (clay) in the mix; the figure is probably near 5 per cent by volume. This not only increases the cation exchange capacity, but also the moisture retention and possibly enhances the activity of microflora.

Root penetration of a soil is exactly what we hope for. The root itself excretes powerful acids from the region near the root tip which helps decompose soil solids such as rock. We have often heard the expression that a turf can produce its own soil. In many ways that is exactly what happens. Even when the soil is near ideal to start with, such as on a properly prepared putting green, the root penetration helps to keep it properly aerated and influences the amount of organic matter and humus present. In most cases, all three functions are beneficial.

The exchange of gases with the atmosphere and within a soil is a vital process. Oxygen is probably the most important of the gases, because it is essential for every living organism. Proper aeration, through mechanical methods, proper watering and proper mixing of prepared soils cannot be over-stressed. We have direct control of all these procedures and the natural aeration of roots, earthworms, and the like are incidental.

Turf roots need almost as much air-filled pore space as moisture filled pore space to grow properly. We have more exactly specified the range of tolerance of turf in this area within recent years, but the first figure I ever saw of 25 per cent air, 25 per cent water, and 50 per cent solids for best plant growth is still correct enough for practical purposes.

Dr. Marvin Ferguson first told me of it, and later I saw published information stating that bentgrass can survive on the oxygen in fresh water. Be sure that the oxygen in trapped water is quickly depleted in the presence of living organisms such as turf roots, so I emphasize *fresh* water.

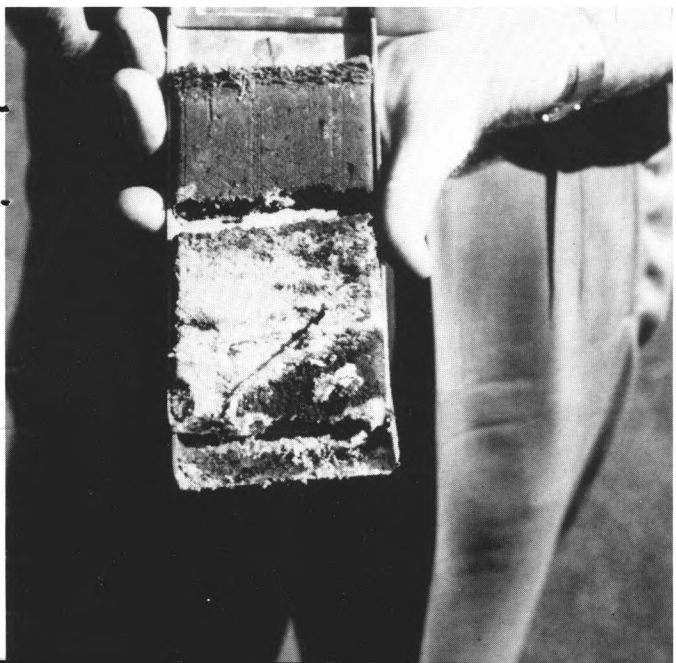
No matter how much pore space we put into a soil mix originally, the pore space remaining after compaction will determine its adequacy. Because of this, the intended use of the area is an important consideration in determining how porus a soil has to be to produce good turf. In most cases, proper pore space is obtained by adding the correct amount of properly sized sand.

Proper components and their correct use in construction are a key factor in green construction and turf manageability thereafter.

Most of the functions just described within a soil are closely related to and overlapping with the movement of moisture, soil solids and soil additives also taking place within the soil.

The movement of soil moisture basically is described as infiltration, the movement of water into a soil; percolation is described as the movement of water through a soil. The rate of infiltration and percolation is influenced primarily by the size and distribution of soil pores and the shape of the soil particles. Water moves much faster through large pores than through small pores, because of cohesive as well as adhesive forces which are greater in the smaller pores. The large pores are important for the rapid movement of water into and through a soil as well as for proper aeration. The shape of the soil particles, whether sphere shaped, blocky or platy, also has an influence on the rate of moisture movement and aeration. Sands are typically spherical in shape encouraging more rapid moisture movement, as opposed to clays which have platy characteristics and slow down moisture movement. In order to get sufficient movement of moisture (drainage) as well as sufficient capacity for moisture retention for use by the plant, it is necessary to select or manufacture a soil with the proper amount of both large and small pores. This in itself is a big order, but we are also looking for a soil with good nutrient retention (high cation exchange capacity) and one which is resilient after compaction. This can be best done only by a laboratory equipped to perform a thorough physical analysis as described in the USGA Green Section's publication, "Method of Putting Green Construction."

Soil layering can cause many problems with water movement.



With soils on the golf course other than the putting greens or tees, we must either try to select the best soils on which to build, or as it is more often the case, resort to mechanical aeration as a means of introducing adequate pore space.

The movement of soil solids influences the physical structure of soils over a period of time, and we are highly interested in this activity, because it influences the productive longevity of soils. Movement of soil solids could completely change the nature of a soil and its ability to grow plants.

Studies at Texas A&M thus far have given no indication of significant movement of soil solids. This research, however, is really just beginning and it is far from conclusive. Earlier studies have definitely shown movement of smaller particles such as silts and clays into larger particles below such as sands and gravels if the particle size differential was greater than five to seven times the particles above. This knowledge is rather useful in installing french drains or ordinary drain lines as well as in mixing and constructing putting greens. I would hate to count the number of times I have seen drains fail on golf courses simply because this fact was unknown or ignored. There is certainly

Many factors can cause shallow rooting in turf, especially poor watering practices and a soil which has inadequate drainage. In this case a water leak from an irrigation valve in the center of the green separated the turf mat on top from the roots below. The turf rolled up like a rug.

no useable pore space in rock, and the useable pore space between them is quickly filled with smaller particles which may or may not have sufficient pore space for good drainage if there are no barriers.

The movement of soil additives has to do with the leaching or dissipation of such things as nutrients and pesticides. Once again, the other factors discussed come into play, especially cation exchange capacity, biological activity and moisture movement.

Cold fear gripped the public in the last three or four years when stories of thin egg shells, diminishing wildlife species and pollution of human food and water hit the papers. The move toward eliminating this pollution would no doubt have also eliminated recreation, wildlife, business and ultimately the human race if left unchecked in the hands of the alarmists.

We have every reason to fear pollution, but let's not go beserk until we have decided just what pollutants are and how best to cope with them. Anything without the proper checks and balances can be detrimental. Increasing population is a pollutant source, but let's not adopt Hitler's techniques for solving it.

For the past three years the Green Section has sponsored studies on the movement of nutrients and pesticides through putting green soils because of the concern about waste of nutrients through leaching and the harmful residues and lechates containing pesticides. The studies indicate that many of our fears are unfounded, especially concerning mercury and arsenic. In most cases these two elements do not run off or leach through the soil in quantities declared unsafe for human consumption by the federal government when used in the amounts normally recommended for turf work.

The loss of nutrients is relatively minor and most times necessary to maintain proper drainage and aeration. Nitrates in lechates can be harmful, but as yet the general feeling is that the benefits outweigh the detrimental effects.

The interaction of soil additives with the soil and with each other is relatively unresearched, but what little is known about the exchange of ions between particles is another story in itself. At a practical level, we are most concerned with keeping the soil pH in a favorable range for the optimum exchange and utilization of these elements.

Most of the information presented here is common knowledge or readily available from turf texts, but it is my hope that some additional information has been added and the entire article presented in such a way as to invoke some thoughtful practical applications.

THE RULES OF GOLF AND GOLF COURSE MAINTENANCE

by JOHN P. ENGLISH

The highest priority in maintaining a golf course for informal play or championships has to be assigned to the tender loving care of the turfgrass on tees, fairways, rough, and putting greens, and no Green Committee Chairman or Golf Course Superintendent should let anything interfere with the pursuit of this priority.

As with every complex operation, however, there are other priorities. One which ranks close behind, certainly, is that of maintaining a course so that the Rules of Golf can be applied easily and consistently to all predictable situations.

For a simple example, take the boundaries—the stone walls, fences, stakes and even lines on the ground which tell whether a ball is in or out of bounds. Golf courses which have clear-cut and complete boundaries are, sadly, the exception. Members know that a ball in Farmer Jones' pasture is out of bounds, whether stakes mark the property line or not. Members know, too, that a ball over the stone wall on another hole is out of bounds—but what about a ball nestled on the inner side of that irregular, tumbled-down stone wall? Exactly what points on the stone wall define the boundary? Members generally drive no more than 220 or 230 yards at best, so the boundary stakes on still another hole are carried forward only about 250 yards, where the line terminates in open ground. Good enough for member play most of the time, but along comes young Jack Palmer, fresh from the tour, and pulls one 285 yards into the open ground somewhere beyond where the line terminates.

How does any Rules of Golf Committee

The boundary of water hazards (yellow stakes) and lateral water hazards (red stakes) should be precisely delineated and defined.

decide whether these balls are in or out of bounds?

These are elementary situations, to be sure. They can be seen and corrected by forward-looking Rules of Golf Committees just before championships. But Golf Course Superintendents who are knowledgeable about the Rules can greatly improve the course for member play and simplify occasional preparation for championships by adopting regular maintenance practices with the Rules of Golf in mind.

Definition 21 provides in part that: "When out of bounds is fixed by stakes or a fence, the out-of-bounds line is determined by the nearest inside points of the stakes or fence posts at ground level . . ." Referees in important championships and club members in friendly conflict are always entitled to a clear line of demarcation, along which they can easily sight from stake to stake or whatever and which extends even to those unlikely places where balls rarely—but sometimes do—come to rest.

It is a simple thing for a superintendent to establish a boundary with standard large white stakes and keep an eye on them from time to time, insuring that all are in place and in good order. Many do? All should.

This sort of thing is multiplied in more subtle and complex ways all over a golf course.

A superintendent, in his effort to maintain his course under the Rules, will be guided first by that basic Rule 36-6 which covers not only out of bounds but also other boundaries and margins and provides in part:

"The Committee shall define accurately:

"a. The course and out of bounds.

"b. hazards and lateral water hazards, where there is any doubt.

"c. Ground under repair.

"d. Obstructions.

Hazards, of course, start with bunkers, also known in the vernacular as traps. Definition 14 describes a bunker as "an area of bare ground, often a depression, which is usually covered with sand. Grass-covered ground bordering or within a bunker is *not* part of the hazard."

Both the Rules of Golf and sound maintenance call for such sand as may be in a bunker to remain within a clearly defined margin. Nature, through heavy rain storms, and groundsmen, raking hastily by hand or with machinery, tend occasionally to be forces in opposition.

When a substantial amount of sand has been washed out of a bunker or pulled out by a mechanical rake and a ball comes to rest on this sand, a Rules Committee may have another near-insoluable problem in determining whether the ball is in or out of the hazard. And, of course, there are limitations on what a player may do when his ball is in a hazard: He can't ground his club, he can't remove loose impediments, he can't test the surface.

Insuring all Out of Bounds stakes are in place and in golf course

The golf-course superintendent with an understanding of the Rules can train his crew so that such situations rarely occur and certainly do not persist.

Water hazards and lateral water hazards (they are two different things) present a more complex problem. Rule 36-6B places on the committee in charge the responsibility of identifying not only the margins but also the types of hazards. Since these decisions represent judgment calls, the Golf-Course Superintendent is well advised to counsel with both his Green Committee and his Golf Committee.

Definition 14b says in part that "a water hazard is any sea, lake, pond, river, ditch or any other open water course (regardless of whether or not it contains water) . . . All ground or water within the margin of a water hazard, whether or not it be covered with any growing substance, is part of the water hazard . . . "

Since the definition clearly implies that a water hazard includes not only water but also a certain amount of dry land, its margin has to be delineated by something other than the water-line. Usually this delineation is carried out by means of short colored stakes or lines on

good order is a simple yet essential requirement of todays superintendent.

the ground or a combination of both. The margin normally is drawn to include in the water hazard not only all ground which is, or may at times be, covered by water, but also all rough, eroded ground along the banks which cannot be properly maintained for normal play. If a ball coming to rest on a banking of a water hazard might often be something less than playable, the custom is to include the area in the water hazard so that a player can operate under the lesser penalty of Rule 33-2 or 33-3, a privilege he would have if the ball had gone all the way into the water.

Having reached a decision on the proper margin for a water hazard, the Committee and Superintendent must then determine whether it is, in fact, a water hazard under Definition 14b or a lateral water hazard under Definition 14c. The difference is that a lateral water hazard is "a water hazard or that part of a water hazard running approximately parallel to the line of play and so situated that it is not possible to drop a ball behind the water hazard and keep the spot where the ball last crossed the hazard margin between the player and the hole." When such a situation exists, the water hazard, or a part of it, is declared "lateral" simply by changing the color of the stakes or lines which define its margin, for example, yellow for water hazard and red for lateral water hazard. The different meaning of the stakes should of course be explained on the scorecard or on a sign on the tee. When a water hazard has been declared lateral, the player can proceed under Rule 33 with an additional option.

An alternative to the lateral-water-hazard device is to establish a ball-drop area in some central, fair position when, in the language of the USGA's recommendations for local rules in the Appendix to the Rules of Golf booklet, "it is not feasible to proceed exactly in conformity with the Rules." The delineation of a ball-drop area should be carried out by the superintendent quite specifically and clearly, and it should be maintained in such a way that a player, having accepted a penalty and dropped there, will have a fair shot.

While golf is played every day on courses where the water hazards and lateral water hazards are not precisely delineated and defined, this gives the members less than they deserve in the way of a complete golf course and can create insoluble problems for a Rules Committee in a competition.

Unlike the boundaries of the course and the margins of hazards, the limits of ground under repair need not always be drawn by the Committee or the Superintendent in order to comply with Rule 36-6c, although such delineation is advisable. Ground under repair, according to Definition 13 is "any portion of the course so marked by order of the committee concerned or so declared by its authorized representative. It includes material piled for removal and a hole made by a greenkeeper, even if not so marked . . ."

The best Superintendents look on ground under repair as an option to be invoked in an emergency, not an easy alternative to cleaning up the mess in the first place. Grass clippings, branches, stones and old lumber should not be left long where they might interfere with play, especially near putting greens. Drains which must be dug up should be filled in and levelled promptly. But newly seeded areas and sometimes newly planted trees are properly classified as ground under repair from which Rule 32 provides relief until ready for play.

Also, low, poorly drained areas on the course where casual water tends to accomulate after rains should receive attention because many players find it persistently difficult to apply Definition 8 and Rule 32 in ground which is somewhere between wet and muddy. Regular corrective maintenance over the year can simplify the consistent application of Rules.

A similar situation prevails with respect to obstructions, which a committee in charge of a course is required under Rule 36-6d to define

accurately where there may be doubt. In its technical meaning under Definition 20, an obstruction is anything artificial on the course, such as a bench, a protective screen, a fence, a Coke bottle, a rake—anything essentially made by man, as opposed to stones, branches and leaves created by nature.

The problem in defining obstructions arises from the fact that Definition 20 lists several exceptions to this otherwise simple statement. The exceptions are important and they provide that the following are not obstructions even though they seem to conform to the definition: "a. Objects defining out of bounds, such as walls, fences, stakes and railings (because they are off the course, not on it); b. Artificial surfaces and sides of roads and paths; c. In water hazards, artificially surfaced banks or bed . . . ; d. Any construction declared by the committee to be an integral part of the course (as, for example, a bank surfaced with railroad ties)."

The reason for the distinction is important. Rule 31 gives a player relief from obstructions, in strictly specified and limited circumstances, but not from non-obstructions, such as the cement-lined banks of a water course or the artificially supported bank of a tee. Where there might be doubt, the superintendent can help by getting a decision on the situation from proper authority and insuring that it made known.

Maintenance impinges on the obstruction Rule in another way, too. Rule 31-2b permits relief from an immovable obstruction under strictly defined circumstances and in very specific, if complicated, ways. Attention to the placement of these immovable obstructions in the first place, and to the ground around them where relief may be taken, again will ease application of the Rule—the intent of which, of course, is to provide some relief from the obstruction. Oftentimes there are options in the exact placement of an immovable obstruction, and the helpful Superintendent is one who evaluates the effect of relief under Rule 31-2b before he makes the final placement and who maintains the ground around it with the same Rule in mind. After all, relief which requires a player to drop in a micro-jungle is limited relief indeed.

Good housekeeping and that other good quality known as common sense guide the scrupulous superintendent in many of the other areas where maintenance and the Rules overlap.

On slopes where balls may come to rest or roll, depending on the cut of the grass, for example, it is worth-while for a superintendent to think about the proximity of a boundary or hazard and whether balls should be allowed to roll naturally toward it with a short cut or restrained by grass allowed to grow a bit longer. The possible effects of dropping a ball on a slope in accordance with Rule 22-2 requires the same consideration. It is normally preferable, when possible, to maintain slopes where a ball may be dropped under any Rule in such a way that the ball has a good chance of coming to rest before it rolls into a hazard, out of bounds more than two clublengths or nearer the hole.

In bunkers where larger pebbles tend to work to the surface, maintenance with an eye to the Rules calls for their careful removal. Pebbles and stones are loose impediments, under Definition 17, and Rule 33-1 prohibits a player from moving one when his ball is in the hazard.

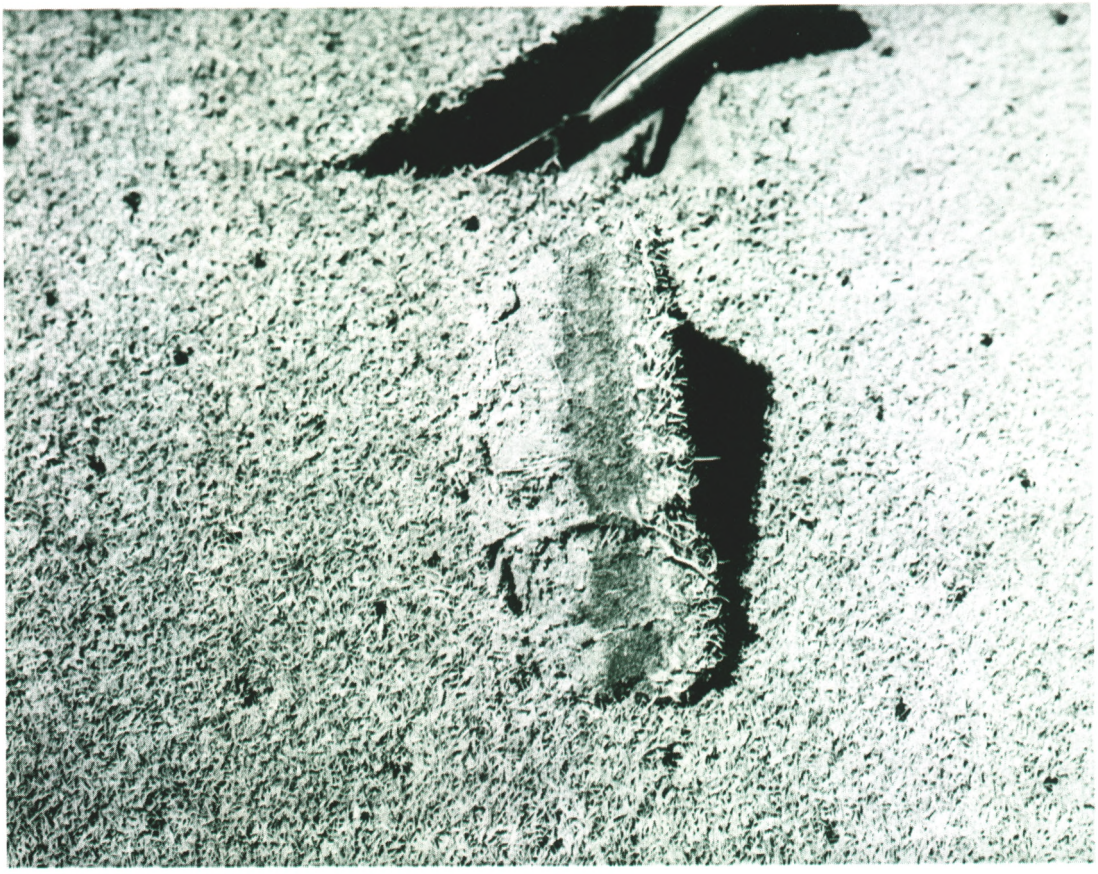
Along roads and paths, from which the Rules give no relief (unless a Local Rule is adopted), the same tenets of good housekeeping require that to the greatest extent possible edges and potholes be levelled and smoothed so that a player whose ball comes to rest on or against it can have a semblance of a fair shot without undue damage to his club.

If a superintendent remembers all these applications of the Rules while keeping the fairways green and full and the putting greens firm and true, he will be a gem indeed and a treasure to his Committee.

About The Author

John P. English is Director of the alumni association of Williams College, Williamstown, Mass., and past Assistant Executive Director of the USGA (1948-1959). He has written many articles on golf, participated in a number of golf association and conference programs as well as radio and television commentary. He is past President of the Massachusetts Golf Association. As a recognized authority on the Rules of Golf, he also has a keen interest in the care and conditioning of golf courses.

THATCH—



—A PART OF TURF

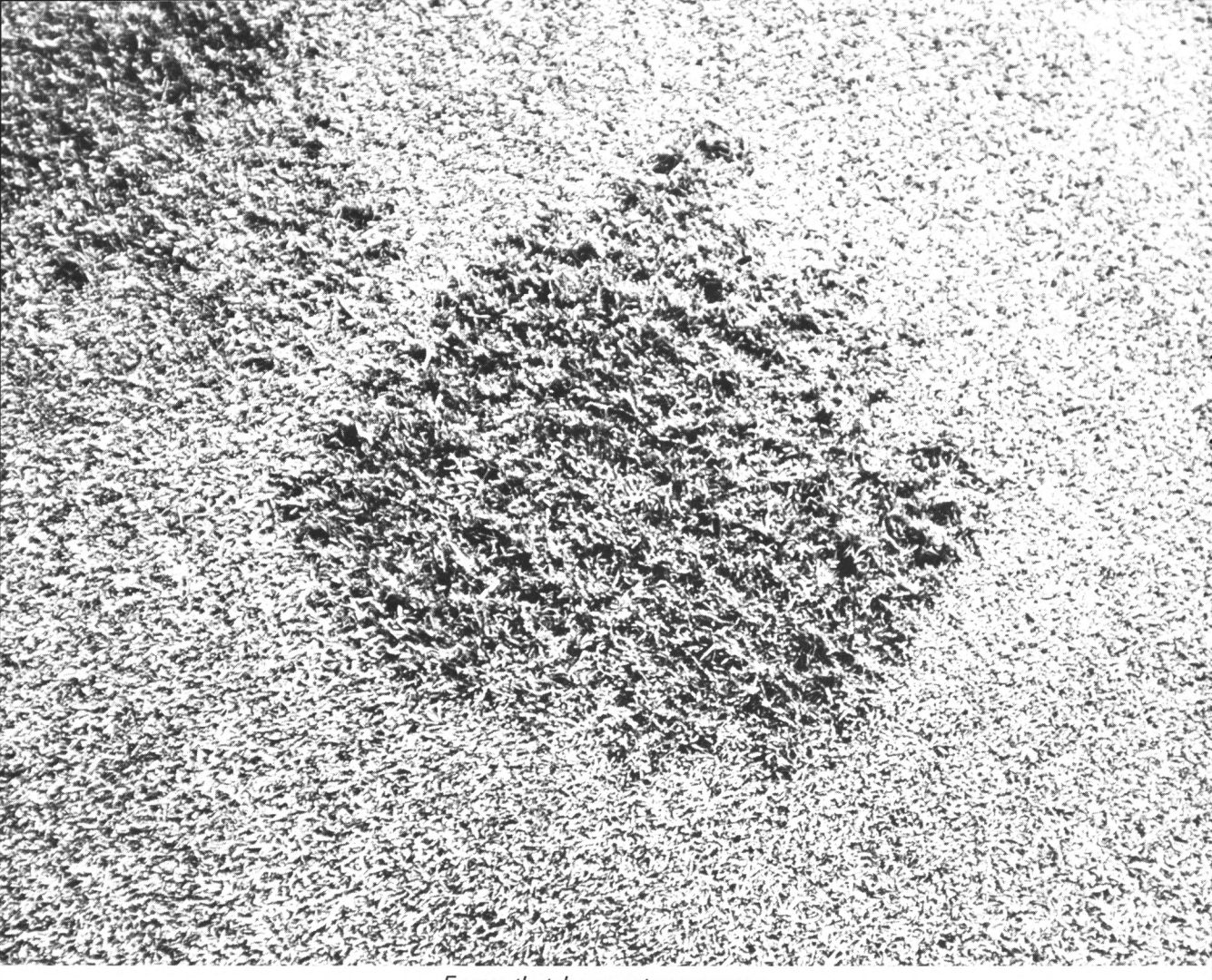
by **LEE RECORD,** Mid-Continent Director, USGA Green Section

Thatch and mat are terms used interchangeably to describe a condition in which excessive vegetation has accumulated. Although these two terms actually relate to different conditions, it is possible for mat and thatch to occur together, but either may occur singly as well.

Thatch is an accumulation of dead or undecomposed stems and leaves of the soil surface. Mat is the thickly overgrown and tangled mass of living roots and stems hidden beneath the green vegetation. This is associated with sponginess or fluffiness of the turf.

Some of the first signs to look for when identifying mat are uneven mowing, scuffing and scalping the turf. Because sponginess is associated with this condition, the putting serface is not always a true playing surface. Mat, therefore, is a common condition frequently brought about by rapid growth due to excessive fertilization. Mat can lead to severe mowing problems.

I am sure you have experienced, or at least seen a matted condition on greens during the summer, especially during periods of high humidity. Greens have become spongy or, if you wish, fluffy, and the playing surface has been scalped. (See Page 10) It is during this stress period that disease activity is high. By having an excessively matted condition, fungus



Excess thatch can act as a sponge.

organisms are protected from contact fungicides and systemic fungicides may not be as effective, depending on the pathogen. The mat itself serves as a breeding ground, favoring fungus development. Certain diseases may be quickly brought about after foot traffic presses the healthy turf against the fungus infected mat. We can conclude, therefore, that a matted condition contributes greatly to an environment which encourages disease activity. Fortunately, mat can usually be eliminated without injuring the excess vegetation and will cut or remove prostate stems and leaves. If you prefer, brushing the greens and close mowing are also sound cultural practices to follow when removing a building up of mat.

One other phase of a cultural program in holding mat in check is through the use of top-dressing. Top-dressing is frequently associated with vertical mowing or raking of the putting surface. Top-dressing may be used by itself if the material is worked into the matted condition. If top-dressing is not worked into the mat, a layered condition can easily begin. This in turn will impede the movement of water and may also contribute to a very shallow root system.

Thatch as it Relates to the Game

But what about thatch? What about the layer of dead but undecomposed vegetation frequently found on greens? How does it affect our turf management program, and what effect does it have on the game?

Thatch is a much more serious problem than mat because of difficulty associated with its removal. Thatch is beneath the living turf and consequently, when you remove thatch you are also removing some of the living turf which is lying above it. There is no question that thatch accumulation hinders plant growth and, although most turfgrass species are perennials, parts of each species in question are continually

dying and are being replaced by new life.

Any condition that favors increased vegetative production of grass necessarily aids in thatch development as well. Today's bluegrass plant breeder for example, is trying to develop greater plant density with dwarf bluegrass species. This in turn yields more vegetation and this eventually means more thatch. There is no question that rapid thatch development is a direct product of today's intensive turfgrass management programs.

Factors Favoring Thatch

Many other factors favor thatch accumulation. Soil types certainly have a bearing. Thatch is more likely to form on a heavier clay soil than on a light-textured soil. When grass is killed through winter injury, disease or if an insect problem has been present in the thatch or mat area, thatch accumulation is aided. Compaction, too, plays a part. Weeds in fairways or roughs or even in greens contribute to thatch buildup. The height of cut clearly has a bearing as to the amount of thatch which will accumulate within a given period of time. Excessive nitrogen speeds thatch formation. Rapid growth provides the entanglement of prostate stems and leaves producing mat which in turn leads to thatch formation.

It has been pointed out recently that insecticides, too, may favor the development of thatch, particularly when using chlorinated hydrocarbons for earthworm and grub control. Thatch may also occur because of an abundance of heavy clippings. This is brought about by excessive fertilization, watering practices, and to some extent, non-removal of clippings. Thatch also occurs when there is a slow decay of dead plant parts. In fact, any factor that slows down organic decomposition favors thatch buildup.

We do know that a frequently top-dressed turf seldom produces a thatch. It is obvious that an application of fresh soil contributes to a more rapid breathdown of dead vegetation. Are there certain elements lacking at the original surface to bring about decay? Could fungicides be affecting the beneficial micro-organisms? Could it be the pH level creating an unfavorable balance for micro-organism activity? It may be a deficiency of free calcium, nitrogen or any of the minor elements associated with soil organisms. It's difficult to say, but we do know that top-dressing works!

This is a sample of soil that shows the mat, thatch and soil layers distinctly.

Thatch is important, however, in developing the resiliency and cushion that is needed in greens or on fairways. Thatch helps to buffer soil temperature from air temperature and thatch helps to prevent the encroachment of weeds. Most agronomists feel the optimum level of thatch on greens and fairways should fall in the neighborhood of 1/4 to 1/2 inch. The desired amount of thatch can be maintained through the use of aeration, spiking, vertical mowing, top-dressing, brushing, lime applications and other phases of cultural management. When there is not enough thatch on greens, excessive ball marks and pitting, along with a poor playing surface are frequent complaints.

Although thatch is important in any golf course management program, it can also create problems for the Golf Course Superintendent. Excessive thatch is undesirable and the disadvantages are legend:

1) Dry spots develop and require increased attention in water management programs.
2) Thatch can create an uneven playing surface.
3) Conditions within the thatch provide a favorable environment for disease.
4) Insect activity may be stimulated.
5) Excessive thatch brings about desiccation in early spring.
6) Fungicide and insecticide treatments are not as effective when thatch levels are excessive.
7) Water infiltration rates are affected, decreasing the efficiency of water.
8) Management practices required to reduce thatch are expensive.
9) It is difficult to obtain satisfactory overseeding.

Thatch Research

Fifteen years ago there was very little research being conducted investigating the development and control of thatch. Since that time, a great deal of money has been spent in research to discover what could be learned about thatch decomposition. R.E. Engel and R.B. Alderfer, of Rutgers University, presented one of the first papers after a 10-year study on Seaside bentgrass, dealing with the effect of cultivation, top-dressing, lime, nitrogen and wetting agents on thatch development. A turf cultivation study conducted by F.B. Ledeboer at the University of Rhode Island reported that cultivation appears to increase surface decompostiion. Ledoboer worked with glucose, sucrose, fertilizer, dolomitic limestone, gypsum and top-dressing combinations on thatch decomposition, and reported them unsatisfactory for increasing the rate of known thatch decomposition. C.Y. Ward, of Mississippi State University, reported that top-dressing and cultivation were deterrants to thatch in bermudagrass. J.D. Butler, at the University of Illinois, worked on "Thatch: A Problem in Turf Management," where he showed that thatch may be desirable, depending upon where and under what conditions the thatch exists. Butler pointed out the following benefits by having thatch:

- Shading and lowering of the soil temperature. With a mulch, soil temperature tends to be lower during the day and higher at night.
- Some protection from frost and low temperatures can be achieved from the insulation provided by thatch.
- Reduction of water loss, as thatch may protect the soil from drying winds.
- Reduction of the weed problem.
- Recycling of nutrients: With thatch some turf areas have looked good for many years without supplemental fertilizer.

Most of the thatch research in the past had attempted to find the best management programs and mechanical renovation procedures to reduce thatch accumulation. Today a new focus in thatch research is directed more to the biological degradation of the thatch layer. J.B. Martin, at Michigan State University, investigated the total cell wall, the hemicellulose, cellulose and lignin analysis that make up the thatch layer on the leaves, stems and roots of Toronto bentgrass, Merion bluegrass and Pennlawn red fescue. He showed that lignin, the most resistant plant constituent to microbial activity, was found in greatest quantities in the thatch layer nearest the soil. Fescue contained higher percentages of lignin than either that of bluegrass or bentgrass. In comparing the living plant parts, roots have significantly higher percentages of total cell wall constituents and lignin than the stems or leaves. He also concluded from his study that clippings of turfgrasses contribute very little to thatch accumulation.

J.S. Koths, of the University of Connecticut, showed that although changes in the thatch microenvironment bring about quantitative changes in microbiol balances, such ecological changes do not necessarily contribute to a more desirable thatch balance. A great proportion of the viable microflora is inactive. Increasing activity is important and can be obtained through top-dressing. Changing the physical characteristics of the thatch layer to provide microecological sites that promote continued activity by the resistant microflora may be the most important attribute of top-dressing.

Thatch, a part of turf, plays an important role in providing optimum playing conditions for the game of golf. How the Golf Course Superintendent manages thatch plays an important role in his success or failure in his profession.

NEWS NOTES

CHARLES K. HALLOWELL

The turfgrass world lost another pioneer with the passing of Charles K. Hallowell on October 3, 1974. Charles Hallowell was a graduate of Pennsylvania State College in 1917 and served as County Agricultural Agent in Philadelphia, Pa. from 1923 through 1954. He was closely associated with golf course superintendents' activities nationwide.

He conducted the first comprehensive turfgrass survey in the United States for Los Angeles County in 1950 while on sabbatical leave. This was a cooperative project sponsored by the University of California, Los Angeles, and the Southern California Golf Association. Mr. Hallowell served as Mid-Atlantic Director for the USGA Green Section from 1955 to 1961. His entire professional career was dedicated to his teaching and work with turfgrass.

START THE YEAR RIGHT!

It won't be long before you'll be working over 1974 income tax returns and wish there were more deductions to list. Don't let that happen to you again in 1975. Contributions to the USGA Green Section Research & Education Fund, Inc., are tax deductible. And every dollar you give goes directly to turfgrass research; there are no administrative costs. Your support is needed for better turf and playing conditions in the future. If you enjoy good golfing turf, please send your contribution in any amount to the USGA Green Section Research & Education Fund, Inc., Golf House, Far Hills, New Jersey 07931. Become a part of the research effort. Do it today and start the year right.

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
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I certify that the statements made by me above are correct and complete.
Robert Sommers, Managing Editor

TURF TWISTERS

AGENTS THAT MELT

Question: Will the runoff from the salt and other melting agents used on our winter paddle tennis courts injure our turf this spring? (New Jersey and Massachusetts)

Answer: Every ice-melting agent that we know of has the **potential** of harming the turf, either through extremely heavy use or a buildup in the soil over several years. In reality, however, except in extreme cases, little harm should be done with the natural dilution of the agents with the snow and normal yearly rainfall. But don't overuse or abuse them. Use just enough to do the job and only then when needed. In our travels, we have seen instances where heavy duty forced air heaters have been installed under the courts to melt the ice and snow naturally. But this was before the era of the energy crunch.

FERTILIZERS THAT SPIRAL

Question: With fertilizer prices spiraling, where should I send my soil samples for chemical analysis? (Georgia)

Answer: You are right! The key to growing good grass economically in this day and age lies in soil testing. But test results are only as good as (a) proper sampling methods; (b) a good laboratory; (c) competent interpretation of results by someone familiar with turfgrass requirements. Check with your County Extension Agent, State Laboratory or Green Section representative. There are reputable commercial and fertilizer company laboratories as well, but they should have a background in turfgrass management.

TWO ROWS THAT FAIL

Question: We're thinking of an automatic irrigation system this year. Is a "two-row" system adequate under semi-arid conditions? (Colorado)

Answer: A "two-row" system is inadequate under most conditions, semi-arid or not. It heavily irrigates the center of fairways while leaving the perimeter and rough areas relatively dry. If your club is interested in uniformity of playing conditions, a "two-row" system is generally not the answer.