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A MONTHLY PERIODICAL TO PROMOTE THE BETTERMENT OF GOLF COURSES

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The Vegetative Method of Planting Creeping Bent[1]

By LYMAN CARRIER.

It would seem that the vegetative method has been sufficiently discussed, so that it might go in a class with other common operations in the maintenance of golf greens which need but to be mentioned to be understood; but our correspondence reveals the fact that there are still a great many people who have a very hazy idea as to what it is all about. Such questions as, "How is the vegetable grass planted?" "How far apart do you make the rows on the green?" "Where can I buy the seed for planting vegetatively?" all show that those asking them are in the kindergarten, so to speak, in respect to the vegetative planting of creeping bent stolons. A recent letter had the request "Where can I buy stolon grass seed?" It is for the new recruits to the turf-growing fraternity that the following description of the grass and the method of planting is prepared.

First let it be clearly understood that there is no seed or seeding involved. As it was necessary to invent a term to distinguish this method of planting from seeding, the word "vegetative" was used, because the stem—a vegetative part of the grass—is planted. All grass stems are jointed like a bamboo fishing pole. The small, hard portions from which come the leaves are called nodes by botanists, and the spaces between these hard places internodes. We use the term joint to include both nodes and internodes. Each joint—or, to be more exact, each node—has one bud. No variation from this has ever been discovered in any species of grass. While a grass stem is growing at its tip a great many of these buds remain dormant and never start to grow; but if the tip is cut off or the stem becomes injured, some of these dormant buds shoot out into branches. It is a provision of nature to help perpetuate the species. In the case of some grasses these buds will not only develop into branches, but the nodes will also send out roots. The number of grasses which have the ability to root at the nodes is small compared with the great number which do not possess it. Bermuda grass, velvet bent, and the true creeping bent are the principal grasses with which the golfers are familiar, that have the ability to take root whenever the stems come in contact with moist ground. With each of these three grasses all that is needed to start a new plant is a node. To demonstrate this, I have cut away everything but the node and found that the bud would still give rise to a healthy shoot. One other thing needs to be understood. In planting these joints or nodes it is not necessary that they have roots on them. The roots will come when the conditions of moisture and temperature are favorable for their growth.

WHAT IS CREEPING BENT?—Creeping bent is a grass that spreads by long creeping stems above the surface of the ground. It belongs botanically in a group of grasses which contains redtop, Rhode Island bent, and velvet bent. The term carpet bent was once applied to creeping bent, because it had been customary in the seed trade to designate the bent seed received from Germany as "creeping bent," although there was never more than a mere trace of true creeping bent in it. Most of the leading seedsmen have very obligingly adopted a suggestion made some time ago by the Green Section and now advertise the German seed as "South German mixed bent." This does away with the necessity of having the term

[1] In this article Prof. Carrier presents in substance the address which he delivered before the Annual Meeting of the Green Section January 4, 1924.

"carpet bent," which we would now recommend be dropped. This grass is certainly entitled to its true original name.

VARIETIES OF CREEPING BENT.—There are many varieties or strains of creeping bent. Just as all horses do not trot under 2.10 nor all golfers break 80, so all varieties of creeping bent do not produce turf of equal merit. This may be appreciated when it is known that, since we started systematic breeding work with this grass some seven or eight years ago at the Arlington Turf Garden, we have made over one hundred selections of different strains. Of these hundred or more selections all except a half-dozen have been discarded for one reason or another. Some were too coarse; some were susceptible to disease; some became unsightly during hot weather; and the turf of others was thin. We are still making selections whenever we find a variety that has any promise of superior value.

Nursery-grown sod of the Washington strain of creeping bent. This is the natural growth without being cut or rolled.

While the turf formed from any strain of creeping bent planted vegetatively is probably better for athletic fields of all kinds in the North than that produced from seed of any other grass, yet it is not advisable for a greenkeeper blindly to plant his putting greens with any creeping bent he may find growing about his course. There is an altogether too prevalent misconception that bent is bent and that equally satisfactory results can be obtained from stolons grown wild along ditch banks as from those produced in nurseries. It should be understood that the strains of creeping bent which are distributed by the United States Department of Agriculture have been carefully studied for two or more years before their release.

Many of the commercial growers of bent stolons at the present time, but not all, have obtained their foundation stock from the Arlington turf garden or from some one who had previously been given a start from that source. We like to encourage others to be on the lookout for improved strains of creeping bent, but, at the same time, we must caution clubs against the purchase from commercial growers of anything but carefully selected and tested nursery-grown stock. The man who believes he has a better variety than those now commonly grown is perfectly justified in trying it himself, but he should be sure of his ground before he goes into the production of it commercially or induces his friends to make extensive plantings of it. The Green Section will gladly arrange to have impartial tests made of any new selections that appear of promise.

SELECTING STRAINS.—Many persons have noticed spots of extra-fine turf on bent greens. The size of these spots may vary from a few inches up to 2 or 3 feet in diameter. It is usually noticeable that these spots are freer from weeds than is the surrounding turf. If a number of these areas are observed it will be seen that they vary much in texture and color. Each of these spots is the product of a single seed, depending in size on its age and the aggressiveness of the grass. It was the frequently repeated question "Why can I not get a whole green like that spot?" which led to the first selections being made of creeping bent and to the vegetative method of planting the grass.

Selections of creeping bent for the production of stolons to be planted vegetatively are best made on old bent putting greens. Before making a selection the particular spot of turf should be studied carefully to see if it meets all the requirements of desirable turf. There is no use to start with a mediocre strain. Growing grass in a nursery and then planting a green with the resulting stolons will not change the inherent quality of that particular strain of grass one iota. It would probably be a saving of time and trouble in the long run to keep the spot of turf from which the selection is to be made under observation throughout an entire season before taking it up to plant in the nursery; or, only part of the particular patch of grass may be transplanted and the remainder left to demonstrate its fitness for further use. The point we wish to make clear is that no one can tell from one observation of a strain of creeping bent whether it will make turf that will stand up under all conditions from one season to another. The only way to be sure is to try it out.

PLANTING A NURSERY.—Before planting a green it is necessary to grow a quantity of the runners or stolons. These are best propagated in rows 4 to 6 feet apart. The ground in the nursery is prepared before planting in the same manner as for most other crops,—that is, it should be plowed and then harrowed until it is firm beneath and mellow on top. If it can be fallowed a few weeks in the summer, to let some of the weed seeds sprout so they can be killed, all the better. The rows are laid off using a taut string as a guide. With a sharp-pointed stick or something similar, trenches not over 1 inch deep are made. The turf which is to be planted is next taken and torn apart. It will be found that in old bent sod and nursery-grown sod the stolons tend to run in one direction. In nursery-grown sod the long runners separate easily. The runners and any small pieces of sod are then scattered along in the trenches. Two or three runners side by side are enough. The planting in the row is made continuous. A creeping bent nursery is not planted as one would set out

cabbage plants. We have tried that method, and so have a lot of greenkeepers, but for some reason the grass does not grow and spread as it does when the stolons are stretched out end to end in a continuous row. As soon as the grass is placed in the trenches it is covered not over one-half inch in depth, using the ordinary soil of the nursery. It is better to have some of the tips of the leaves showing than it is to have it all covered out of sight. The covering is well pressed around the stolons. This can be done by walking down the row, taking very short steps. The row is then watered, using a hose or sprinkling can. In our nursery we seldom give more than this initial watering, but of course there would be faster growth in dry times if it were watered regularly. We have frequently had a spread of 3 feet on each side of the original row in one year's growth from the time of planting. It depends, however, a great deal on the particular strain of bent, how rapidly it will spread. Rows of the Washington strain grow about half as wide as those of some other strains we have had.

One square foot of nursery sod, which will consist of a mass of stolons 2 or 3 inches thick, will plant 100 linear feet of row. If it is ordinary putting turf or old sod picked from about the course, it will take more than 1 square foot to plant this length of row. The subsequent care after the nursery is planted may be summed up in two words,—*clean cultivation.* All weeds should be pulled out of the rows, the spaces between the rows must be kept free from weeds and the soil on the surface loose and friable.

PLANTING FOR TURF.—The preparation of a putting green or turf bed for planting with stolons does not differ from that needed for seeding. But before the work of planting is started there must be provided within easy wheelbarrow-distance from the green a pile of top-dressing with which to cover the stolons. It will take about 15 cubic yards of material for a green of 6,000 square feet. While all of this will not be needed for the first covering, it will be necessary to make several top-dressings later; and so it is advisable to provide ample material at the beginning. This top-dressing for covering the stolons may be any good mellow soil which does not run together when wet and form a crust. If the soil contains a considerable amount of clay it will need to have sand mixed with it. A good rich sandy loam is ideal. It should be of such a texture that when a handful of the moist top-dressing is pressed into a ball it will readily crumble to pieces again.

PREPARING THE STOLONS FOR PLANTING.—The stolons should be cut into pieces from 1 to 2 inches in length and separated so they can be evenly broadcast. Now, the cutting and separating of these creeping bent stolons is a whole lot easier to write about than it is to do in actual practice. The methods of the past of cutting the sod into pieces by running it through a chopping-box or fodder-cutter and then picking the chunks apart by hand, are too slow for jobs where more than one or two greens are to be planted. If the nursery is home-grown—that is, easily accessible to the course where the planting is to be done—the method for chopping the stolons is simpler than where sod has to be shipped from a distance. In the former case no more stolons should be taken up in the nursery than will be planted that day. These should be cut off above the surface of the ground. Remember that the roots are not needed if the stolons are planted immediately. If there are no crowns of the grass with their intertwining roots to contend with, separating the pieces of stolons after the material has been run once or twice through a fodder-

cutter is not difficult. A different method from the above which was tried out at one club this last fall worked successfully. A lawn-mower with a grass-catcher attached was run up and down the nursery row. The clippings were in fine condition for planting. A rope was attached to the front of the mower, and two men pulled while a third man pushed and guided the machine. Where this method is followed it is not necessary to take up the rooted crowns, which will soon produce another crop of joints for further planting. Power machinery for cutting and shredding nursery sod has been successfully tried out. These machines do the work of a large number of laborers.

PLANTING THE STOLONS.—If the ground is dry, it is advisable to wet the green a few hours before planting. One of the chief troubles I have had in supervising the planting of some 200 putting greens by the vegetative method is to get some greenkeepers and laborers to realize that they are handling live grass which must not be allowed to become dry. Creeping bent stolons will stand a lot of rough treatment while they are moist. Chopping and shredding do not injure the vitality of the buds. But if you let them get thoroughly dried out you might as well bid the grass good-bye.

Scattering the pieces of stolons for sod. The top-dressing has been spread in the background, but not rolled.

The cut pieces of stolons are spread evenly over the surface of the green. There should be no large bare spots. A live joint to every square inch is desirable to give first-class turf, but it is necessary to spread somewhat more thickly than that in order to be sure of an even stand. One square foot of good thick nursery sod will plant 10 square feet of green. Much planting has been done at a thinner rate than this and good turf has resulted, but it takes longer and requires more labor in weeding and plug-

ging grass in the bare places than would be necessary if sufficient material were used at the outset.

As soon as the stolons are spread they are covered lightly with the top-dressing. Three-eighths of an inch of the top-dressing, if properly put on, is sufficient,—that is, if it is dropped directly on top of the pieces of grass and not thrown sidewise so as to roll underneath the stolons. I like to have portions of the pieces of grass showing above the dressing. Do not bury the stolons too deeply. Most of the young shoots are not strong enough to force their way through an inch of top-dressing. They will take root more quickly and grow faster on the surface of the ground without any covering than they will when top-dressed, provided they are kept continually moist. The covering serves the purpose of holding the cut stolons in place and in contact with moist soil.

PLANTING ORGANIZATION.—The equipment needed for planting the stolons after they have been cut up and shredded consists of a half-dozen galvanized iron 10-quart pails, 4 or 5 wheelbarrows, 4 or 5 shovels, a light roller, and enough 1-inch by 10-inch boards to reach from the pile of top-dressing to the farthest corner of the green.

The efficiency of a planting crew depends a great deal on whether it is properly directed or not. Any lost motion—one man idling while another is in his way—adds decidedly to the cost. A well-organized crew may plant twice as much ground in a day, and without greater effort, than one which is out of balance.

I try to get the following arrangement where possible: 3 men with pails to scatter the stolons; 4 men with wheelbarrows to spread the top-dressing; 1 man with roller to direct the work and roll the green as fast as the top-dressing is applied. Starting at one corner of the green, each of the men spreading stolons should start planting a strip about 2½ feet wide, walking backward as he scatters the pieces. Each man should walk directly backward, like a crawfish, and not sidewise, like a fiddler-crab. The man supervising the work should see that the stolons are scattered evenly and that there are no vacant places between the strips. It takes some training before three men will learn to spread the pieces at the same rate and work together as a team.

The top-dressing is applied immediately, working from the side of the green for the first trip. I have the spreading done by hand directly from the wheelbarrows. The workers soon learn to let the soil sift through their fingers directly on top of the stolons. They should never try to cover more than they can easily reach. As soon as a strip is covered, it should be rolled lightly, and then the boards may be laid on it for wheeling on the top-dressing for the next strip. If the three men spreading stolons get more than 10 minutes ahead of the men applying the top-dressing on a dry day, one of them is changed to help spread the top-dressing. A crew this size should easily plant 12,000 to 15,000 square feet of greens in a day. Some planting crews this past fall did much more than that, while others did not do so well. Be sure to have the top-dressers working back of and not in front of the men spreading stolons.

WATERING.—As soon as the chopped stolons are spread, top-dressed, and rolled, the green should be watered. It is advisable to set the most trustworthy men you have at the watering, for the final success of the whole procedure depends a great deal on the watering the greens receive during the first two or three weeks after planting. The surface

of the green should be kept moist all of the time. You can not make up by extra watering one day for neglect the day before.

The watering is best done by hand, with the hose equipped with a rose nozzle. On large greens it is advisable to have an extra hand to carry the hose on and off the green. One man trying to do the watering and at the same time drag the hose around is sure to draw a lot of the stolons out of place. Do not be afraid to water during the day. The old fear that watering on bright sunshiny days will kill grass has proved to be groundless.

SUBSEQUENT CARE.—The grass should begin to come up in about a week after planting, if the temperature is warm. When the nights are cold it may take longer for it to show. In three or four weeks there is usually enough growth to make it advisable to mow it. After it has been cut, the next thing to do is to top-dress lightly. One cubic yard to an average green is about right. The top-dressing should be worked down around the roots of the grass and into the depressions. When the planting is done in the fall, one or two top-dressings are usually all that are advisable before cold weather comes. Just as soon as growth starts in the spring this same treatment should be repeated—that is, cut, top-dress, and smooth up the surface. A month of good growing weather in the spring is usually all that it takes to make the grass grow together into a turf. If there are any bare spots of 5 inches or more in diameter, they should have small plugs of the bent planted in them. These plugs can usually be taken from thrifty tufts of the grass near the spots, or they may be taken from around the margin of the green. Bare spots no larger than a man's hand will be quickly covered when the bent gets to growing vigorously. The treatment in the spring should be aimed toward making a true putting surface.

The first two or three times the green is cut, it is customary to let the clippings fall on the ground and to cover them with top-dressing. The young tips of the stems will take root and grow even though no joints are visible on them. Of course, if the growth is heavy and there is danger of the clippings smothering the grass beneath, the clippings should be removed. There are some excellent pieces of turf which were produced by planting the clippings from creeping bent greens. In most cases it is not advisable to let the grass on a putting green grow sufficiently long to permit of the use of the clippings in this manner, but a turf bed might well be kept for such a purpose. During good growing weather the turf bed might be clipped every ten days or two weeks and the clippings used for planting. The tender tip is the most active part of a stolon and will make a faster growth when planted than will the older joints.

The Soil Foundation of a Putting Green

Address Delivered by Frank B. Barrett, Hollywood Golf Club, Before the Annual Meeting of the Green Section, January 4, 1924.

Mr. Chairman and gentlemen: By reason of some remarks made by me at the meeting of the Green Section in Chicago in 1921 I was accused at that time of being a comedian. Now, whoever heard of a recognized chairman of a green committee being called a comedian, especially by his fellow club-members? In my opinion he is usually called some choice names you have heard which would classify him in a tragedy.

Now, because I breezed along in windy Chicago two years ago, I see no reason why the Green Section should expect the same results here in old New York and order me to talk on the subject of construction of putting greens. Certainly there are many here better qualified than I to discuss that subject, but since I have been staged as a small part of the show I will endeavor to tell you how we get the best results in our part of New Jersey.

As our soil is chiefly sandy loam, we are able to do construction work in a different method from that which would be followed if the soil were heavy clay or gumbo. Usually we construct with a regular soil fill, then about 15 yards of manure well disked in, then 24 to 18 inches of top soil, evenly distributed. Drain-tiles of 3½ and 4 inches are then placed in herringbone fashion and the soil replaced for the working of disk-harrow, spike-harrow, and smoothing-harrow. A reasonable amount of hand-raking is always necessary, whether seed or turf is used to cover.

Of course, in heavy soil sand is very necessary to disk into the soil, and should be used with considerable manure. For holding moisture in very sandy soils, a 4 to 6-inch layer of humus and well-rotted leaf-mold 12 to 18 inches beneath the surface is advantageous.

In my opinion, the most advantageous feature, also the most imperative, is that of drainage, both surface and tile, and one is as necessary as the other; yet we find that most of the time drain-tile is not installed except where the green happens to be placed in a wet spot. I do not think we can be too emphatic as to the necessity for using drain tile; whether a green be in a wet spot or on a hill, the use of it makes wonderful returns when turf growing is considered. It is an item of probably $250 to a green, which is but a small item added to the cost of construction. To drain the average green, needing 800 to 900 feet of drain-tile, plus labor, should bring the amount well inside the price quoted. Do not understand me to mean that tile will take care of pockets on the surface of the green, for it does so only to some degree, and certainly it is of no use in winter, as winter-killing will occur in these defective surface depressions.

I was visiting a course last fall near New York City where they were building some new greens, and I was asked my opinion about them, and I said they were very wonderful. We try to be polite at times, although we are frank. I said, "Where is your drain-tile?" They said, "We don't put any in." I said, "How much is the first green going to cost you?" They said, "We don't know." I said, "Why? What is your reason?" They said, "Well, we don't know." Then they said, "We only have two or three greens that have any drain-tile in them, and they are not any better than those that have none, so, with these, we are going to omit the tile." I insisted that I was right; and they afterwards in-

stalled tile in the new greens they were putting in, and I do not think they will ever regret it.

I might give you another instance. A few weeks ago I was visiting a city in the upper part of this state, about 300 or 400 miles from here, and, being there on business and having a little time at my disposal, I rode about the city, and of course when I saw a golf course I started to look it over. They were constructing a new green rather near the clubhouse, and the greenkeeper came over and wanted to know what I wanted. I said I was just a visitor in the city, was from New York, and was interested in golf courses. He said, "What do you think of it?" I said, "I don't think much of it." He said, "Well, who are you?" I said, "Oh, I am nobody." He said, "Well, you must know something about it." I said, "May be. Why do you build it that way?" He said, "Well, that is the way the chairman of the green committee wants it." I asked, "Do you approve of it?" He said, "No; I don't think much of it." I asked, "Why don't you put in some drain-tile to help it work?" He said, "We can not afford to use drain-tile." I asked, "How much is it going to cost you to build it?" He said, "I don't know, but it will cost a good deal; we had to cart all this dirt up here, and I was about three weeks building it with four men." I said, "You can not afford to spend the money for drain-tile?" He said, "No; we don't use that." I said, "Are you a member of the Green Section of the United States Golf Association?" He said, "Oh, yes; you mean that little pamphlet? That is the finest thing in the world. That bulletin is worth twice as much money as they ask for it, because that is the only place I can find anything worth while knowing." I said, "Well, if you will give me a copy of that bulletin I will show you my name;" and I showed him, and then he was very polite. I said to him, "Who is the chairman of your green committee?" and he gave me his name. I said, "Is he in town?" He said, "No; he is away now." I said, "Here is my card; tell him that this gentleman disapproves of his work and thinks he will regret it; he is spending a lot of money, and the thing is badly shaped and constructed to begin with. Who ever heard of a hollow on top of a hill? If you want quick results, first take the front part off of it, and let the water run out."

I hope I did some good. Now, those are the little things that all of us, I believe, can do—men who are sincerely interested in improving golf courses. I do not believe people's feelings are hurt if you tell them the truth. They may be offended for a moment or two, but afterward they will think you are a wonderful fellow.

There is another matter which should be of great interest to you and your club, both as to the construction cost and maintenance. I refer to the unnecessary types and sizes of putting greens; and the whole matter is wonderfully handled in an article of this month's[1] BULLETIN by Prof. Piper, which is the first and only article on the subject which has come to my notice; and the matter has been for several years a noticeable item of abuse in new construction. Prof. Piper's article on "The Size of the Putting Sward" I beg of you not only to read, but to study and to give it your serious consideration. You may be able to apply thoughts to your own course and cheapen your maintenance account.

I can bring out a few thoughts for you when I tell you of an incident

1 December, 1923.

similar to the one I related just a moment ago. Over a year ago (I will not say where it was, but it is between here and Chicago) I was at a certain place. I had been there a couple of days at meetings of a board of directors on a business matter, and they invited me out to play golf and loaned me clothes and golf clubs; but they took my money just the same. I met a man who happened to know me, and he went to some of the men there and said, "Get his opinion."

Now, here is the story. It is a large city, a city of 50,000 or 75,000 inhabitants, with a lot of wonderfully good sports, fine men, manufacturers chiefly; and they had played on a 9-hole course for about 12 years, and then they wanted to get the real thing. Well, they sent for someone who ought to know about soil conditions and topography and all those things, and started in to lay out an 18-hole course. They retained a first-class architect, and he appointed a superintendent, and they began the work. They took me out to see it and asked my opinion of it. They said, "How much do you think you could build a course like this for over your way?" I said, "I don't know, but probably for $50,000 or $75,000." They said, "Do you mean complete, ready to play golf on?" I said that I did. They said, "Well, we have spent over $100,000 on this piece of property already, and we can not play on it yet." I said, "I can not believe you have spent any such sum of money, provided the money has not been wasted." They said, "No; it has been properly spent." I said, "Then, if it has been properly expended, I do not care to believe it." They said, "What is the argument?" I said, "Well, you did not get your money's worth." I succeeded in interesting them with the few remarks I made, and they took me to the accounting office and showed me bills of $103,000 for labor, seed, fertilizer, and a few implements. The prices were all right; they had been paying at the rate of 40 cents an hour, and had paid the superintendent the proper fee. Where did it all go? They did not know. The course was to have been ready last May, but they have not been able to play on it all this season, because it was not fit. I said, "This is very sad; you are certainly good sports; you have put up your money." And one of them said, "Yes; and the worst part of it is that $25,000 of that money was to go toward a new club-house, and I guess that will have to wait for another year." I said, "There is something wrong somewhere." They said, "What is it? What can we do to remedy it?" I said, "I am in no position to help you." They said, "Well, will you criticize, please?" I said, "Yes. Who did the work?" They told me, and the man who did the work had been retained as greenkeeper. Well, I always fight open and above board, and I said I would like to have them call a meeting and have that man there. They made arrangements to have him there, and they became so interested that they had nearly all of the Board of Governors at the session the next morning. Well, we walked around the course a bit where the club-house was to be, and I said that I would like to see the course. We traveled over two or three holes, and I looked at the greens, and they had no bent on them. I said to the greenkeeper, "Why did you build a green like this?" He said, "It is a beautiful green, is it not?" I said, "It certainly is; but why did you build it?" He said, "Because it is a beautiful green." I said, "Fine; but this is your third hole and you have a hole here of about 275 to 325 yards. How long is it?" He said, "This hole is about 375 yards." I said, "Not with me." He said, "Oh, yes; it

must be 375 yards." I said, "Well, we will measure it." So we measured it by strides, and it figured exactly 290 yards. I said, "Well, there you have a green for a 290-yard hole with an area in excess of 10,000 square feet." He said, "Yes; I guess so. I don't know." I said, "It looks to me in excess of 100 feet wide and a little bit longer." He said, "I think so." I measured it, and it measured about 115 feet across and 120 feet deep. One of that committee was a man who is state champion of the game, and several others were very good players—men who play a fine game—and I said to them, "Do you call this a good green?" They said, "Yes; it is a beautiful green." I said, "It certainly is; but why do you want to have a green of this type and size?" They said, "Well, what is the matter with it?" I said, "There is a whole lot the matter with it. To begin with, you have 6 or 7 feet of fill on this side and 4 or 5 feet on that side, and the part that you would make the real green to this hole you did not need to fill at all; so this green has cost you three or four times what it should have cost you. Do you think that is a fair hole to play, for instance, for an ordinary player like myself?" They thought a bit, and then they said that it would not be a fair hole. I said, "What is the idea of building it that way?" They said they wanted to make it beautiful. I said, "Yes; but don't you understand that here you have a green with an area of nearly 12,000 square feet to be used for a mashie pitch of a 290-yard hole? Just think what it will cost to maintain that green for a period of 21 years; just think what it means to water that green alone; just think what it means to keep the grass growing on it, for beauty alone." They said, "Yes, there is certainly something in that." Then we took the next hole, and that hole was 150 yards, an iron shot. They built the green on a knob, likewise with a considerable fill. For that 150-yard hole they had something again in excess of 10,000 square feet of green, with a 30-foot pitch down hill. I said, "Gentlemen, I think I have had enough. This is where your money has gone. I can see that you have spent nearly $110,000, when you should have spent only about $60,000 or $70,000." We walked down the course, and I said to the man, "What are you doing with your greens anyway?" He said, "What do you mean?" I said, "Just look at this." He had a gang of men working there cleaning up along the side rough. I said, "Why don't you work on your greens?" It was the 1st of November. "Why don't you get your greens in shape?" He said, "I can not do anything else than what I am doing." I said, "Oh, yes; you can." We got down to the 11th hole, and I said, "What is that over there?" He said, "That is an old celery field." I said, "What are you doing with it, plowing it?" He said, "Yes." I said, "Why don't you use it—make some use of it as it is?" He said, "What is your idea?" I said, "My dear fellow, that is the stuff over there that will make your greens. You can cart that out merely for the price of the cartage. That is the kind of stuff that we pay $16 to $20 a ton for in New York. It is called humus. Here you can get it for nothing." I said, "Why don't you put it on your greens and fairways? They need it badly enough." Previously to that I had found some brownish-red stuff on the ground, discolored by the soil, and I said, "What is that?" He said, "That is lime." I said, "How much did you put on?" He said, "We put a lot on—a lot of lime." I said, "Well, why don't you wash some of it off? Then it will do more good."

Well, I just went from one thing to another. But what I want to

bring out is this, that all you men who know this game and who are interested in it can find an opportunity to plant the seeds of efficiency where needed. There are a lot of people spending their money in places doing things because they do not know, because they do not think; and we fellows just walk around and permit them to do it. Now, are we really sincerely interested in the good game of golf if we permit men to do that sort of thing? You may make yourselves unpopular for a moment or so, but when it is all over you will feel much better, and so will the other fellow. I am speaking along these lines, because that is the work of the Green Section. Whether you have your names on the front page or whether you are a high private in the rear rank, I say that we all have our opportunities, and should make the best of them.

Now, gentlemen of the green committees, yours is a business proposition, absolutely without sentiment, "with or without a budget," and, as such, efficiency is the only item your boards of governors can not control. So you must bring it forth with your work and use plenty of energy to put it over. Consult with your greenkeeper and help him to think out his problems and troubles. Your team work must bring more satisfactory results, for greenkeeping parallels the saying, "Life is one damned thing after another."

(Mr. Barrett's address was followed by a general discussion with regard to what is the proper depth for good, rich soil on the top of a new putting green. Widely divergent opinions were expressed on the subject, whereupon Dr. Piper took occasion to make the following remarks:)

DR. PIPER. Mr. Barrett has opened up a very complex question and one which I was hoping would come up in the course of this discussion. It happens to be a subject which we have been investigating a good deal, and I am sure that we are not yet ready to say the last word in regard to it.

Some years ago there was a putting green at the Columbia Country Club which was built on a surface of natural soil, which is a fairly heavy clay soil—not so heavy but what the water percolates through it fairly well; so it is well drained. A new green was built close to it, and 18 inches of very rich soil was put on top of it. The turf of the old green, which was very superb bent turf, was removed and put on the new green. That was three years ago, but the turf has never seemed to be as good on the new green as it was on the old green, although it is absolutely the same turf. Apparently the explanation is that where we have 18 inches of very rich soil we can not control the fertilizing of the grass. On relatively poor soil you can control it from the top, but on the very rich soil you no longer have that control. That seems to me to be part of the answer, at any rate.

Now, another point. Mr. Barrett's greens are superb; there are no better greens in the country than his—that is, among seeded greens. He has a sandy loam soil which drains perfectly. That is quite a different story from a soil where an inch or two below the surface you have a very stiff, heavy clay, which is very commonly the case. The subsoil will then become wet and waterlogged, and you will have more or less trouble from that condition.

It is our present belief that 4 inches of good loam top soil is sufficient. We think that will give you the resiliency of soil needed, and ample feeding for the grass roots.

Now, as to the depth of grass roots, we have a very extensive series of experiments going on, and the results have not yet been published. But this fact stands out, that the depth of the roots is in exact proportion to the height to which you let the grass grow. If you keep the grass short, your roots will be short—certainly so with creeping bent. We never have found those roots over 2 inches long under putting-green conditions; that is, their feeding is practically all done from the surface soil. Now if that is poor soil and you do not feed it much, the roots will go deeper. The exact details of those experiments will come out in an article one of these days; but our opinion is that 4 inches of good loam top soil is enough. It will do no harm to have more, provided you do not put so much manure and stuff in there that you can not control the growth of the grass. There are scattered all over this country putting greens that were built simply by mowing the natural grass on them, seeding with creeping bent, and then fertilizing; and although that type of putting green is becoming rare, very fine turf was grown on them.

I want to emphasize again that what we consider the main thing in regard to the depth of the soil is the nature of the subsoil. If your subsoil is good, permeable soil, such as Mr. Barrett has, you are not likely to have any difficulty; but where you have a still, heavy subsoil and only 1 inch of soil on top, your soil is altogether too thin. These are our present views.

Tile-Drainage for Golf Courses

By WENDELL P. MILLER, *Agricultural Engineering Department, Ohio State University*[1]

Tile-drains are a necessity on the average golf course for two reasons. The daily golfer readily observes that tile-drains are needed to remove surface water which accumulates during periods of excessive rainfall so as to obviate the necessity for fishing for golf balls in natural depressions and artificial traps. The second and real reason for tile-drains, and the one which I want to discuss, is the necessity for the removal of excess ground water.

Those of you who read THE BULLETIN from cover to cover know of the countless failures and difficulties in golf course management which have been charged to faulty underdrainage conditions. Practically every ill from which a course may suffer has at some time been blamed upon the thing which we call excess ground water. But have you ever heard anybody say that he had proof of damage from too much tile-underdrainage? While tile-drainage is not a cure for all the ills of the golf course, it is a factor which merits more careful consideration than it has received at the hands of architects, contractors, and greenkeepers. Those responsible for our golf courses can not be blamed for their sins of omission, because there has been and still is a great lack of fundamental drainage information and engineering data. A large part of the information which I employ when designing a drainage system, is the result of personal experience gained since my father first sent me out as a boy with a hoe to clean out the clogged tile outlets of our farm drainage system.

The following are the most important and undisputed benefits to be derived from tile-drainage:

1. By removing the excess ground water, tile-drainage firms the soil

[1] In this article Prof. Miller presents the substance of his address on this subject delivered at the annual meeting of the Green Section, January 4, 1924.

and eliminates the direct damage to the turf from puddling caused by trampling soggy clay or silty soils. The earlier drying of the soil in the spring resulting from good drainage means that a course can be brought into condition two weeks to a month earlier without excessive labor or damage to the soil.

2. Tile-drainage not only removes the surface water and the excess ground water from the soil, but it also increases the amount of moisture available for plants.

3. It keeps the soil in a sponge-like condition, ready to receive and retain a larger percentage of the rainfall, thus reducing the amount of surface run-off and erosion of the soil.

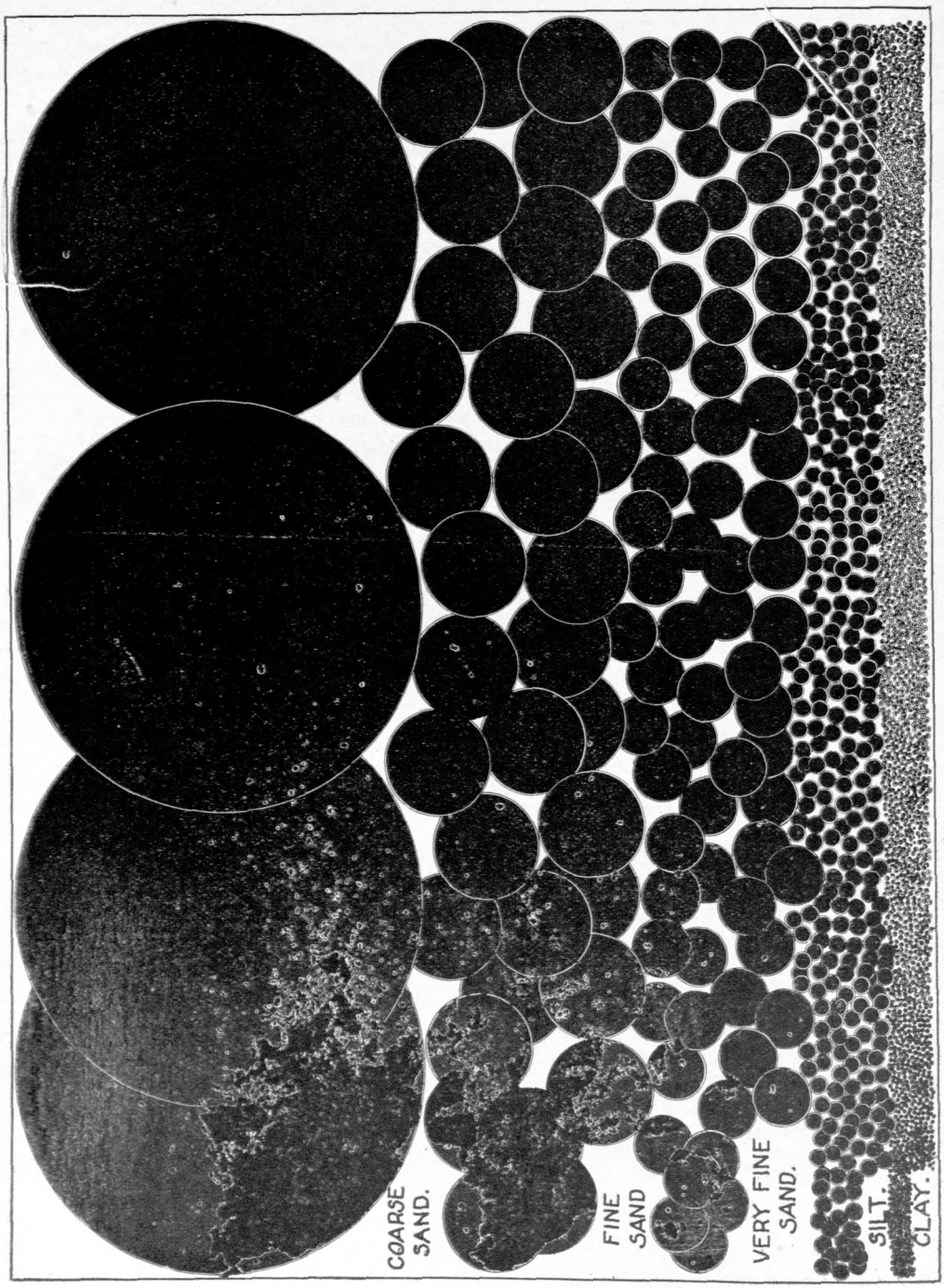
4. By increasing the aeration of the soil, it promotes greater bacterial action, which in turn increases the available supply of plant food.

5. It eliminates winterkilling and frost-heaving of the grass roots.

Several other minor benefits have been listed from time to time but most of them are secondary to the ones mentioned.

All soils are composed of decayed rock and organic matter. A soil of one region is likely to differ from the soil of another region in source of origin, mode of origin (glacial, residual, etc.), time of origin, and so many other factors that the drainage characteristics of two soils may be entirely different. From the drainage and soil-moisture standpoints the most important point of variation in soils is that of size and arrangement of soil particles in the soil mass.

For the purpose of describing soil texture, the Bureau of Soils of the United States Department of Agriculture divides all soil material, on the basis of the size of the soil particles, into 7 "soil separates." These separates, listed in order of size of soil particles, are as follows: clay, silt, very fine sand, fine sand, medium sand, coarse sand, and fine gravel. All soils are then classified by determining the percentage of each of the above separates contained. There are three groups of "soil classes." Those which contain less than 20 per cent of silt and clay particles are called sand soils. Those that contain between 20 per cent and 50 per cent of silt and clay are in the group called sandy loams. The sand and sandy loam groups usually have natural underdrainage and seldom require uniform tile-drainage for the control of excess ground water. Soils of the third group, those which cause trouble by lacking natural underdrainage, contain more than 50 per cent of silt and clay. The most common soil classes of this group are silt loam, clay loam, silty clay loam, silty clay, and clay soils. On page 68 a comparison of the diameters of the various soil separates is illustrated. The white areas are the soil voids or spaces which can be occupied by excess soil water or by air. The black line around each soil particle represents the film of soil moisture which surrounds each soil particle. This film of moisture is the only water that plants can use. Now imagine that the soil particles shown in the diagram are thoroughly mixed, so that the fine sand fills the voids between the coarse sand, and the silt and clay fill the smaller voids resulting from the mixture of sands. This process of filling the voids with still smaller and smaller particles of clay has gone so far in some soils that the voids have become too small to permit the percolation of water through the soil. On the other hand, with a soil in which the soil particles are quite uniform in size, the smaller the particles the greater the percentage of voids in a



Relative Sizes of Soil Particles.

given soil mass. In other words a bucketful of dry clay will hold more water than a bucketful of dry coarse sand. In nature one rarely finds a soil in which the soil particles are of uniform size, and hence almost every soil class, and even the soil types of a given class, have widely varying water-holding capacities and drainage characteristics. Many other factors, such as organic matter content, cultural methods, and kind of crops grown, also change the drainage characteristics and complicate the problem.

This discussion of soil structure has been given in the hope that it will explain why it is impossible at the present time to give any set rules for the proper spacing and depth of tile lines which will apply to all soils. This also explains why the drainage systems of two adjoining golf courses which may be alike in structural details, give unlike results in the removal of excess ground water. It also means that the answer to the question, How much drainage is needed? must be secured from each particular soil by careful physical examination. The answer is not to be found in text-books on methods of constructing drainage systems.

Excess ground water acts as a lubricant on the soil particles. When the ground is full of excess ground water the soil particles can easily roll around on one another, and we say that the ground is soft and water-logged. Working or trampling a soggy soil will cause the smaller particles to slip in between the larger particles, thus making a more compact soil mass. When a soil thus treated dries out, it becomes very hard, and is spoken of as a puddled soil. Grass will not thrive on puddled soils, and under such conditions tile-drainage removes the water very slowly.

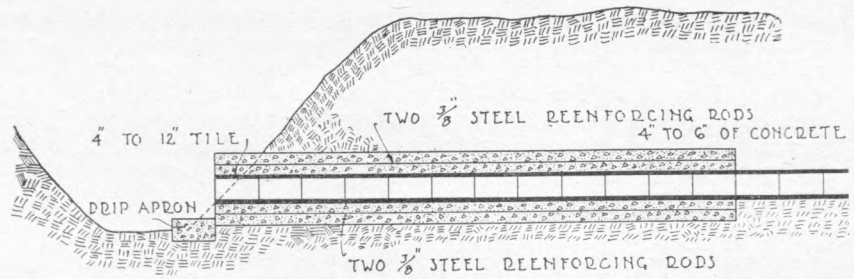
Air and water can not occupy the same space at the same time. Nature abhors a vacuum; hence when the excess ground water is removed from a soil by tile-drainage, air immediately filters into the voids between the soil particles. Tile-drainage prevents the air starvation of plant roots and of the soil bacteria which assist in making available the plant food of the soil.

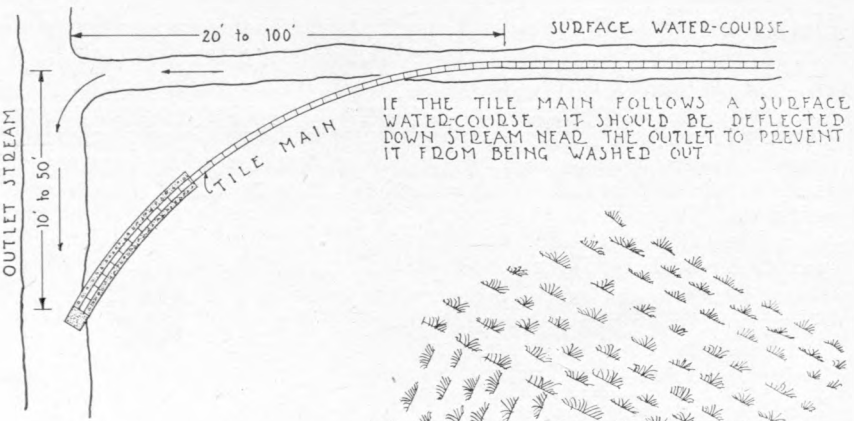
Tile-drains are to the soil what the spillway is to the dam. If it were not for proper spillways to limit the head of water in our big dams, the water would wash out the dams. Exactly so tile-drains, by limiting the height of the water-level in the soil, prevent the water from heavy rains running away over the surface of the ground, as it would if the ground were already full of water.

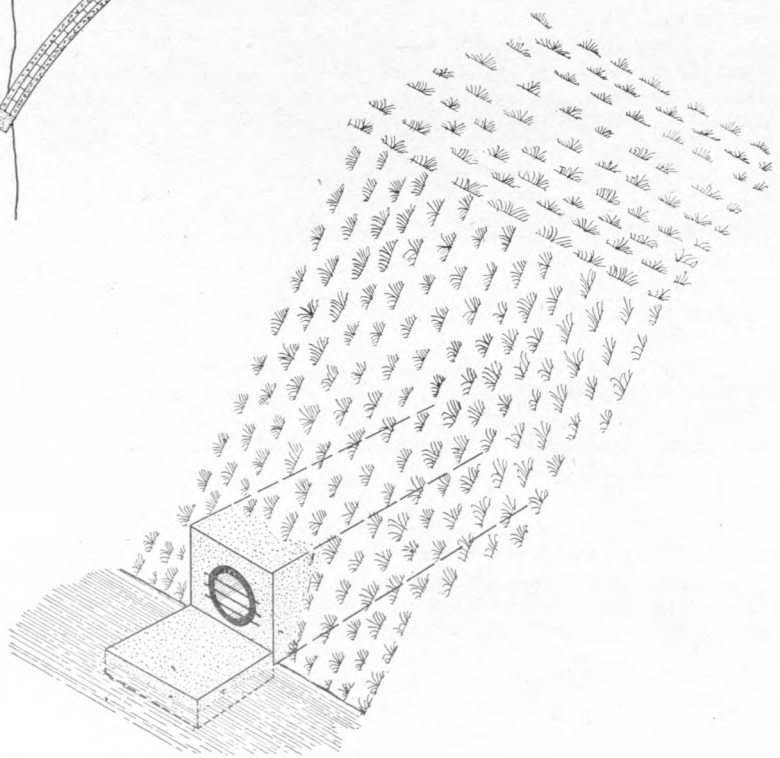
Soil particles change very little in size with change in temperature, but water expands greatly when freezing. Hence the plants on a water-logged soil suffer more in winter than those on dry soil, because the expansion of the freezing water breaks the roots.

With this discussion on *why* tiles drain, a few remarks on *how* tiles drain may not be out of place.

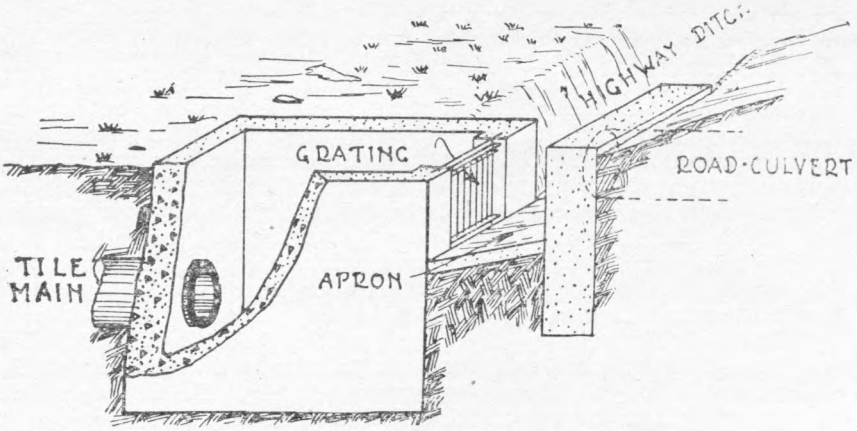
THE OUTLET.—A good outlet is the first essential of good drainage. No amount of care in the design and construction of a tile-drainage system will overcome the handicap of a poorly chosen or poorly protected outlet. The ideal outlet provides for free flow from the mains at all times, is low enough to permit a good grade in the main, yet requires a depth of cut which is just sufficient to take care of the flow from submains and laterals. A majority of the drainage systems have their outlets in an open ditch or tile built and maintained by the county. When these county drains are being constructed or rebuilt, the abutting property owners may well give more attention to seeing that they provide a complete and sufficient outlet.



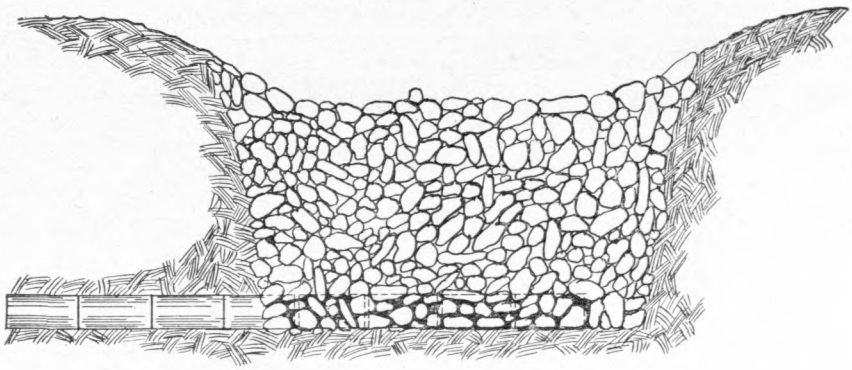




Tile outlets should be protected from undercutting, weeds, frost, rabbits, and crushing, by incasing the last 10 to 20 feet in concrete. No forms are required to build this outlet.



Flood water from road culverts and ditches can be safely admitted to the mains if intakes and screens are provided to prevent debris entering the tile. The box should be covered with a concrete slab, removable for cleaning out the basin.



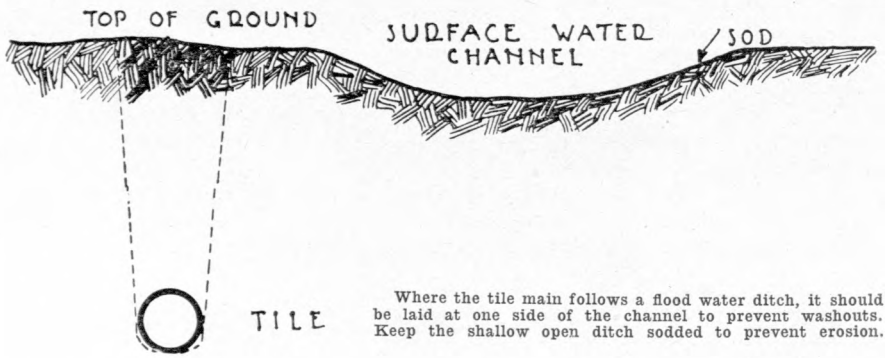
A coarse stone intake may be used where a catch-basin is not desired.

CONCRETE FOR PERMANENCE.—Proper protection of the outlet is the best insurance of permanent efficiency in a tile system. An unprotected outlet is often undermined by the outflowing water, and the tiles will drop, one by one, until a large ditch or gully is washed back for some distance into the field or until the tiles are completely obstructed by weeds and mud. A concrete or masonry head-wall with a splash-apron to prevent the water from undermining the wall should be built at the outlet of the main. If located in the natural channel of the surface runoff, the head-wall should have a spillway large enough to take care of surface water. The foundation and wing-walls should be deep and heavy enough to prevent the spillway from ever being washed out or toppled over. The last 10 feet of the main should be constructed of bell-and-spigot sewer pipe with cemented joints. If the main comes so close to the surface of the ground that there is danger of the tile being broken, old iron well-casing or iron road-culvert pipe should be used instead of sewer pipe. The end

of the tile should be protected with a grating of iron rods or a trapdoor to prevent the entrance of animals.

A Systematic System.—With the outlet located, a complete survey should be made of all the area which the outlet will ever be called upon to serve. With this information at hand, a complete drainage scheme can then be outlined. If the layout is planned only a little at a time, and is so constructed, the result will probably be a collection of overlapping small systems, which will make up one large and inefficient system. With the plan for the whole area completed in the beginning, it is, however, possible to install at first those lines which serve the wettest portions and yet contribute toward the finally complete and efficient system. In most cases the employment of a competent drainage engineer is cheap insurance against future difficulties.

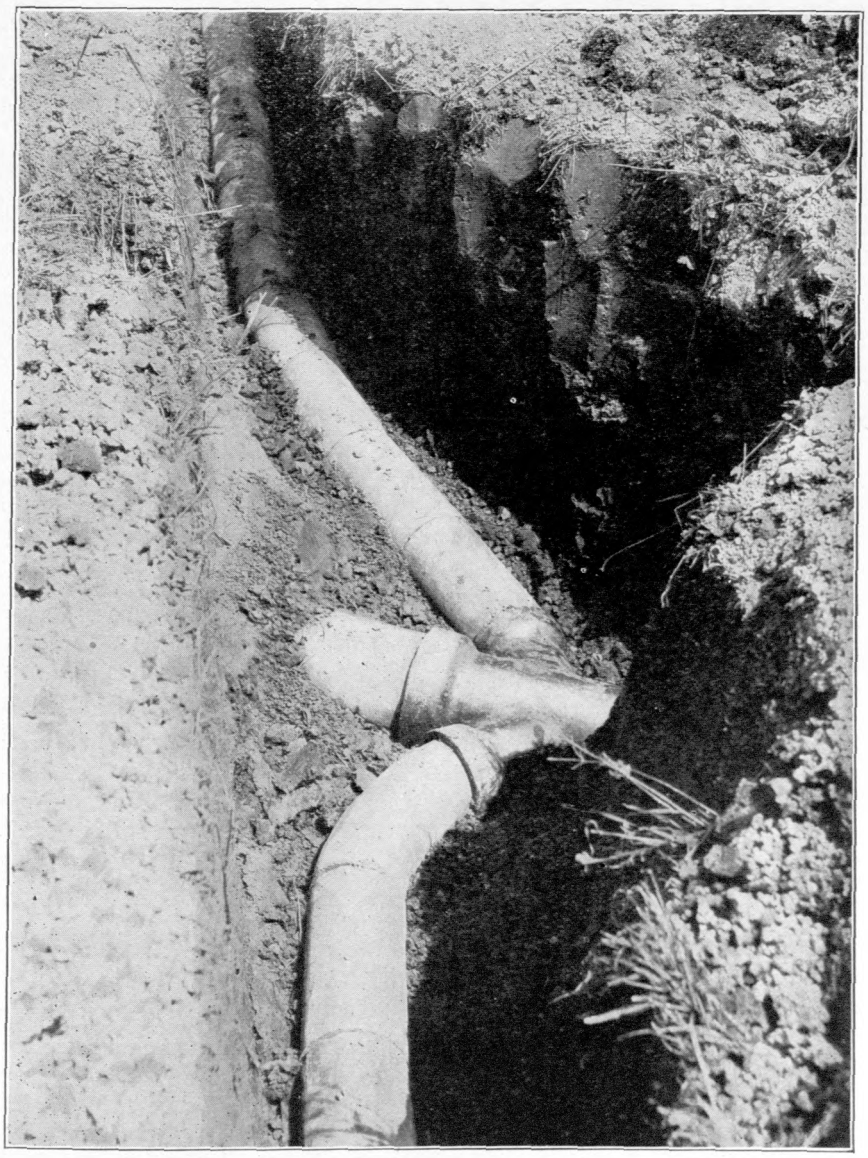
Drainage Geography.—So far as possible, the mains should follow the lines of lowest elevation through the area to be drained, so that the laterals can have good fall and yet not be too deep. The laterals should be straight, and as far as possible should run in the general direction of the greatest slope. They should preferably be laid out in parallel lines. The schemes of lateral layout in general use are (1) the natural, (2) the



Where the tile main follows a flood water ditch, it should be laid at one side of the channel to prevent washouts. Keep the shallow open ditch sodded to prevent erosion.

gridiron, and (3) the herringbone systems. (1) The natural system is used to drain the hollows and depressions in land which is too rolling to permit of a more regular layout or where the entire area does not require uniform underdrainage. The lines are more or less irregular, since they follow the depressions. In uniform drainage these lines become the mains and submains, and the laterals will be laid out according to one of the following schemes. (2) In the gridiron system the laterals are on only one side of the main. This is usually the most economical system which can be used in draining level land and flat slopes, since only the land immediately adjoining one side of the main will be double-drained. With this scheme it is usually possible to get the shortest length of main and the fewest number of junctions in proportion to the total length of laterals. (3) The herringbone system, so called because of its resemblance to the skeleton of the herring, has the laterals entering the main from both sides; and while the land on both sides is double-drained, yet it will be so drained only where it is wettest, a feature which is often of benefit in those places where this system is adapted.

Draining for Posterity.—If correctly planned and constructed, tile



Ready-made junction-tiles should be used to connect laterals to the mains. Loose-fitting connections should be avoided.

drainage is much more nearly everlasting than most other improvements on the golf course. However, one clogged outlet or tile may render a whole system useless. Attention to the correct construction of the fine details is absolutely essential to secure proper performance. Where possible, laterals should enter the main from above. If mains can not be placed deep enough to permit this type of junction, the last two rods of tile should be given a gentle curve in the direction of flow in the main

and as much increased fall as is possible. Ready-made junction-tile or sewer-pipe fittings should always be used. Loose-fitting connections should be cemented.

To allow for expansion, soft clay tiles should be spaced at least ¼-inch between joints, and hard burned tiles at least ⅛-inch apart. To prevent accumulation of silt in the lateral lines, it is good practice, where possible, to give them a gradually increasing rate of fall as the outlet is neared. Abrupt decreases in the rate of fall should never be made, unless provision is made for collecting silt that may be carried by the water. As far as possible the rate of fall should be kept uniform even though there are small surface irregularities. To prevent the roots of water-loving plants and trees from clogging the tile lines, all trees and brush should be cut along tile lines. Elm, willow, cottonwood, and elderberry are particularly troublesome. Where the tiles must pass under trees of these species the tiles should be incased in concrete.

The Measurement of Golf Holes

By Alan D. Wilson

So many questions are asked as to the proper manner of measuring golf holes that it has been suggested this article be written, not however to lay down any hard-and-fast rules but simply to give a practical method and one which we believe to be in the nearest accord with the best-recognized practice. In order to give the article authority, it has been submitted to Howard F. Whitney, Chairman of the Rules of Golf Committee, and it is published with his approval.

As discs and cups are constantly moved, no absolutely accurate measure of a hole can be had from day to day, but it would seem as if the fairest measure of the average distance would be from the center of the back or so-called championship tee to the center of the green. If also regular tees and short tees are used, the holes may likewise be measured from them if it is desired to give this information on the card. If these shorter tees are not measured, a player can approximate the length of the hole pretty closely from the measure given from the back tee.

The question is constantly asked whether holes should be measured in an air-line or along the contour of the ground. For practical reasons the contour of the ground is usually the better method. In the first place it is much easier, and in most cases it gives a result almost identical with that of the air-line method. If the play is over rising ground followed by falling ground and then another rise, it is true that the contour method slightly increases the length, but as a large part of the play is uphill, this seems entirely fair, because the hole plays long even as measured. Of course, in certain exceptional cases the air-line method should be used. Let us take, for instance, a one-shot hole of, say, 160 yards in a direct line, played from a high tee over a deep ravine to a high green beyond. The air-line measurement would be 160 yards. If a contour measurement were used, following down into the ravine and up the other side, it might show a distance of 200 yards, which would be entirely misleading, as the contour of the ravine in no way enters into the shot. In general, then, for the sake of practical convenience, holes should be measured on the contour of the ground; but in the unusual case where the contour does not enter into or affect the play of the shot, the air-line method should be used.

Dog-leg holes should be measured from the back or championship tee on the line of play which would be used by the standard good player—a

man, say, who could drive 225 yards—and not on the line taken by either the very short or the very long player, both of whom, due to their variations from normal, are more or less golfing freaks. The measurement, therefore, should be made from the center of the tee on the line indicated above to an angle point clear of the dog-leg which properly opens up the green, and from this point to the center of the green. If measurements are also to be made from the regular tee and from the short tee, the same theory should be followed; that is, one should measure on the line which would be taken by the standard player of regular tee-length or of short tee-length.

Holes with long diagonal carries, on which the player has the option of biting off just as much as he thinks he is able to chew, should be measured on just the same theory as above, namely: from the back tee, on the line which would be taken by the standard good player—one who could carry, say, 190 yards; and from the regular tee and from the short tee, on the lines which would be taken by the standard player of the class who would be expected to use these tees—let us say 160 yards and 125 yards.

There has developed in this country recently, probably due to the increased power of the modern golf ball, a desire for long golf courses, and due to this desire clubs have yielded, in some cases, to the temptation of what might be called artificially lengthening their holes by the use of such expedients as measuring from the back of the back tee to the back of the green. This would probably add 30 yards to the length of the hole, and while it may look pretty on the card and add 500 yards to the apparent length of the course, it not only adds nothing to the play but deceives the stranger as to the length of the hole, and also deceives the regular player by making him think that he is getting, let us say, 450 yards in 2 shots, when actually he is getting about 420 yards. This is, of course, a harmless deceit, but, all said and done, it is pretty bad practice in what we believe to be essentially a sportsman's game.

U. S. Golf Association Decisions on the Rules of Golf

Question.—In an open tournament conducted by a club, medal play, a player drove a ball from the fifth tee, making a poor shot. He immediately teed up another ball and took another drive, not with the idea of playing his second ball but presumably because, exasperated, he wanted to show himself and others that he could send it out. His first ball was in the fairway. He played his first ball, taking up the second. What penalty, if any, should be imposed?

ANSWER.—This situation is covered by Decision 267 of the Decisions by the Rules of Golf Committee of the Royal and Ancient Club of St. Andrews, which is as follows: "By the custom of the game the competitor is disqualified. After teeing his ball for the first stroke in a stroke competition, the competitor may not play a practice stroke at any tee or during the play of any hole." This applies to medal play only. In match play there would be no penalty, but the act of the player would be considered very bad form.

Question.—In the back of our 12th hole there is a deep ditch diagonally across which there is a water pipe 4½ to 5 feet above the ground. A's ball on the second shot landed in this ditch, directly under this pipe. Measured perpendicularly the pipe was therefore more than a club's length from the ball. The pipe was too low for A to take his stance thereunder, and the pipe would also inter-

fere with his back swing. A claimed that he could pick up his ball and drop it a club's length from the pipe, measured horizontally. B claimed that the pipe was more than a club's length from the ball and that therefore the ball must be played from its lie. Who was right? Is the player himself the sole judge as to whether his ball is unplayable?

ANSWER.—A could not move his ball except under Rule 22. The player himself is the sole judge as to whether his ball is unplayable. Under the conditions, a local rule should be made for a player in this ditch and he should be allowed to drop in the hazard away from the pipe without penalty.

Question.—A and B, as partners, were playing a 4-ball match with C and D. B had a private match with C. We all played our second shot toward the green. As it was dusk, A accidentally played his third shot onto the green with C's ball, thinking it was his own ball. C started a search for his own ball, and in the meantime A holed out and went into the club house. After 15 or 20 minutes had elapsed, C came into the club house and found that A had his ball. C, in his private match with B, claims he has a right to go out the following day or any other day, replace his ball, and play out the hole. B played out the hole and claimed the hole in his private match with C.

ANSWER.—Under Rule 10 for 3-ball, best-ball, and 4-ball matches, and Rule 20 under General and Through the Green, A is accordingly disqualified for playing his opponent's ball. In equity B has no foundation for his claim of the hole against C. In this case C did nothing in violation of the Rules of Golf, but was the injured party. Under the conditions and in all fairness, B's claim of the hole should be ruled out and B and C should come to some equitable arrangement to decide the hole.

Question.—You state that when a handicap match ends in a tie, a full 18 holes must be played off after the completion of the round in order to determine the winner. Does the handicap apply on the second 18 holes also? Is it not true also, as a general proposition, that where handicap matches are tied the handicap always applies on the extra holes that are played the same as on the original 18 holes?

ANSWER.—Handicaps are made to equalize the two players for 18 holes. If they tie at the end of the round the full 18 holes should be played over again in fairness to the one receiving the handicap. In answer to your second question, the handicap applies in this case the same as in the other. The handicap should be adjusted over a certain number of holes in order to equalize it for the full 18 holes. For instance, if the player receives three strokes handicap, they may determine the playoff by playing 6 holes and the player receiving one stroke handicap.

Does your greenkeeper get The Bulletin? If not, see that his name is on the mailing list. He is the man who needs assistance. Any member club may obtain any number of additional subscriptions for The Bulletin, for use in connection with the work of its own club only, for $2 per year.

GREENKEEPERS' REGISTER

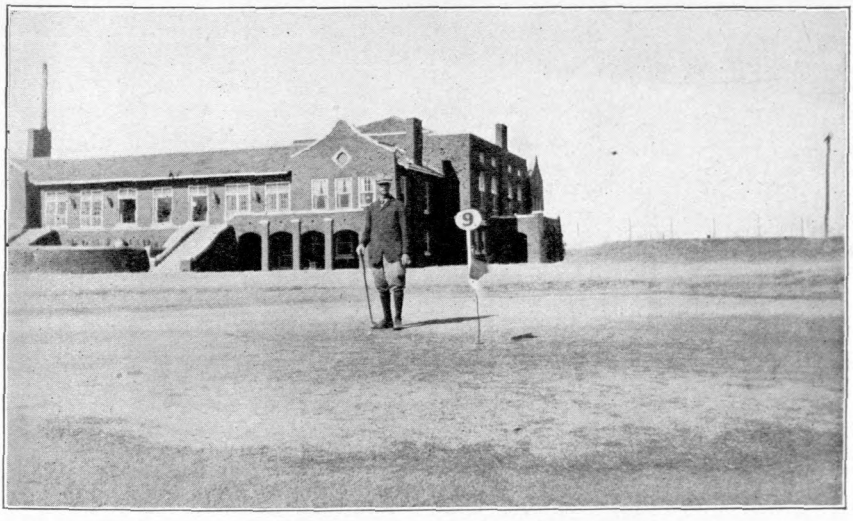
The editors of The Bulletin will be glad to receive letters from greenkeepers seeking employment and place such men in touch with golf clubs needing services of greenkeepers.

Cottonseed-Hull Greens

By C. H. LEAVELL, *El Paso, Texas.*

The attention of the writer was first directed to the matter of cottonseed-hull greens by an article in THE BULLETIN of December 16, 1921, by C. V. Piper and R. A. Oakley, wherein they described how Mr. Tom Fairbairn had used cottonseed hulls for putting greens in Mexico. Cottonseed hull is a woody fiber made from the seed of the cotton grown anywhere in the south. The cotton seed goes through a machine in which the oil-bearing kernel is removed, leaving a dry, linty hull as a residue.

The ground should be properly drained before placing the cottonseed hulls, and the soil itself rolled, tamped and scraped so that all loose soil is removed, leaving the surface hard and smooth with possible slight undulations or rolls to make the final putting surface more interesting. A sloping surface is easily made. If the soil is sandy or of such loose



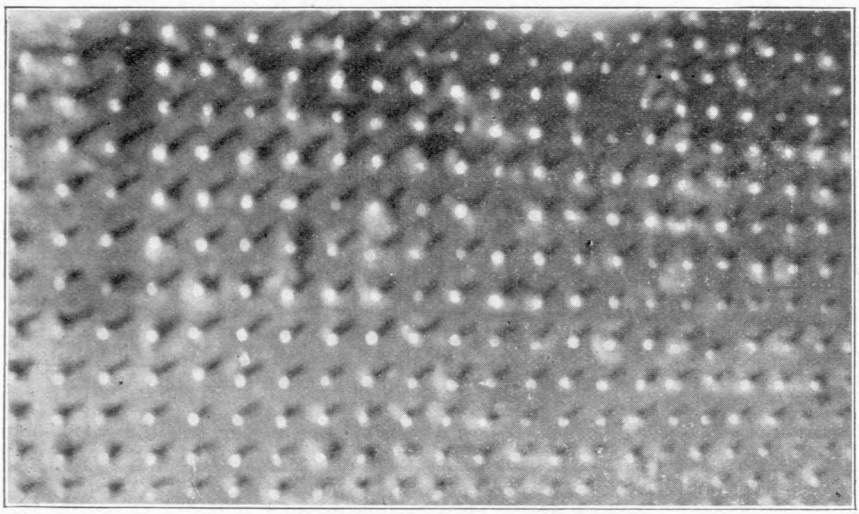
Cottonseed-hull green, showing in foreground how the cottonseed hulls and the grass blend together at the edge of the green.

character that it can not be packed, it will be found necessary to remove 3 or 4 inches of the surface and cover it with crushed stone or a gravel, which when rolled and tamped makes an excellent base for cottonseed-hull greens.

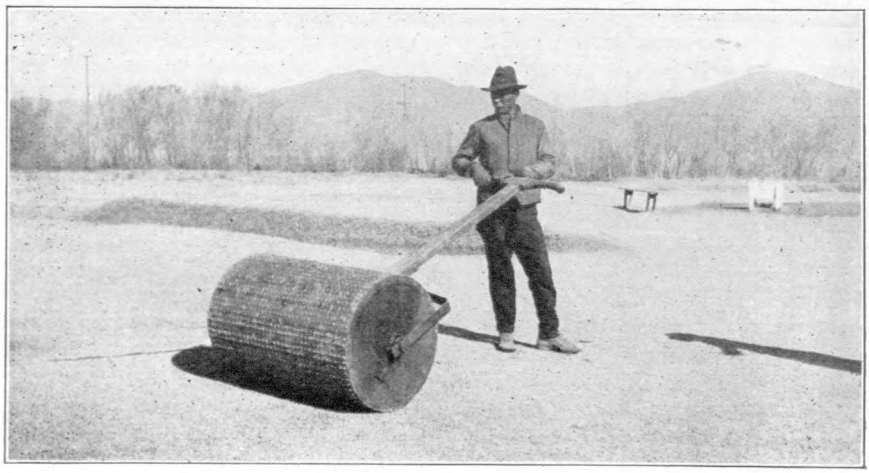
The hulls should be laid on the ground by hand, to a depth of 4 inches, as nearly even as possible, at which stage they are very fluffy, light, and loose. A common roller is then used, and a heavy board 12 to 15 inches broad and 3 feet long used for tamping. Gradually the mat of the hulls is pounded and worked into a single blanket. Around the edge next to the grass a shallow trench about 3 inches deep and 3 inches broad should be dug, and into this the edge of the cottonseed-hull mat folded, and then the soil and grass brought up to it on the outside. This will protect it from the most severe wind. It takes about two or three weeks' use and rolling to reduce the mat to where it is anything like first class; but the longer

it is used, the better the putting surface becomes. The final mat should be about ¾-inch thick.

Cottonseed hull has a marked tendency to pack on the surface, thereby making the putting extremely unstable. This we have overcome by the



Portion of surface of wooden roller, showing dowel-nails used for producing indentations in surface of green.

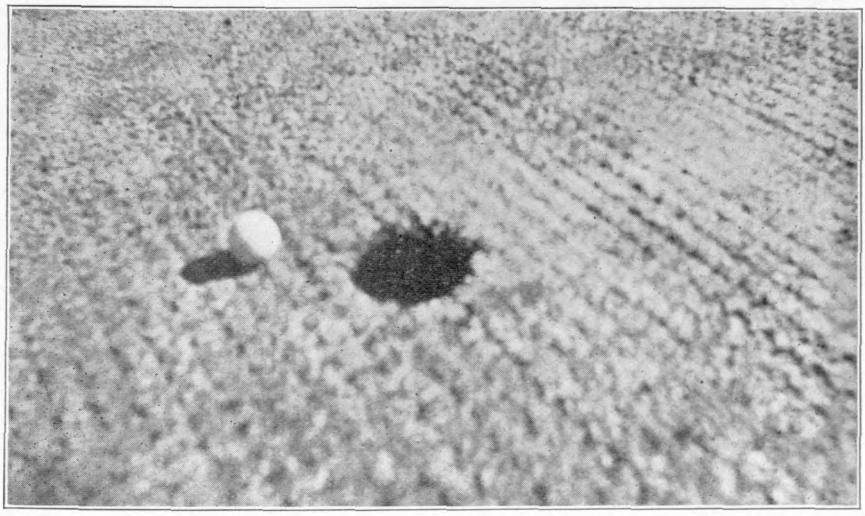


Wooden roller used to make indentations in surface of green.

use of a wooden roller, here illustrated. The face of this roller is covered with dowel-nails set at 1-inch intervals. The roller weighs from 150 to 175 pounds. After the mat has become fairly firm the use of this roller will roughen up the surface, making small indentations somewhat like the

top of a pepper-box. Without this roller I do not think the cottonseed hulls would be a success.

One man with this roller is sufficient for the maintenance of 18 holes. There is no sand to haul and sift, and once properly laid, the cottonseed hulls would not have to be relaid under two years. The cup should be moved from time to time the same as on grass greens. Our experience here is that it takes about 40 to 50 minutes less time for a foursome to play 18 holes than on sand greens, and I believe that our club is saving $2,000 per year on expense of upkeep.



Close-up view of portion of surface of the green, showing the indentations made by the wooden roller.

I am informed by Mr. Robert S. McCart, of El Paso, that he has patents pending and is prepared to make license-fee contracts.

For courses anywhere in the arid district of the west there is no question about the practicability of cottonseed-hull greens. The hull, as I stated before, is really a wood fiber, and where there is much moisture or rain the hulls, of course, swell a great deal and the putting is much slower than on an ordinary grass green. Therefore in a wet country I am sure that the base of every green should be of porous material, such as crushed stone or gravel large enough to pass through a 1-inch-mesh screen. One ton of cottonseed hulls is necessary for a green 20 yards in diameter.

NEW MEMBER CLUBS OF THE GREEN SECTION.—North Penn Golf Club, Bradford, Pa.; Country Club of Fort Dodge, Fort Dodge, Iowa; Danville Country Club, Danville, Ill.; Sunset Ridge Country Club, Winnetka, Ill.; Orlando Country Club, Orlando, Fla.; Shewami Country Club, Sheldon, Ill.; Highland Country Club, La Grange, Ga.; Biddeford and Saco Country Club, Saco, Me.; Westmoreland Country Club, Chicago, Ill.; Richmond Country Club, Richmond, Ind.; Penns Grove-Carneys Point Golf Club, Penns Grove, N. J.; Santa Ana Country Club, Santa

Ana, Calif.; Happy Hollow Club, Omaha, Nebr.; Pike County Country Club, Louisiana, Mo.; Klinger Lake Country Club, Sturgis, Mich.; Old Country Club, Flushing, L. I., N. Y.; Highlands Country Club, Grand Rapids, Mich.; Raritan Valley Country Club, Somerville, N. J.; Montecito Country Club, Santa Barbara, Calif.; Gowanie Golf and Country Club, Mt. Clemens, Mich.; Jericho Country Club, Vancouver, B. C., Canada; University Golf Club, Great Neck, L. I., N. Y.; Forest Hill Golf Club, Belleville, N. J.; Waccabuc Country Club, Lake Waccabuc, N. Y.; Cascade Hills Country Club, Grand Rapids, Mich.; Michiwaukee Golf Club, Milwaukee, Wisc.; Mesaba Country Club, Hibbing, Minn.; Toppenish Golf Club, Toppenish, Wash.; Verity Park Golf Club, Middletown, Ohio; Metropolis Country Club, White Plains, N. Y.; Colonie Country Club, West Albany, N. Y.; Fox Chapel Golf Club, Pittsburgh, Pa.; Marlborough Golf and Country Club, Montreal, P. Q., Canada; Quincy Country Club, Quincy, Ill.; Racine Country Club, Racine, Wisc.; Redlands Country Club, Redlands, Calif.; Avon Field Golf and Tennis Club, Cincinnati, Ohio; Jamestown Country Club, Jamestown, N. Dak.; Washington Country Club, Washington Court House, Ohio; South Shore Country Club, Chicago, Ill.; Champaign County Country Club, Champaign, Ill.; Sioux City Country Club, Sioux City, Ia.; Madison County Country Club, Edwardsville, Ill.; San Gabriel Country Club, San Gabriel, Calif.; Country Club of Salt Lake City, Salt Lake City, Utah.

QUESTIONS AND ANSWERS

All questions sent to the Green Committee will be answered in a letter to the writer as promptly as possible. The more interesting of these questions, with concise answers, will appear in this column each month. If your experience leads you to disagree with any answer given in this column, it is your privilege and duty to write to the Green Committee.

While most of the answers are of general application, please bear in mind that each recommendation is intended specifically for the locality designated at the end of the question.

1. Seeding Northern Putting Greens.—The following seed mixture has been recommended to us for putting greens: Chewings' fescue, 60 per cent; recleaned redtop, 30 per cent; bent grass, 10 per cent. We understand that the best seed obtainable for putting greens would cost about $1.75 per pound. It is out of the question for us to pay a high price for our seed, and we shall therefore appreciate your advice with regard to seeding our greens. (Maine.)

Answer.—We would not advise you to waste any money on Chewings' fescue seed. You should aim to get bent grass greens. The best plan would be to seed with German mixed bent alone, but if the expense of this would be too great you could well use a mixture of three-fourths recleaned redtop and one-fourth German mixed bent, as in a few years the redtop will be entirely crowded out by the bent. This seed should be sown at the rate of 5 pounds per 1,000 square feet of putting green surface. The top two or three inches of your soil should be a loam or sandy loam with a fair amount of manure thoroughly mixed in. Do not use any peat

or lime. For the later upkeep of your greens you will get the best results by top-dressing with good compost, and occasionally stimulating when need appears, with ammonium sulfate applied at the rate of 3 to 5 pounds per 1,000 square feet and thoroughly watered in.

2. Impractibility of Keeping Soil Permanently Acid for Bent Grass; Fertilizers for Bent.—In the Rhode Island State College Extension Bulletin No. 13, of June, 1922, Kingston, R. I., they advise that on plats that are approximately ten years old, fertilizing with 250 pounds of ammonium sulfate, 250 pounds of acid phosphate, and 250 pounds of muriate of potash per acre once a year, has resulted in an acid soil that for the bent grasses was very desirable and discouraged all weeds and bluegrass. Would you advise us to follow that procedure on our creeping bent greens? (Kansas.)

Answer.—We have visited the grass plats at Kingston a great many times, and the report does not exaggerate the benefit derived from the method of fertilizing which they advocate. It needs explaining, however, that the soil at Kingston is very acid to start with. We do not get nearly as striking results here at Washington, but we do get a marked improvement in the freedom from weeds by the use of ammonium sulfate. We would not use acid phosphate, however, as it encourages white clover wherever that plant is common. The method of fertilizing we advocate, based on a number of experiments besides those conducted at Rhode Island, is to apply ammonium sulfate, not to exceed 5 pounds per 1,000 square feet of green, once or twice in the spring, and once a year to give the greens an application of bone meal at the rate of 10 pounds per 1,000 square feet, and muriate of potash applied at the rate of 3 pounds per 1,000 square feet. An application of ammonium sulfate may be repeated again in the fall if the grass appears to be in need of fertilizing.

3. Ridding Putting Greens of Clover.—We have unusually large greens, clay soil, and surface well covered with bent, which has been kept fine by a daily cutting the past season. This spring a very marked increase in clover has been noted. Will you kindly advise the best action to take to eliminate the clover from the greens? It is generally considered that clover is objectionable in greens, but some have argued that a green consisting wholly of clover would be satisfactory. Will you kindly give your views on this matter? (Pennsylvania.)

Answer.—We note that you think clover is much more abundant this spring than it was last season. If you will watch your greens carefully you will see that the clover varies greatly in proportion at the different seasons and in different ways. Taken all in all, we would say that the high-grade putting greens of the east have about 25 per cent of their surface covered with white clover. This is never desirable, but of course there are limits to the expense one can go to keep it down. The best method we know of is to avoid the use of lime or other alkali fertilizers and to fertilize with ammonium sulfate, with the idea of getting the soil more and more acid, under which condition white clover and many other weeds do not thrive.

4. Grasses for Southern Golf Courses; Treatment of Bermuda Putting Greens.—Our course is on high sandy land and we are having some trouble in keeping the turf in satisfactory condition. What grasses and what treatment would you recommend for our conditions? (Georgia.)

Answer.—For your fairways ordinary Bermuda grass is best on the higher ground, and carpet grass on the lower or moister ground. In

places St. Augustine grass can be used if desired. For your putting greens the Atlanta strain of Bermuda grass is best. In growing fine Bermuda turf it is necessary to have a clay or clay loam soil. High quality Bermuda turf can not be grown on decidedly sandy soil. For treatment of sandy soils we would recommend that clay or clay loam be mixed into the top 4 inches of the soil until a clay loam consistency is secured. Then with proper fertilizing fine Bermuda turf can be grown. In the further top-dressing of such greens the soil should be of a loamy consistency.

5. SEEDING NORTHERN FAIRWAYS.—The following seed mixture has been recommended to us for our fairways: Kentucky bluegrass, 40 per cent; Chewings' fescue, 40 per cent; recleaned redtop, 20 per cent. Would you advise us to accept this recommendation? (Maine.)

Answer.—We would not advise you to use any Chewings' fescue under any circumstances. You can not find a single course in New England which has obtained satisfactory results with this grass either on putting greens or fairways. Beside, the seed is expensive and poor in germination. We would advise you to use 4 parts Kentucky bluegrass and 1 part redtop. The minimum rate of seeding would be 100 pounds per acre. Somewhat more seed would be desirable, but I think you could count on getting a satisfactory stand by seeding at that rate. As redtop seed is considerably cheaper than that of Kentucky bluegrass, the cost of seeding could be reduced by using Kentucky bluegrass and redtop in equal proportions and at the same time quite satisfactory results could be obtained. Under New England conditions the redtop and bluegrass will in time be replaced mainly by Rhode Island bent, which comes in naturally and makes exquisite turf; but in the meantime these grasses are the best and cheapest that you can use. The best time of seeding would be the middle of August, although in your latitude spring seeding gives fairly good results.

6. BURNING FROM THE EXCESSIVE USE OF AMMONIUM SULFATE.—We have been using ammonium sulfate on our greens at the rate of 20 pounds to a green, which is the equivalent of not to exceed 5 pounds to 1,000 square feet of surface or less. We have frequently noticed that for a few days after the applications our greens appeared to be mottled by patches of sickly, yellowish green grass, looking somewhat like grass that had been covered for a time. We have a notion that our treatment has resulted in the burning effect described on page 205 of Volume I of THE BULLETIN. Is our diagnosis correct? (Wisconsin.)

Answer.—The use of ammonium sulfate will prove harmful if carried to extremes. Do not overdo anything. Two applications a month apart in the spring of not to exceed 3 pounds per 1,000 square feet of green, and a similar application in the fall, are all that the grass usually needs. More is likely to cause a condition such as you describe.

7. WINTERHARDINESS OF CREEPING BENT; ITS USE ON SANDY SOIL.—Please advise us if creeping bent grass will winterkill in this part of the country and if it is adapted to growing on sandy soil. (Wisconsin.)

Answer.—We have never found that creeping bent winterkills in any part of the country. Of course, there is likely to be winterkilling of any grass if the soil drainage is bad. With a sandy soil it is advisable to add clay to hold the sand together. There is no first-class turf grass that will grow on shifting sand.

8. SPRING FERTILIZING OF FAIRWAYS.—What treatment would you ad-

vise for the fairways this spring? The application of ammonium sulfate was wonderfully successful last spring and made the links beautiful, but the effects seemed to wear off in a couple of months, and during the dry weather in May and June we were afraid the ammonium sulfate was going to burn the grass. (Virginia.)

Answer.—The effects of ammonium sulfate are temporary and hardly observable after two months. Bone meal or acid phosphate would probably give more lasting benefit to your fairways, and one application in the spring is advisable.

9. Spring Cutting of Putting Greens.—Do you advise close and frequent cuttings of putting greens in the spring? (New Jersey.)

Answer.—There is much difference of opinion on this subject. Our own opinion is that greens should be cut close early in the spring and kept cut fairly close during the season. We have found it difficult to get turf in good condition after the grass has been allowed to grow to a fairly good height for a considerable period of time. Bent greens will stand closer cutting than will fescue greens.

10. Liquid Manure As a Substitute for Ammonium Sulfate.—Could we expect to obtain the same results from the use of liquid manure alone as a fertilizer as are expected from the use of ammonium sulfate? (New York.)

Answer.—From what little we know of the action of these two substances, the results they produce are not the same. Both give excellent results when used as fertilizers, but ammonium sulfate tends to make the soil acid, a condition which discourages the growth of many weeds, yet which, on the other hand, is decidedly beneficial to the growth of the bent grasses. We know of a number of courses where excellent greens have been produced by the use of liquid manure.

11. Mushroom Soil, Ammonium Sulfate, and Bone Meal as Fertilizers.—We had planned to fertilize our greens this spring with bone meal applied at the rate of 100 pounds to a green. We are, however, able to purchase mushroom soil for $1 a cubic yard, nearby. What is your opinion of the value of mushroom soil at this price? (Illinois.)

Answer.—At $1 a cubic yard mushroom soil is very cheap, and even at $3 a cubic yard it is by far the best and cheapest fertilizer you can buy. Bone meal is a good fertilizer, but slow in acting. If you should need to stimulate weak places in the turf quickly, use ammonium sulfate at the rate of not to exceed 3 pounds to 1,000 square feet.

12. Depth to Plant Grass Seed; Frequency of Watering.—I should like to know your estimate of the proper depth to plant grass seed. I have always thought it best to have the seed close to the surface, but am now advised to cover the seed with a ¾-inch top-dressing. Will fine grass seed come through such a cover? I am also informed by some that they never water seedings until the grass comes up. (California.)

Answer.—Grass seed should always be sown shallow, and preferably on a firm seed bed. It should never be sown more than ¼-inch deep. In the use of water, forget all about rules and use water whenever necessary; that is, keep the soil moist. The amount of water and the frequency of watering depend on the weather, the character of the soil, and other conditions.

Meditations of a Peripatetic Golfer

There are three really important things that help on golf courses to grow and maintain good turf: (1) barnyard manure, positively the most efficient of all fertilizers; (2) sand, for any course where the soil is of a clayey texture; (3) clay or clay loam to top-dress on land that is very sandy. Put your money first of all in manure, and secondly in sand or clay loam, as the soil conditions may require. Do not spend money on other materials until you have these in ample quantities.

They bragged about having the largest putting green on record. Wonder if they figured on the cost of upkeep.

Sowing 25 pounds of seed to each 1,000 square feet to renovate a putting green so constructed that the grass does not have a "Chinaman's chance!" As Bismark once said, "The stupidity of the average man is beyond belief."

A golf course, good as to layout and architecture, but very expensive to maintain. The upkeep of a golf course is a perennial need. In the building of any course the cost of upkeep needs serious consideration. It may be great or small, largely depending on the architecture.

A mud hole for a tee shot hazard! Certainly not a thing of beauty. Better drain it and make a sand waste.

It would make greenkeeping a whole lot easier if the Weather Bureau would abolish the month of August.

A greenkeeper writes that many of the "Questions and Answers" are practically identical. Just so. Most men have to read a thing about seven times before it reaches home.

Lime and phosphorus encourage the growth of clover. If you want clovery greens and fairways, by all means use lime and phosphorus.

Earthworms take notice! The robins are here.