Bulletin *of the* Green Section *of the* U. S. Golf Association

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A MONTHLY PERIODICAL TO PROMOTE THE BETTERMENT OF GOLF COURSES

ISSUED BY THE GREEN COMMITTEE OF THE UNITED STATES GOLF ASSOCIATION

CONTENTS

Address all communications to W. B. Lydenberg, Executive Acting Secretary, P. O. Box 676, Eleventh Street Station, Washington, D. C.

Announcements

First Meeting of the Delegates to the Green Section of the U. S. Golf Association.

There will be a meeting of delegates to the Green Section of the U. S. Golf Association at the Wardman Park Hotel, Washington, D. C., between July 19 and 22. The exact date of the meeting will be announced on the bulletin board of the Columbia Country Club the first day of the Open Championship. Look for the notice and don't make any dates until you see it. There are many important subjects to be discussed relative to the work of the Green Section, and every delegate to the Section should be present.

Any member of a subscribing club, even though not a delegate, who is interested in the work of the Green Section, will be welcome.

Turf by Vegetative Propagation.

Recently attention has been called by the press to the vegetative method of propagating turf of the bent grasses for putting greens. The statements that have been made are for the most part inadequate and leave the reader somewhat misinformed with regard to the more important features of the method. In view of this the Green Committee wishes to announce that the July issue of the Bulletin will contain an article in which the subject of the vegetative propagation of turf will be discussed in full detail.

How We Solved the Problem of Good Fairway Turf at Pine Valley

Alan D. Wilson

Pine Valley, to be entirely Irish, is made up of hills—big, bold, sandy hills which some freak of nature has pushed up from the level Jersey plain by which it is surrounded. Small lakes lie among them, and when George Crump, while on a shooting trip, first discovered the country, it was covered with a dense growth of pine and oak. After eight years of experiment and effort, we now have good playable fairways with plenty of fescue and bluegrass; but it is still far from perfect turf. We think we are on the right road, however, and can report very real progress.

Few people would have had the vision to see a golf course in such surroundings, and fewer still the courage to start to make one in the face of such serious obstacles. Thousands of trees had to be cut, and, worse still, the stumps had to be pulled. The sand was beautiful, clean, gray sea sand, just such as you see fifty yards back from the surf along the Jersey coast. Perfect mounds and bunkers ready made, everywhere. No mud, no dust, the best of all soil for golf, but, by that same token, little or no food for plant life and nothing to hold moisture. And so Crump faced the problem of how to make grass grow in the sands of Pine Valley.

The first eight fairways built were covered with manure, and this was

worked well into the ground with disc harrows. The ground was well cross-harrowed, raked, and then seeded with sheep and red fescue. The seed germinated quickly, grew beautifully and everything promised well, although the grass was somewhat sparse and a lot of wash took place after every heavy rainfall.

It was hoped that these were youthful troubles which maturity would cure, but when the first hot dry summer came, the dream was shattered. The grass grew brown, curled up, and large areas of it died. These were refertilized and reseeded and the whole course given a winter covering of manure. In the spring, disc or chain harrows were used, seed and top dressings put on, sometimes of humus, sometimes of mushroom soil, sometimes of bone meal. In a constant effort to enrich the soil, everything was tried.

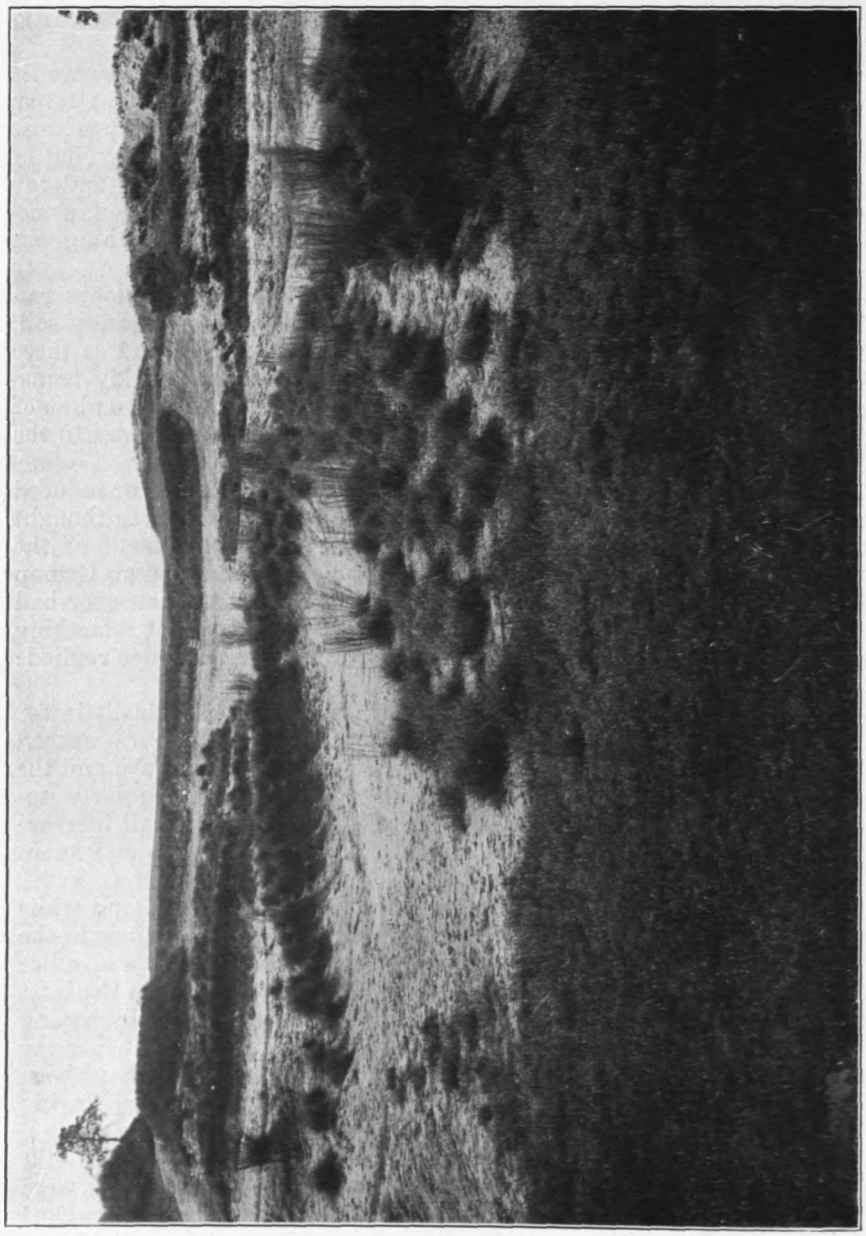
During cool, wet summers, great progress was made and hopes ran high. The fescue grasses behaved as is their natural habit in a sandy soil, and grew in tussocks, leaving bare patches of sand between; and as these had no grass roots to hold the soil, the wash of the rains quickly transformed them into little cuppy hollows. The fairways looked green; but of course the ball seldom stopped on a tussock, usually finding its way to the little hollows between.

It was essential that in some way the grass should be coerced or seduced into growing in these hollows and making a solid mat, and it was thought that this would be accomplished by just a little more enrichment of the soil. Manure was always on the course at this period, and George Crump could never get enough. Once an admiring friend—and no man ever had or deserved to have more of them—asked him if there was not something he really wanted for a Christmas present, to which George at once replied: "Why, yes; a carload of manure."

The constant fertilization helped the existing grass but did little for the bare patches; for as soon as a heavy rain came the manure washed away from them, and if we had no rain it dried up and blew away; and the same thing happened to seed and top-dressing, which were regularly applied twice a year. The net result was progress, but only a small increase in grass for the large effort spent. Again a dry summer came and again the grass simply faded away.

A water system of 120 gallons a minute had been installed, and while it saved the greens, it did not leave enough water to be of much use to the fairways. It was, of course, realized that in using the manure and other materials as a top-dressing, we were putting it where it would do the least good; that we were not only losing a large percentage of its value by having it wash or dry out and blow away, but, worse still, we were inducing the roots of the grass to seek food near the surface, when we should have been forcing them to go deep, the only place of safety in a sandy soil during our hot dry summers.

There seemed no way to accomplish this in the holes already built unless they were ploughed up; but all the remaining holes as they were constructed were covered very heavily with manure and this was ploughed under before seeding. This proved a distinct improvement in method and produced much more vigorous grass, but still the fescue behaved like fescue in the uncut natural state, and grew in tussocks; and still there were bare patches between, though not nearly so large or so numerous. This method was also used in renewing bad portions on several of the old fairways.



The sandy nature of the soil at Pine Valley is clearly indicated in this close-up view of sand bunkers in front of No. 2 green.

Clay loam brought in from Pennsylvania mixed thoroughly with our own soil, in building several new greens, had proved entirely successful; it produced a perfect putting-green turf.

This then was the situation in January, 1918, when Pine Valley suffered its only real tragedy in the untimely death of George Crump, the man who dreamed it and who had then worked and slaved and succeeded in turning his dream into a wonderful reality for the benefit of those of us who were left—we who had advised so much and helped so little. He had not only done all the work but he was the real spirit and inspiration of Pine Valley, and his sudden death left the club in a peculiarly helpless condition. Fortunately his brother-in-law, Mr. Howard D. Street, took up the burden, and has since acted as secretary of the club and chairman of the green committee.

Early in 1918 a portion of the first fairway was topdressed with a mixture of clay and manure, and in the autumn another portion which had entirely gone to pieces during the summer, was covered with clay and manure, which was ploughed in, and the ground was then seeded. The results were so promising in each case that we wished to go further, but were in doubt as to the proper road.

In the spring of 1919 representatives of the Department of Agriculture were called on for advice, and felt that it was imperative that the sandy soil be given some heavier body to prevent the loss from wash and to hold food and moisture. As it was, the rain ran down through the sand and left no moisture; the top dressing largely washed off or blew away; the grass got little good of either, and the hollows between the tussocks deepened until the roots of the grass were actually exposed.

Two remedies were suggested. First, the radical, and undoubtedly the best plan, had it been practical, of covering all the fairways with four or five inches of clay and manure compost, ploughing it in deep, reseeding, and starting afresh. This would have put the clay and manure just where they would have done the most good, *i. e.*, several inches under ground, and the roots of the grass would have been forced to grow down if they wanted food and water—the only safety for grass roots in a hot, dry climate and a sandy soil. But this meant putting the entire course out of play for at least a year. The second remedy was to seed with a quickly growing grass and topdress in spring and fall with a compost of clay and manure, in the hope that the clay would fill the hollows between the tussocks of fescue; that the quickly growing grass would root in the clay, thereby keeping it from washing away, and that the clay would work down into the sand, just as sand goes down when applied to greens on a clay soil.

We tried the first method on one entire fairway—our worst—and on hopeless spots of others. The second we employed on all the rest of the course. Both methods have been entirely successful. The first is a big undertaking, but it is, we believe, the logical answer, for it forces the grass roots to go deep, and therein lies safety. Also, you do it once and for all.

On fairways where we have used both methods, the grass with clay and manure ploughed under has a better color and a more vigorous look in dry weather than the surrounding clay-topdressed grass. Far be it from us, though, to decry the second method, for it has been our salvation and has given us better fairways in two years than we expected to get in four or five.

The hollows between the tussocks have disappeared, the ground no

longer washes unduly, there is a good solid green carpet throughout the course, the clay disappears down into the sand with amazing speed, and it has enabled us to keep the course regularly in play; but it is a constant and expensive work and the end is not yet. We will certainly have to continue spring and fall topdressings for three or four years to come, in order to get the same result which, by ploughing in, we would have gotten at once; and it is highly probable that we may have to go on with occasional top dressings of clay, say once a year, for a long time to come.

In the beginning, we were fearful that this clay top dressing would result in mud and detract from the previous joy of playing shots from the light sandy soil; and so at first we put it on only sparingly, one-third clay and two-thirds manure. We found, however, that in a few weeks, if we had some rain, the clay would entirely disappear, and so we increased the amount of clay to one-half. Now we are recommended to try seventy-five per cent clay and twenty-five per cent manure; but when we see the first sign of clay remaining on the surface, it will be the signal to stop until it disappears.

Various grasses were experimented with for use as a "filler" to the red fescue, such as bent, redtop, white and Japanese clover, Kentucky bluegrass, and even crested dog's-tail; and for some strange and to us perfectly unknown reason the blue grass proved by far the best suited to our purpose. It is supposed to like a clay soil with plenty of limestone, yet it thrives with us and acts as if its roots were following our clay topdressing down into the sand in the hope of finding limestone below, while most of the other grasses germinate, grow a while and disappear.

Now, as to methods. As soon as active work is over in the fall, we begin a compost pile on each fairway, clay which has been screened and manure in three-inch layers, about fifty cartloads to a fairway. These are turned several times during the winter. When spring comes, each fairway is given an application of about 750 pounds of fine bone meal, about 50 pounds of seed, red fescue and Kentucky blue grass mixed, and then topdressed with 50 cartloads of clay compost, which is applied with an ordinary manure spreader. As soon as this is done, new compost piles are made and the treatment, except for the bone meal, is repeated early in September. This means in all about 750 tons of manure and 750 tons of clay a year.

For the sake of economy, we use a local clay, light in character, which contains a fairly large percentage of sand. A heavy clay could hardly be treated in the same way but would probably have to be ground fine and kept dry until application.

The success of the past two years tempts us at times to think "we have solved the problem;" but we recognize that the past two summers have been most unusual in that there has been little hot weather, plentiful rains, and no protracted dry periods—in other words, perfect weather in which to grow grass. Our method is evidently good in favorable seasons; but how will it stand adversity in the shape of a drought? We fully realize that we are still following the lines of the old mistake in putting too much on top of the ground and too little below. This has been forced on us because we did not feel justified in ploughing up the course and putting it out of play for a year; but the fact remains that we are not forcing the roots of the grass to go deep but are encouraging them to stay too near the surface.

The clay we have put on will hold moisture; but have we put on enough

and has it gone deep enough to be useful in really dry weather? This we do not know, and so we are fearful of an unusually dry summer. Certain it is that one week without rain makes our grass lose its color; two weeks turn the fairways completely brown; but where it used to die, one day's rain now makes it green again. The suddenness of the color transformation is amazing. In any event, we do not intend to take a chance on losing our grass if it can be avoided, and so we are now putting in a water system which will give us 500 gallons a minute and which is planned to water all the fairways and to give each square foot of soil a pint of water every other day if needed, and every day in a pinch. This, it is thought, will give a penetration of three inches, which will not only prevent too quick evaporation but will encourage our grass roots to stay down where they belong. With this help we hope to get through even a dry summer, not without damage, but without disaster, and if so we may then be justified in saying we have "solved the porblem."

The other turf problems at Pine Valley are chickweed, crab grass, goose grass, pearlwort, brown-spot, moles, divot-making members who never replace, and the grubs of the green beetle. These problems we fight but have never yet solved.

After our struggle to secure good turf in the pure sand at Pine Valley, the sum of our experience is that three things are absolutely necessary to be added to insure success: clay or loam, manure, and a plentiful supply of water. Somewhere in his writings, Horace Hutchinson has said that the ideal soil for golf turf is a sandy soil with a "spit of clay" in it.

From our experience at Pine Valley we now are sure that one can not procure and maintain good golf turf in pure sand without adding the "spit of clay," without manure to give sustenance to the grass, and, *in our climate,* without a plentiful supply of water for both greens and fairways during the summer season. To secure sure success, both the clay and manure must be ploughed deep into the soil before any seeding is done.

After the turf is secured it is necessary to continue topdressings regularly, in order to have a well consolidated, smooth surface to the turf, and to avoid cupping.

It is a very costly undertaking to construct a golf course in a soil of pure sand. But it is wise and economical to spend your funds right in the beginning. It saves years of time; it saves labor, anxieties, and in the long run it saves money. Above all, it insures successful results.

When brought to good condition, it is truly the ideal course for golf, incomparably better in every way than any course constructed on clay soil.

Golf for All

Ex-President Taft in a recent newspaper article (copyrighted by the Public Ledger Co.) says: "Golf has been said to be the game of the rich. This is not true in Scotland, where there are many public golf courses and where working men can play in the long twilights of the summer, morning and evening. There is no reason why it should not be a game for the wage earners and those of little means in this country; and it is most gratifying to note that in many of the large cities free golf courses are being laid out and offered to the public."

The Changa or West Indian Mole Cricket As a Pest on Golf Courses

W. R. WALTON

Many reports of injuries to golf courses by the "West Indian mole cricket" or "changa," have been received from the Gulf and extreme southeastern states.

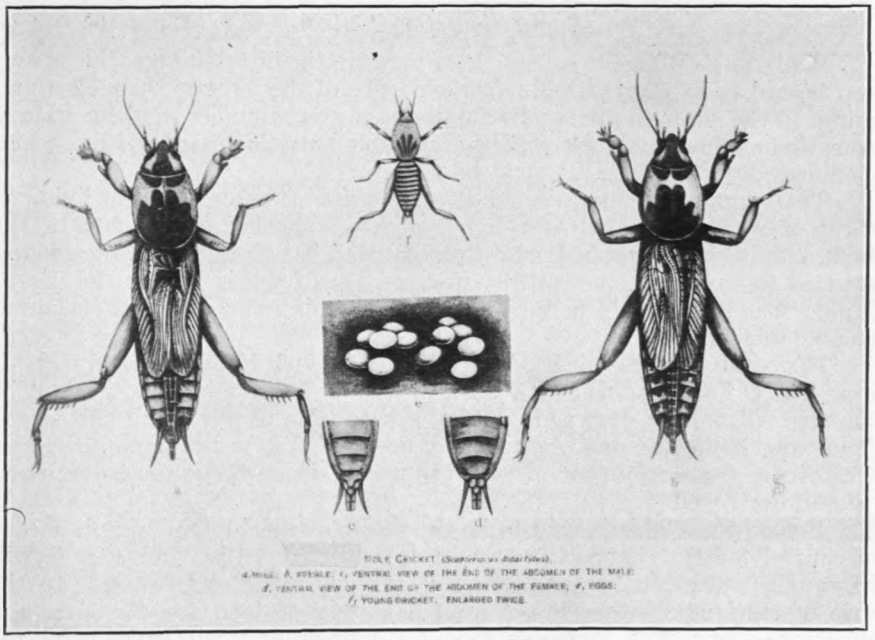
This insect, a native of the West Indies and South America, has become well established in the southeastern United States.*

Because of the fact that the West Indian name is both euphonious and brief, we shall refer to it hereafter in this article as the *changa*. Another common name having considerable vogue in this country is that of "ground puppy," a name which is rather misleading, because there is nothing dog-like about this insect, which resembles a mole rather than any member of the canine tribe. A native species, the northern mole cricket, has been known to entomologists for many years, and is of comparatively little economic importance, although widely distributed throughout the country east of the Rocky Mountains. Another introduced species, the European mole cricket, recently has become quite a pest in the nurseries of northern New Jersey, where it is said to injure the roots of young trees as well as root crops, such as beets, etc.; the native species has been known to injure potato tubers quite severely at times. The changa is reported as being the "most serious insect pest of general agriculture in Porto Rico," where it damages crops to the extent of $100,000 or more annually. The changa is rather closely related to our common field crickets, although in appearance it is quite different. It is known to be present in Georgia, Florida, and Alabama, and is believed to be spreading to other states nearby. As its name and form imply, it is essentially a subterranean creature, spending the greater portion of its existence burrowing through the soil underground. The changa avoids the light, and for this reason, whenever it becomes necessary for it to emerge above ground, the dark hours of the night are selected. The insect requires a soil containing considerable moisture for its operations and in cases of prolonged drought is known to travel under cover of the night for considerable distances. Although the mole-like fore-legs of the changa (see illustration) render it a rather clumsy creature, it is capable of running rapidly, and the adults fly with considerable facility. The insect is particularly partial to the lighter, more compressible soils which permit of tunnelling without the removal of the material displaced by its movements.

The changa feeds almost entirely upon vegetable matter, remaining underground and feeding from below. It is especially fond of the tender roots of grasses and hence arises its motive for injury to golf courses and especially to the greens.

In Porto Rico it feeds upon many kinds of vegetables as well as grasses, sugar-cane, and rice. The adult changa is brownish in color and about one and one-quarter inches in length. It is provided with two pairs of wings, the upper pair of which are small and horny or leathery in texture. The lower pair are large and soft in character, and it is this pair

*A full discussion of this pest in Porto Rico has been published as Bulletin No. 23 of the Porto Rico Experiment Station, by Mr. R. H. Van Zwaluwenburg, from which most of the accompanying text has been complied.



E. L. Worsham and W. V. Reed, Georgia Experiment Station.

of wings which sustain the insect while in flight. Like ordinary crickets, the changa possesses a chirping or stridulating apparatus which is operated by rubbing together the upper wings or tegmina. The adult insects are capable of living for several months, and may survive for as long as six months under favorable conditions. The eggs of this pest are laid in underground, oval chambers from 3 to 8 inches or more below the surface of the ground. The egg is about one-eighth of an inch long, half as broad, and grayish or greenish in color. The eggs hatch in about 19 days, and in warm climates, such as that of our extreme southeastern states, may continue hatching during the warmer 7 or 8 months of the year.

The young changas are active immediately upon hatching and are born with ready-made appetites. They feed voraciously almost from the beginning of their lives and consume food in proportion to their size as they develop. The young insects resemble the adults very closely, except that they do not possess wings. When held captive in the hand, mole-crickets develop an astonishing amount of energy in their fore-legs. Instances are on record from the West Indies of fowls being killed by the changa. In the Windward Islands fowls are said often to be killed by swallowing live changas which, finding themselves in uncongenial quarters, promptly burrow through the bird's crop or gullet, resulting in the death of the bird and the escape of the insect.

The insects are inclined to be exceedingly impolite among themselves, as they do not hesitate to commit cannibalism and devour one another upon slight provocation. If a strain of such individuals could be successfully propagated and turned loose on the putting green, the troubles of the greenkeepers in Florida and Georgia with this pest would be mitigated, to say the least. However, as such a scheme obviously is preposterous, the following suggestions for the control of the changa on golf courses may be found useful.

Suggestions for Control.

PLOWING.—Where it is possible to plow up the infested area, this operation is said to be of great value, as exposure of the insects, their eggs and young to the sun and air results fatally to a great number of them. However, this method doubtless will be applicable but seldom on golf links, and some less drastic treatment must be used.

TRAPPING.—Although the adult insects are often attracted to lights at night, it was found that trap-lights proved altogeher inadequate in the experiments carried on in Porto Rico. Burlap bags laid flat on the ground are said to have been successfully used as traps for this pest in the Isle of Pines. The bags should be inspected each morning and any crickets found under them killed.

FLOODING.—In case infested greens are in such locations as to make it practicable, flooding them with water for a few hours might be tried. The changas will not be drowned, as they are capable of surviving submerged for hours, if not for days. But many of them will be brought to the surface of the ground by contact with the water, where they may be gathered up and destroyed.

POISONING.—This is said to be the most practicable and simple means of control for the changa, at least in agricultural lands. Whether it will be equally successful on golf grounds remains to be ascertained. In the case of cultivated crops, but a limited supply of food for the insects is present at any time, while on the golf courses and particularly on the greens, an abundant supply of tender grass roots is available, unless the greens have already been very thoroughly devoured by the insects. The most satisfactory bait used in the Porto Rico work was ordinary low-grade wheat-flour with which was mixed three per cent of Paris green. This was distributed broadcast at the rate of 300 pounds per acre and resulted in a fairly satisfactory control. The distribution of this bait in small heaps near the entrances to the burrows of the insects may be tried on greens, but in this case it will be very necessary to guard against the liability of poisoning any domestic animals which could gain access to the poison. White arsenic may be used in the place of the Paris green where desirable, as it usually may be obtained much more cheaply. There is a bare possibility that the tender grasses of greens may be burned by the application of the arsenicals as recommended and in this case hydrated lime may be added to the bait in sufficient quantities to overcome the trouble.

FUMIGATION.—Little, if any, work of this character seems to have been attempted against the changa but it seems quite possible that, under some conditions, such soil fumigants as carbon disulfid or even para-dichlorobenzine might be found useful. Since the burrows of the insect are often but a short distance beneath the surface of the soil, it may be found possible to reach them successfully with soil fumigants. The use of carbon disulfid may be attempted in cases where the infestation is of limited extent and injury is severe, in the following manner: Inject about one teaspoonful of the liquid into the soil at intervals of a foot or two over the surface, by means of a long-spouted oil can, and cover the same for an hour or two with large pieces of heavy canvas or burlap which have been previously wetted with water. This precaution will prevent the heavy gases from diffusing into the air and allow them to penetrate the soil. This method should be applied with caution as injury may result to the turf from this gas. Doubtless the best time to use this method would be the evening hours, just before dusk.

Making Putting Greens on a Southern California Golf Course

NORMAN MACBETH

I. *Grass Greens.*

Nothing has been written in golfing journals about grass putting greens in Southern California for the simple reason that there have been none, until quite recently, to write about.

Eleven years ago there were three grass putting greens in this locality, and all of them were failures in every respect. They were poor to putt on and too hard to pitch upon. Not much could have been expected, as no attempt was made to get good soil or suitable seed. These three greens disappeared ten years ago, and during the next six years no attempt was made to get anything better than oiled sand putting greens. It was commonly understood that there was no use attempting to get grass greens; that while you could grow anything else in Southern California, you could not get putting greens.

An explanation can be made for a general lack of interest in the making of further experiments, which is that the majority of local golfers had learned the game on courses which had sand putting greens, and the fairgreens of which had a growth upon them for only a few weeks after the winter rains. It was not, however, until it became demonstrated by means of irrigation that good fairgreens were easily obtainable that any further attempt was made to get grass putting greens. About four years ago one of the local clubs made one grass putting green, and while it was not particularly good it was a sufficient improvement to encourage the gradual elimination of sand greens on that course. Inside of two and a half years all of the eighteen greens were in grass, and all were passable. The fairways were of Bermuda grass, which very quickly predominated in the putting greens. Most of these had been sown with mixtures of redtop, bluegrass, Australian rye and clover, but as no attempt was made to keep out the Bermuda very little could be concluded as to the suitability of any particular grass.

Something more than a year ago I took the responsibility of creating a golf course for the Wilshire Country Club in Los Angeles, and as it had been demonstrated that Bermuda grass would make excellent fairgreens in this climate, and on a similar soil, I chose it rather than try an expensive experiment. There was so little to be concluded from the local grass putting greens that very naturally I sought information from the east, and from such sections of the south as had used Bermuda grasses. From no one did I get much encouragement to believe that any particular grass would be an undoubted success, and in the end New Zealand fescue and redtop were sown in equal proportions upon the majority of the greens. From the previous local results I had made the following conclusions:

1. That to judge the results from sowing fescue and redtop a fight must be made to keep Bermuda grass out of the greens.
2. That the best way to keep Bermuda out was to isolate the greens as much as possible from fairways. This was made easy in a great many cases by the topography of the ground

3. That in cases where sand bunkers could not be used to separate the greens from the fairways, the greens must be very large so as to permit of a periodical and very thorough raking of the edges to keep the Bermuda out.
4. That a careful selection of soil must be made, not only to get a good seed bed, but to avoid adobe because of its hardness when dry.
5. That because the greens must depend upon continual and heavy sprinkling there should be no pronounced high spots; and that tiling was advisable.
6. That as Bermuda seed was being sown in the surrounding fairways it would be policy to sow the greens rather lightly at first to give a better opportunity to weed out such Bermuda as would inevitably blow in at the start.

The greens were sown in June, July, and August of last year, and were opened for playing in December. The grass was thin, but stood the heavy traffic from continual play during our cold weather unexpectedly well. The preparation of the soil was the same as would be required elsewhere, a good deal of sand and peat-moss being worked into the seed bed. It was impossible to get rotted manure of any kind, or mushroom soil; so in order to avoid weed seeds a manure from steers fed on cotton seed was used and found satisfactory.

In greens where an equal weight of Chewings fescue and redtop seed was sown, the redtop most decidedly predominated in growth, and became coarse. Where planted sparsely this grass became very coarse indeed—along the edges of sand-traps for instance. One green was sown with only Kentucky bluegrass and two greens with only redtop. The texture of these two grasses seemed identical for putting purposes, but neither gave good enough results to be continued alone, and in March of this year every green was sown with as much New Zealand fescue seed in weight as had originally been used of all seeds combined. This seed was worked in after the greens had been spike-rolled and a topdressing of soil, steer manure, and peat was applied. This new seed has already improved the greens to a most noticeable extent, and in a couple of months more there should be a very good and true putting surface.

There was some rye-grass in the greens, and while our mowing machines do not cut it, by now it is almost entirely eliminated.

A month after these greens were first sown there were some greens on a neighboring course planted with New Zealand fescue only. The planting was much heavier than at the Wilshire Club, and the greens were given three months longer to grow before being played upon. The growth on these greens is very promising, and while the putting surface is not yet good, the stand of fescue grass was good, and encouraged me to use only fescue for the spring seeding of the Wilshire greens.

It is too early to draw definite conclusions as to whether fescue will thrive here, or whether the continual play throughout the year will be too hard upon it. So far it is an improvement upon redtop in every visible respect. Another twelve months should be a sufficient time to determine the fate of New Zealand fescue for putting greens, and if it grows successfully the principal menace to good putting greens will be the continual

enroachment of Bermuda grass. Time alone can tell whether the fight against it can be successfully maintained, although up to the present the Wilshire greens have been kept without it.

II. *Oiled Sand Greens*

In Southern California, where oiled sand putting greens were used for more than twenty years, the construction of them became well understood and uniformly good putting surfaces were obtained by the majority of the clubs. Where they can be afforded, grass greens are now being made, but many "skin" courses still remain in California and Arizonia, and are likely to be used for some years to come.

All sand putting greens in this part of the world are treated with oil, and although I understand that there are sand greens made at Pinehurst which are sprinkled with water, I have never seen that type and cannot, therefore, draw comparisons. To obtain a good putting green with an oiled sand surface the method of construction described below cannot be departed from very much.

BASE.—The putting greens need a carefully prepared base, and, quite apart from reasons connected with the design of a golf course, care must be exercised to choose places for greens which are not settling basins for moisture. If moisture collects under the base it generally results in settling, and if the green is placed where rain water flows across it continued trouble from the washing of sand will result.

On a good many courses the sand putting greens are slightly raised above the level of the surrounding grass or dirt fairways, and on others the edges of the greens will be raised and the inner portion slightly dished. In my opinion it is generally more satisfactory to make them without any change in level from the surrounding ground, as when greens are raised an approach shot will frequently be deflected away from the center of the green, and when the greens are dished an approach will often gain impetus as it reaches the edge, or curl in from the sides, with a better result than was deserved by the player.

To make the base, the soil should be well broken up to a depth of four inches and dried so as to be friable. Crude oil (from 16 to 40 gravity) should be mixed into the soil and then a tamper should be used. This base should be made as compact as a soft mass can be, and I do not advise less than from 3 to 4 inches in thickness. If too thin it will peel up with continual play.

When the base has been well tamped and the oil has become fairly well-absorbed, the surface should be trued up with a straight-edge. A board 1½ inches thick and 10 feet long, with sharp edges, will be found good for this purpose, and all hollows should be eliminated. Sand putting greens should be either perfectly flat, or else sloped distinctly in one direction only, for the reason that curves or undulations are extremely difficult for a player to see because of the dark color of oiled sand. When the surface of the base has been fixed, a coating of heavy oil should be applied. In California it has been customary to use what is called "85 per cent road oil," the coating being about a gallon to a square yard. This should be sprinkled with dry sand, which will absorb the surplus oil. Generally it is policy to apply dressings of sand lightly, several days apart and only when the sun has brought too much oil to the surface. This surface should be rolled and allowed to harden before being used to play.

PUTTING SURFACE.—This is made by applying a dressing of oiled sand to the base. The base should be hard enough so that it does not absorb oil from this topdressing and so that there is no adhesion of the topdressing to the base. The topdressing must be made of a sand which does not pack, and as a rule a sea sand will be suitable because it will be both fine and clean. There should be no silt or soil in it, as the presence of dirt makes it form into lumps. This sand should be mixed, before application to the greens, with a crude oil of about 16 gravity. The amount of oil to mix with it can be learned only by experience, but very thorough mixing must be given in order to get a uniform texture in the top dressing.

The top dressing of sand should be spread very thinly over the base and brought to a uniform degree of thickness by the use of a broom. A large street-sweeper's broom will be best for this, and most greenkeepers obtain the best surface by *dragging* the broom. The man using it will drag the broom after him and brush in a circular way, beginning at the hole and walking around it in a constantly increasing circle. This not only makes it easy to spread the sand fairly evenly, but it also makes the brush marks run *across* the line of a player's putt, no matter from what part of the green he may be playing the ball.

No definite quantity of oil can be named as being exactly right for each cubic yard of sand used in topdressing the greens, as the temperature of the day will vary the conditions, as also will the kind of sand used. Ordinarily the putting greens will be keener to play on in the morning than later in the day, when the sun will have softened the oil somewhat. Too much oil can be very quickly corrected by sprinkling with dry sand, and after brushing this into the surface (rotary brushing) an immediate improvement will result. If the topdressing is too thick it should be corrected by removing sand, and this can best be done by using the broom in *straight lines* from the hole to the outside edge of the green, and shoveling the sand into a wheelbarrow for removal. The bare places can be covered by dragging the brush in the rotary manner previously suggested.

If the topdressing becomes too hard or crisp, as it sometimes does in cold weather, it can be softened by sprinkling with distillate and using the brush.

The amount of sand put on as a topdressing must be learned by experience, but of course very slow putting will result from a thick covering, and *vice versa*. Pockets or hollows in the surface of the base will fill up with sand and will not be noticed by players, but each one means a sudden slowing up of the ball, and great care should be taken to avoid them in making the base.

BRUSHING THE LINE OF PUTT.—There are few oiled sand greens which do not require continual brushing, because footmarks are left sufficiently deep in the topdressing to deflect balls. It is usual therefore to brush the line of the putt, and for this purpose a piece of old carpet is perhaps the most serviceable. The flag-stick used to mark the hole is frequently used as the handle of the "sweeper," and in such cases it should be only about 5 feet long. Attached to the top of it should be a cross-piece like a thin broomhead, 2 feet wide, and to this is nailed a strip of carpet.

This brushing of the line of putts is a nuisance which adds greatly to the time required to play round a course; but it is difficult to obviate. It is less necessary when the topdressing of the greens is thin and fairly dry; but I have never seen it eliminated. In some clubs on crowded days a man

will be kept at every green to do the rotary sweeping with the broom just after each match leaves a green, and the players are not then allowed to use the carpet sweeper. This saves time, but frequently one man or caddie in a fourball match will spoil the line of a putt.

Local rules are essential when oiled sand greens are used, as to brush a putt the ball must be disturbed and replaced; also it is necessary to allow the cleaning of balls on putting greens, as occasionally a grain or two of sand will, because of the oil, adhere to the ball and if in putting these come between the club face and the ball a muffled shot usually results.

In laying out a course on which it is intended to use oiled sand putting greens it is a great mistake to design holes requiring a pitch shot onto a green. No matter how much back-spin is imparted to the ball, it can seldom be made to hold, because the base of the greens is too hard. This type of green can be made so that it is delightful to putt upon; but on the whole an indifferently good grass green is preferable, because it does not eliminate pitch shots.

Experience With Brown-Patch at the Morris County Golf Club

W. D. VANDERPOOL

About three and one-half years ago, in the middle of August, the newly constructed greens and fairways at the Morris County Golf Club, Convent, N. J., were in splendid shape, considering their newness. The weeds and summer grass had all been removed and they were ready for the usual light topdressing which is applied at that time of the year.

By September 1 six of the new greens and six of the new fairways were practically ruined. The greens were so badly damaged that it was necessary to turn them under and reseed them. The fairways were given a heavy topdressing of compost, seed was sown the following spring, and they are now in good shape.

In this article I am going to describe the conditions; but I can not offer any positive solution of the problem, at least as far as the fairways are concerned.

There is no question in my mind (and this conclusion has been corroborated by the Department of Agriculture) but that the cause of the damage was the brown-patch fungus in its most virulent form. It is a very serious matter if this form of blight is going to do such extensive damage.

Shortly after the grass was seen to be getting brown, we started with light topdressings and sprinkling; this, however, had the effect of stimulating the growth of clover, and did not help the grass. On my return, about the first of September, I found dead patches of grass, with the very green clover growing rankly and spreading every day.

The fairways were badly damaged in places; but the clover was not as abundant there as it was on the greens. The new greens were all seeded with a mixture of Chewings New Zealand fescue and German bent in the autumn, and when the disease struck them they had had about twenty months' growth. The fairways were sown about the same time as the greens, and redtop was substituted for the bent; the greater part of the

fairways was composed of Chewings fescue, which, up to the time of the disease, had made a strong and vigorous growth.

This gives a general idea of the proposition which we had to contend with, and we decided to analyze the situation and see what deductions we could make, with the following results:

1. All the damage done was confined to the area which had been recently woodland and had been cleared for the golf course.
2. Poor drainage had nothing to do with this blight, as the greens which appeared most affected were of the Cape and Redan type, both built up and both under-drained, with no possible chance of having any water remaining there.
3. Wherever the morning sun did not strike the fairways the damage was inconsequential.
4. Although there were four other greens built at the same time, by the same method of construction and with the top soil procured from the same place, these were scarcely damaged at all. Why was this? Our only answer is that they were not in the newly opened woodland.

What, then, can be done to prevent a recurrence of this trouble? From my experience and observation it seems that poor drainage was not the cause of the severity of the blight and that topdressing, such as we gave, did little good—it simply helped the clover. The remedy we now use (and we use it whenever we have hot and muggy spells in July and August) is Bordeaux mixture. We have had several periods during the last two years when the conditions were propitious for a severe attack Whether the Bordeaux mixture prevented it or not, I do not know; but I do know that we have not had any severe recurrence of the blight. Possibly, as a severe disease makes a person immune from a recurrence, this attack may render the soil more or less immune. I do not know. This is merely a suggestion. The treatment of the fairways with Bordeaux mixture is out of the question, owing to the large area which would have to be treated; it would involve too great an expense.

The Brown-Patch Disease of Turf

C. V. Piper and R. A. Oakley

Until recent years practically every brown area that appeared on putting greens during the growing season was regarded as the effect of "sun scald." Now it is known that a fungus is responsible for many, if not for most of them. Drought and heat certainly cause the grass to burn, but the areas injured by disease are quite different in appearance from those injured by other causes. Whether the fungus disease is more prevalent now than formerly is not definitely known, since a critical study of the cause of browning was not made until 1914, when patches appeared in the turf experiments of Mr. Fred W. Taylor at his home near Philadelphia. These patches were particularly abundant on a strain of red fescue which Mr. Taylor transplanted from the Olcott turf garden, located at Manchester, Connecticut. The spots were a foot or less in diameter and very numerous. Mr. Taylor observed that they increased in size concentrically and that a fine white cobwebby covering could be seen on the newly formed patches in the early morning. This indicated a fungus as the causal agent; but laboratory examinations made at that time failed to

disclose the presence of an organism that could be suspected as being responsible for the trouble. Many cases were called to the attention of the writers in 1915. They ranged westward as far as Chicago and northward to the New England States.

The following year there was abundant opportunity to study the malady on putting greens and other pieces of fine turf in the vicinity of Washington, D. C. It was then that the trouble was definitely traced to the action of a fungus and the specific causal agent positively identified. Because of the appearance of the affected turf the name "brown-patch" was given to the disease.

The Disease and Its Characteristics

By orthodox laboratory methods, which involved inoculation of various culture media with material from freshly infected turf and likewise the inoculation of perfectly healthy turf in the laboratory and field, it was proved beyond a reasonable doubt that the fungus causing brown-patch is the one botanically known as *Rhizoctonia solani.* It is a soil organism which attacks a large number of plants in addition to grasses. Prior to this, however, it was not known to attack grasses. *Rhizoctonia solani* produces minute hard black bodies known as *sclerotia.* These form on the dead stems and leaves of the plants attacked and remain in the soil or on the surface until favorable conditions develop for their germination. They function as seeds or tubers and are very abundantly produced. When these resting bodies germinate they produce a fine white cobwebby covering called *mycelium* or "mildew," and it is through the agency of the *mycelium* that grass and other plants are injured, or, under extreme conditions, are killed.

The original infested areas may be very small, not larger than a dollar, or they may be several feet in circumference. The infection may spread concentrically for several successive days, or it may terminate with one night's growth. The grass during the period of active infection has a smoky, withered appearance, such as might be caused by hot water or some strong chemical.

Conditions Favoring Brown-Patch

Brown-patch is a warm-weather turf disease. The conditions most favorable for its growth occur in periods of moist, hot weather of late spring, summer, or early fall. During such periods patches of *mycelium* may be seen on turf in the early morning. A little later these spots take on the smoky or scalded appearance just referred to, and as the day advances and the temperature rises they turn brown as if touched by fire. If conditions favoring brown-patch continue, permanent injury to the turf commonly results, but if cool, dry weather follows, much of the infected turf revives and recovers completely, or nearly so, with the advent of fall. However, there are far too many cases of such complete killing of turf by brown-patch that it has been necessary entirely to remake putting greens which have been attacked by it.

Preference for Certain Species

Some turf grasses are much more seriously injured by brown-patch than are others. In fact, some appear to be nearly immune to it. Bermuda grass and crab grass, for example, have not been known to be attacked,

and white clover likewise seems to escape. Kentucky bluegrass is but very rarely affected. Most strains of the bents and fine fescue are very susceptible, particularly so the velvet bents. Some of the turf-infesting weeds are attacked, including mouse ear chickweed and veronica. Yarrow, which is really a good turf plant, offers but little resistance. Vegetative plantings of most strains of carpet and velvet bents are usually more susceptible to brown-patch than is turf produced from seeding, and pure strains of these grasses are even more susceptible, as a rule, than mixed cultures. Why this is true is somewhat of a mystery.

Time of Appearance and Distribution

No very definite survey has been made to determine the first dates of appearance of brown-patch in the spring or its distribution throughout the United States. In 1917 the first spots appeared in the turf garden at Arlington, Virginia, on June 3. In 1918 they were in evidence as early as May 30, but did not become numerous until July 12. Northward they do not usually develop until late in June. This year, 1921, a few spots were noticeable at Arlington on June 6, and specimens of brown-patch-infected turf were received from Massachusetts about the same date. The disease is likely to appear at any time after May 15 if hot, humid weather obtains. Reports received by the writers indicate that brown-patch occurs from Maine to Minnesota and at least as far south as bents and fescues can be grown successfuly for putting greens. In the northern part of its range it usually does much less permanent injury than in the southern part although at least one example of very serious damage to putting greens occurred in New Jersey in 1918.

Treatment

Golfers very naturally will be more interested in learning of the remedy for brown-patch than of the details of the disease itself. In this they are due for some disappointment, since no really successful remedy has been discovered. Numerous experiments have been conducted with a rather long list of fungicides, and about the only one that offers sufficient promise to justify its use is Bordeaux mixture. Experiments indicate that the disease can be held in check by frequent light sprayings of half-strength Bordeaux; but this is a very expensive and tedious method of treatment. The difficulty with the use of Bordeaux or any similar fungicide is that as soon as it is removed from the plants by rain or by mowing, the disease starts new growth. It is not affected by the fungicide that is in or on the soil or on the older stems or leaves of the grass. Among the chemicals that have been used to combat brown-patch are mecuric chloride, iron sulphate, sulphur, and copper stearate; not one has given promising results.

Experiments are still being conducted with fungicides. But while waiting for help, very serious attention should be given to drainage. Poorly drained greens are more susceptible to brown-patch than are well drained greens; and during hot, humid weather it is very doubtful if late night watering is to be advised. An excess of moisture on the leaves of the grass during the night favors the development of the disease. If the spots that first appear are small it is well to remove them and transplant healthy turf. This may be done in many cases with a

hole cutter. In this way infection may be checked. The use of Bordeaux when occasion seems to justify the expense and effort, attention to drainage and watering, and the quick removal of the first infected spots, are about the only suggestions for controlling brown-patch that can be given at this time.

Hope in Resistant Strains.

Just as some species are less susceptible than others to the attack of brown-patch, so there are strains of certain species that seem to be much more resistant than others. This is particularly true of the bents, and it is especially encouraging, since the disease is a serious menace to vegetative propagation of these grasses. It is hoped that strains of carpet bent will be found to be highly resistant if not actually immune to the disease. A careful search is now being made for such strains, and if it is successful it will go far toward solving one of the most serious greens prolems.

Power-Mowers for Fairways*

It now seems that greenkeepers in the United States are in a fair way to solve the problem of cutting the grass on fairways. The problem of cutting the rough is still unsettled, and the solution of these problems may effect a radical change in the method and practices now in vogue as to the sowing, fertilizing, and treatment of fairways. Heretofore the efforts of greenkeepers have been directed to the production of turf of dwarf grasses which are easily cut; but it would seem that when the problem of cutting grass has been completely solved, it may be better to use seed of the less expensive grasses, the kinds that grow most readily and thus produce a more luxuriant growth, and then keep it down by proper cutting. When a tractor is developed that will cut all the fairways of a course in a single day of say 10 hours, so that one man can cut the course two or three times a week, there would seem to be no reason why most golf courses should not have a good turf, as fertilizer can be applied until that result is obtained.

It must be remembered that all the cutting units now on the market were designed to be drawn by horses and are neither designed nor built to stand the high speed and rough usage of the tractors whose speeds vary from 4 to 15 miles an hour.

Nothing has been done up to this time but to fit tractors to existing mowing equipment. A great variety of tractor-mowers have come on the market within the last year and are now being tried out with more or less success in different parts of the country; but we are yet a long way from having perfect equipment. It would seem that the study and development of the future should be along the right lines to determine the most effective speed and the speed limits of rotary types of mowers, and that effort should be made to design and construct mowers capable of operation at speeds that are high in comparison with the old horse-drawn equipment. It goes without saying that mowing equipment must be designed with heavier and better gearing, bearings, and automatic lubricating devices; and when the most effective speed limit of the mowing

* The Green Committee expects to prepare a questionnaire covering various phases of this subject, and the answers will be published for the benefit of clubs contemplating the purchase of grass-cutting equipment.

unit is established, obviously a tractor must be worked out with an ample reserve power capable of drawing the mowers at the speed desired. Again, the tractor weight must not be so great as to unduly pack the soil.

It would also seem that the best result may be expected from tractors which push rather than pull the mowers, for the reason that by so doing the grass is cut ahead of the tractor, giving a better appearance to the work; but it may nevertheless be possible to work out something by the use of the caterpillar type of tractor or some other type that would pull the mowers and at the same time leave no tractor marks. It would seem that less power is required to pull than to push a load, and it may be that a tractor developed to pull the mowers will show an advantage in that respect over those which push them.

Mechanical means must be worked out by which the drivers of the tractors can raise or lower the mowers from the driving seat and put them out of gear in crossroads and the like. The tractor must be capable of making a turn around bunkers and so operating without injury to the turf, and it must be capable of working close to the greens so as to minimize the handwork.

The advent of the tractor may bring about new cutting methods. With horse-drawn equipment the common practice is to start at the outside and keep taking inside turns until there is a narrow strip of grass down the middle of the fairway left to be cut. With the tractor, which must take wider turns, the practice is to make the first cut down the middle of the fairway, then turn and go back on an outside edge, and keep making the cuts so that the last cut removes the grass on the far side of the fairway next to the middle. To illustrate: on a fairway running north and south, the first cut would be down the middle, then along the east edge of the fairway; the next cut would be on the west side of the middle, then around the east side again, each cut moving to the west until the last cut, as above stated, takes the western edge of the fairway.

While several of the tractors now on the market are doing very good work on the fairways, none of them appear to be wholly fit on the rough. Of course, it is possible to cut the rough with the rotary type of mower, but if it is so done it must be cut and kept fairly close—too close, in our opinion. It seems to be understood that the rotary type of mower will not work in grass that is over four or five inches in length, and it is therefore to be hoped that some concern will work out a tractor and equipment that can be adapted to the work on both the fairways and the rough. This may possibly be accomplished by having rotary mowing equipment for the fairways and some other type for the rough. The equipment for cutting the rough must be so arranged as to collect and pile up the grass cuttings. The raking of the rough after cutting should be avoided. This can, of course, be done by some sort of a grass catcher, by means of which the grass can be dumped into piles or windrows.

The tractor must be capable of being worked over a wet course. The full value of the tractor will only be realized when it displaces horses, and therefore it must be workable in the spring and fall, when the courses are wet. It also appears that a tractor, to be most serviceable around the golf course, should be so designed that it can be used for other purposes; and if horses are to be displaced entirely the tractor should be capable of pulling or pushing rollers, pulling loaded wagons, and the

like, and it should also be capable of furnishing power to operate saws and do the work now done by stationary gas engines.

In the early stages of the development of the equipment, little attention was paid to economy of operation, and it goes without saying that the most successful tractor will be the one that will operate with the smallest consumption of gasoline and oil and against which the smallest charges for repairs and depreciation must be made; in other words, the successful tractor must not only have the widest utility but be the most economical as to initial costs, operation, and maintenance. The next important step in the development of this equipment, in our opinion, is the redesigning and proper construction of the mowing equipment to stand the speed, use, and abuse that will be called for. Better materials and better construction must be put into the mowing equipment.

The day may not be far off when a horse will be a strange sight on a golf course, but it is not believed that the best type of tractor and mowing equipment will be worked out short of several years of trial and experiment. (Contributed to elicit discussion.)

Questions and Answers

All questions sent to the Green Committee will be answered as promptly as possible in a letter to the writer. 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.

Keeping Tees in Good Condition

We are indebted to Mr. Walter J. Travis, Garden City, N. Y., for the following helpful suggestions submitted in the way of a comment on the answer to question 10, page 47, of the March 23d number of the BULLETIN.

Your advice makes no allowance for wind or weather conditions; it makes the hole inelastic, and consequently monotonous—unless there are several tees. Even then, definition 4 and rule 2 are dead letters; or else the back part of the tee is useless.

"Grass tees may easily be kept in condition by moving the plates before any sign of wear appears—by starting at the front and working backward, never forward, except the whole length of the tee. Short-hole tees suffer most; but if the divot marks are covered frequently with loam mixed with seed (preferably fescue, which is more wear-resisting than the softer grasses, such as bents), the scalps will heal rapidly and the tee generally be maintained in good condition. A tee is almost as important as a green. If the tees on a course are kept in good shape one may be sure to find the greens well cared for; they are unfailing barometers, as it were."

1. *I have sent you by parcel post today a sample of a fluid which is being sold as an inoculating fluid for soils and seeds, and great things are claimed for it. I would like to have this sample tested and to know what good, if any, it will do to our putting greens and fairways. They claim this is a germ inoculation for either seed or soils. M. S., Iowa.*

The sample you send is a liquid culture of bacteria useful under certain conditions with some of the leguminous crops, such as beans, peas, and clovers. It has no effect whatever on the growing grasses and is usually not necessary in growing white clover. There are many of these liquid cultures on the market. They contain bacteria which attack the roots of peas, beans, clovers, and other legumes, causing the formation of nodules on the roots and enabling the plant to utilize the free nitrogen of the air. Legumes growing under this condition thrive much better than when these bacteria are not present. The soil where legumes have been growing generally carries sufficient bacteria for inoculating the roots, but when the legumes are planted on new soil it is necessary to mix into the new soil earth from a field where the legumes have formerly been grown, or else artificially supply the bacteria by means of prepared cultures. The liquid is of no use whatever on your putting greens and fairways.

2. *Kindly send as soon as possible full information regarding the eradication of clover from putting greens. F. W. H., Michigan.*

We know of no highly satisfactory method of eradicating white clover from putting greens. Many writers recommend the use of sulphate of ammonia for this purpose. Particularly is this true of English writers and English greenkeepers. So-called turf specialists very generally recommend sulphate of ammonia for the eradication of white clover. However, our experiments so far have not made us very enthusiastic over the method. In fact, for the most part our results have been quite negative. Nevertheless we propose to continue the experiments, and we still have tests under way which we hope will throw some light on the subject. We think there is little doubt that a fertilizer tending to produce an acid reaction in the soil, especially in clay soils in the northeastern part of the United States, favors the growth of the bents and turf-forming fescues against white clover and other plants. A summary of experiments in this line conducted by the Rhode Island Experiment Station, Kingston, R. I., is contained in the article entitled "Ammonium Sulphate" in No. 3 of this volume of the BULLETIN. Why not treat half of one of your greens regularly with ammonium sulphate and leave the other half for a check? In this way you should get some first-hand information.

3. *We are having a hard time in eradicating ants and would be glad to have any suggestions you can make. L. W. M., New York.*

While numerous experiments have been conducted in the eradication of ants no very satisfactory methods have resulted from the standpoint of efficiency and practicability. The best method we have found is to inject a small quantity of carbon bisulphide into the burrows by means of an oiler with a long stem and a spring bottom, such as is used by engineers. Success has also been had with a solution of potassium cyanide; but those who have tried both prefer the carbon bisulphide. This liquid is readily volatile and forms a gas that is heavier than air, and because of this it sinks into the lower chambers and kills the ants with which it comes in contact. If you wish to try the solution of potassium cyanide we would suggest one ounce of 98 per cent potassium cyanide to one quart of water; the two should be carefully mixed and the solution liberally injected into each ant hill for which purpose an oiler may be

used. Potassium cyanide is a very poisonous substance and great care therefore should attend its use. There are some experiments now under way which we trust will result in the development of better methods of killing ants than are now used.

4. *We have decided to seed to creeping bent if it is possible to procure the seed. As we will not seed before August or September this year we wish to ask you if in your opinion it will be possible to procure the seed from this year's crop. We are under the impression that this seed is harvested at or about the same time as our own bluegrass, and if that is the case would it be possible for the bent seed to reach this country in time for our needs? We are being urged to buy what little seed of this kind that we can now, though we are not satisfied that the seed is of average good quality, nor do we believe that the price of $1.40 per pound is a fair or reasonable one even at this time. H. A. L., Ohio.*

We would suggest that you secure quotations and samples of South German mixed bent seed and then submit the samples to us for examination. Names of dealers who have recently had good stocks of this seed will be submitted on application. The German seed crop of the season never reaches up early enough in the fall to be use during the same year.

5. *There is a great deal of moss and some sorrel in our fairways. We have been using crushed lime rock and are planning to put on additional dressing this spring. However, this appears to bring in white clover; in fact, our fairways are very largely white clover. Should we continue the crushed lime rock treatment? E. B. P., New Hampshire.*

The conditions are very exceptional on golf courses where we recommend the use of lime at all. The presence of sorrel and of moss is much more due to poverty of the soil than it is to any acid conditions. In fact, we know of many acid soils which have excellent turf, but the soils are such as can be regarded as rich or moderately rich. We are sure that by the use of appropriate fertilizers your moss and sorrel trouble will disappear. Some mosses, however, come in shaded places and illy drained places. Correction of the drainage, and in some places of too great shade, is the remedy. However, for shady conditions in New Hampshire you can get most beautiful turf either with red fescue or with *Poa trivialis* (rough-stalked bluegrass).

6. *The writer would like to know whether you have had any experience in building greens with sterilized soil in a manner similar to what the tobacco growers use. Roughly speaking, they steam the soil under a pan until a potato will bake about 6 inches below the surface. This is done to eliminate all weed seeds and to kill any fungus and bacteria which may be in the ground. It would seem as though this might save a very considerable amount of work after the greens are seeded and come up, in keeping the weeds out; but I would like to know whether you have had any experience with greens handled that way, and, if so, what your opinion of it is. V. W. B., Connecticut.*

Sterilization of soil for tobacco beds, which, after all, is only partial sterilization, was primarily for two purposes, one to destroy weed seeds and the other to destroy fungus diseases, insects, nematodes, etc., which might be present in the soil. The oldest plan for doing this was simply by

burning trash piled over the seed bed, a plan still used in some regions. The plan now generally adopted by progressive tobacco growers is by means of a steam pan, under which hot steam is kept in contact with the soil for some time. In the Connecticut valley contractors sterilize soil for 50 cents to $1.00 per 100 square feet. At the rate of $1.00 per 100 square feet, that would mean $100 to sterilize a large putting green.

Still another method of sterilizing soil is by using formaldehyde, using 1 gallon of formaldehyde to 50 gallons of water and then applying 2 quarts of this to each square foot. Before applying this the soil should be prepared for seeding, and it is better to apply the liquid in several applications than in one. After applying the liquid the surface needs to be covered with wet bags or blankets so as to confine the gas for 24 hours. After these bags or carpets are removed the soil must be allowed to air for 8 to 10 days so the formaldehyde can evaporate. The cost of the formaldehyde treatment is very considerably greater than that of the steam-pan treatment. All of these methods are described in detail in the U. S. Department of Agriculture Farmers Bulletin No. 96.

In our judgment the expense involved is vastly greater than any possible benefits than can accrue. Temporarily it may be helpful, but not to a degree to justify the expense. Sooner or later organisms that live in the soil are sure to return and weed seeds are carried on to the greens by the feet of golfers, and by other means.

Notwithstanding this adverse opinion, it would be an extremely interesting thing if your club could see its way clear to try out the scheme on one or more greens and give us all the benefit of the results you secure. After all, a real experiment is the only way to get the right answer.

7. *Our soil is medium heavy loam with clay sub-soil; rather acid. For our new fairways we are ordering Kentucky bluegrass and redtop exclusively. Is anything else indicated for this kind of soil for this climate? E. B. P., New Hampshire.*

For your fairways it is all right to seed a mixture of 4 pounds of Kentucky bluegrass and 1 pound of redtop. Kentucky bluegrass may not be adapted to your conditions without liming, and we would not advise you to use Kentucky bluegrass unless it will take care of itself. The dominant grass in New England is Rhode Island bent, and our judgment is that regardless of what you seed your fairways to, in two or three years' time they will be Rhode Island bent with more or less white clover, but on account of the availability and cheapness of the seed bluegrass and redtop are the things to sow.

The Vitality of Weed Seeds in Manure.

Several years ago the Maryland Agricultural Experiment Station conducted some experiments with a view to determining the length of time various seeds remain viable in barnyard manure. Results of these experiments were published in Bulletin 128 of that station. It was found that one year is sufficient to devitalize practically all of the common weed seeds when manure is kept in piles under ordinary conditions and that six months kills a large majority of the seeds. However, no chance should be taken. When in doubt, make the box test referred to in the article on humus-making materials in Bulletin No. 4 of this volume.