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

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Announcements

There seems to be some mystification why clubs that are members of the United States Golf Association are charged less for membership in the Green Section than are other clubs. The answer is that the Green Section is not yet self-sustaining, but is assisted financially by the United States Golf Association out of their funds. As this money comes from the United States Golf Association member clubs, surely they should have some slight concession made them in reference to the Green Section.

It is the ambition of the Green Section that it become self-sustaining and render its service to all adhering clubs at the least possible cost. This will be reduced just as rapidly as is warranted. Its cost to each member can be reduced to a small sum if a large proportion of the clubs become members of the Green Section.

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

The Green Committee of the U. S. Golf Association has decided to hold a meeting or meetings of the delegates to the Green Section of the U. S. Golf Association, in Washington, July 18 to 22, 1921, at the time of the National Open Championship. Some convenient hotel will be selected as headquarters so that the delegates and those interested in the work can get together for informal discussions, in addition to at least one formal meeting. Any member of a subscribing club interested in the subject of greenkeeping will be welcome though not a delegate. A more complete announcement of the committee's plans will be made in the next issue.

Philadelphia the First to Organize District Green Committee

Philadelphia has the honor of leading the way in the organization of a District Green Committee. This was accomplished at a dinner given May 5th by Mr. George W. Elkins, Jr., who was appointed Chairman of the Philadelphia Golf Association Green Committee.

The interest in the work is indicated by the acceptance of the representatives of thirty-five of the thirty-six clubs invited, and by the attendance of thirty-three.

The object of the Committee is to carry out in the Philadelphia District the aims of the Green Committee of the United States Golf Association by the interchange of information and the co-operation which it is confidently believed will bring about better results for all the clubs participating.

A number of meetings will be held during the year, each time at a different club, and it is expected that members of the Committee will be able to get in a round of golf at each meeting and thus inspect the course at which the members are to meet.

Under the supervision of the Committee, mowing machines and other equipment will be tested and the merits and defects of the various makes will be noted. Among other things, all the various types of sprinklers on the market will be assembled and tested at the same time under the same conditions, so that the Committee may have the data as to the sprinklers which get the best results.

An Executive Committee of the Philadelphia Golf Association Green Committee has been organized which will have direct charge of the work, and through this Executive Committee it is contemplated that the member-clubs can obtain information as to seeds, materials, and sources of supply.

Not only will the members of the Philadelphia Committee hold frequent meetings, but the Greenkeepers will be assembled several times during the season so that they may interchange views and confer with the members of the Committee.

These district associations provide the means for more intimate contact between those interested than can possibly be furnished by the Green Committee of the United States Golf Association, and it is hoped that green committees in other centers will promptly follow the example of Philadelphia.

Earthworms

C. V. Piper and R. A. Oakley

Earthworms are also known as angle-worms and fish-worms. They constitute the zoological family called Lumbricidae, of which there are known to exist in the United States 3 genera and 24 species. The number of species is doubtless much greater, but the earthworms have rather been neglected by zoologists. There is yet much work to be done in collecting and studying the American species.

Different kinds of earthworms live in very diverse locations. Some of them are confined to leaf mold in the forests, others to stream banks, etc. Comparatively few kinds live in grass turf or, indeed, in farm land. The common earthworm in turf land in the northern United States is *Lumbricus terrestris Linnaeus,* and the same species occurs in Europe. The probabilities are that it is native to Europe and introduced in America, like most of our annoying pests. It is known from New England, New York, Maryland, District of Columbia, Michigan, Ohio, Illinois, Minnesota, Colorado and California, and probably occurs in all northern states, but it is not recorded from the South. So far as now known, it is the only species that causes annoyance to golfers in this country.

This species is abundant in Europe, and very interesting accounts of its habits were published by W. Hoffmeister in 1845 from studies made in Braunschweig, by V. Hensen in 1877 from observations at Kiel, and by Darwin in 1882. Darwin's account is based on his own observations and those of previous writers. The following notes are compiled from several writers.

Anatomy. The earthworm is about midway in organization in the animal series between the lowest and highest forms, and therefore is an excellent subject to study as a typical animal. Its anatomy has been studied very minutely by a number of zoologists, and nearly every student of zoology learns to know much about the creatures' structure.

Distribution of Earthworms. Earthworms have an exceedingly wide distribution. Some genera, according to Perrier, a French zoologist, have an enormous range. They are found in isolated islands and on land generally from Iceland to the Antarctic. There is little known about how they are distributed naturally. Darwin was perplexed on this subject. He could not understand how they reached isolated islands of the ocean, since they can not endure salt water, and he did not think it probable that young worms or the egg capsules could be transported in earth such as might stick to the feet of land birds or be carried in their beaks.

Senses. Earthworms have no sense of hearing, but the first two segments possess organs that make them quite sensitive to light. On account of this sensitiveness earthworms appear at the surface normally only at night. They have a keen sense of taste, but have no olfactory organs. The whole surface of the body is extremely sensitive to touch, so much so that they never come to the surface when the slightest wind is blowing. It seems to be wind much more than any other factor that determines periodical activity of the earthworms. Every golfer knows that the worms work very actively at some periods and not at all at others. In the cold of winter, however, they are always inactive.

Feeding Habits of Earthworms. In their diet earthworms are omnivorous. They feed on partly decayed leaves, the humus matter in the soil, eggs and larvae of insects, and many living and dead soil organisms. They do not feed on living roots. They also eat raw or roasted lean and fat meat when made available. They are even cannibalistic in connection with their feeding habits. They swallow large quantities of soil, but the soil is ingested merely to assist them in excavating their burrows, as species living in very poor soils almost devoid of humus ingest much soil. Their real food is, however, the organic matter they swallow.

In gardens in the early morning may be found vertical tufts of small straws, leaves, feathers, etc., sticking up as if placed there by children. On examination each of these tufts is found to project from the mouth of an earthworm burrow, and the part in the burrow is much chewed or macerated. Each worm forages as far from the mouth of its burrow as it can reach.

Earthworms seem never to leave their burrows except during heavy rainfalls at night. Hoffmeister thought they normally crawled about on the surface at night, but Hensen regarded this opinion as erroneous. After heavy rains, however, countless numbers may be found on sidewalks or pavements, where most of them perish miserably.

How Earthworms Make Their Burrows. Darwin observed that an earthworm makes its burrow both by pushing the soil aside with its anterior extremity and by swallowing earth and ejecting it as castings. In extended periods of dry or severely cold weather earthworms burrow to a considerable depth. Ordinarily, however, they remain relatively close to the surface. Hoffmeister claims to have found them in Germany at a depth of 8 feet. Eisen and Lindsay Carnagie also are said to have found earthworms at this depth in Sweden and Scotland. Darwin, himself, it appears, never succeeded in finding them at depths exceeding 4 feet, but he states that he had really made few observations with regard to this feature of their habits. Hensen claims that Hoffmeister's figures are too high, as he found the burrows only 3 to 6 feet in depth.

The Nature of Earthworms' Burrows. Earthworm burrows extend downward nearly perpendicularly, sometimes they run a little obliquely. Darwin was of the opinion that they rarely branch, and when branching does occur it is near the surface. Hoffmeister says they occasionally are branched into 2 or 3 branches near the surface. Hensen says they are frequently more or less horizontal at the bottom. According to various observations the walls of the burrows are lined or plastered with casted material dark in color. The thickness of the coating is such as to make the tunnels close-fitting to the worm. This is an advantage to the earthworms in permitting them to cling to the mouths of their burrows with the posterior end while the major portion of the body is extended over the surface in search for food. If those who have held the opinion that earthworms will not pass through a layer of cinders had been familiar with Darwin's writings, they would have known how futile it is to attempt to keep earthworms from putting greens by laying a 3 or 4-inch layer of cinders in the sub-surface of the green. The worms simply push the cinders aside and plaster the walls of their burrows thickly and smoothly with their castings. Darwin observed tunnels through a layer of cinders 3½ inches in depth. The linings of these tunnels were of unusual thickness. Hensen says the walls of the burrows are often felted with a fine mass of root tips. The subterranean extremity of the earthworm's burrow is usually a small chamber, according to Hoffmeister, who also says that each chamber s inhabited in the winter by one or more worms rolled into a ball, but Hensen thinks this is an error, as he never found a mass of worms in one burrow. The chambers are commonly lined with very small gravel or coarse sand, also frequently with seeds, all evidently brought from the surface. Sometimes the seeds are viable and sprout when brought to the surface or exposed by excavating. Truly, seeds are carried by peculiar means to strange locations.

The Relation of Earthworms to the Formation of Leaf Mold. After noting the fact that fragments of marl and cinders which had been applied to the surface of meadows were found after a few years at a depth of several inches, Darwin was led to the conclusion that they were thus buried by accumulations of earthworms' castings. From this decision he was led to one other conclusion, that vegetable mold in the process of making passes through the intestinal tracts of earthworms many times. Darwin suggested that the term "animal mold" might be even more appropriate in some respects than vegetable mold. Earthworms play a much more important part in the making of leaf mold or vegetable mold than is commonly supposed. Whether earthworms swallow soil for food or in the process of making tunnels, they come to the surface to defecate. The soil being mixed with intestinal juice is in a more or less pasty mass, which becomes quite hard upon drying. The ingested soil is ejected or defecated after a definite manner rather than in an indifferent way. Some species of earthworms, under certain conditions at least, eject their castings in such a way as to form towers 3 or more inches high. A species of earthworm that inhabits soil in Bengal frequently builds towers that are 6 inches in height. The towers are more or less regular and considerable skill is exhibited in their making. It is possible that the towers may serve as a form of protection, but Darwin does not dwell upon the purpose for which they are constructed.

Earthworms as Soil Movers. On the movement of soil by earthworms Darwin wrote at great length. His observations and those of others cover wide geographical areas and conditions and constitute a large body of data on the subject. Measurements were made on the rate with which stones, lime and cinders are covered by soil. Most of the covering is attributed to the work of earthworms, although it was recognized that the wind, ants, moles, and other natural agencies play some part. Hensen, whom Darwin regards as an authority on the habits of earthworms, estimated that there were upward of 53,000 worms to the acre in his garden. From this estimate Darwin concludes that there must be at least half that number in meadows, pastures, and ordinary farm lands. The data he obtained from his own measurements and from those of others convinced him that at least 15 tons of castings are deposited upon an acre annually, which means approximately 20 ounces for each worm. Hensen estimated that the worms moved 100 pounds of soil on each acre daily. A whole chapter in Darwin's book on "Vegetable Mold and Earthworms" is devoted to the burial of ancient buildings and the part he believed earthworms played in covering them to considerable depths. "Archaeologists," he says, "are probably not aware how much they owe to worms (earthworms) for the preservation of ancient objects." He cites many cases found in England of the burial of walks and floors of ancient Roman dwellings, and presents evidence to show that earthworms were the most important factors in bringing this about.

Darwin estimates that earthworms have been the most potent biological factors in the working over and in the making of soil. In this connection he says "The plow is one of the most ancient and most valuable of man's inventions, but long before he existed the land was in fact regularly plowed and still continues to be thus plowed by earthworms. It may be doubted whether there are many other animals which have played so important a part in the history of the world as have these lowly organized creatures." Hensen found the excreted pelets to be about 3 times as rich in humus as was the subsoil. He regards their tillage operations important in mixing soils; in distributing humus and making it available; and in aerating the soil.

Reproductive Habits. Earthworms are hermaphrodite; that is, each individual produces both eggs and sperms. Their mating habits are such that the eggs of one are fertilized by the sperms of another. In Germany the worms pair from March until October, abundantly in May and many in June, but few in the other months. The eggs are laid in capsules, 3 to 6 in each capsule, the size of a small pea seed. The young are fully grown in 4 or 5 months, but do not become sexually mature until June.

Enemies. The earthworm has a host of enemies, but in spite of them is well protected and continues to replenish the earth. They furnish food to moles, shrews, hedgehogs, many birds, especially the robin in America; toads, salamanders, ground beetles, millipedes, centipedes, their principal enemy in Europe; a parasitic maggot lives in the body of the worm whose adult is the beautiful fly called Pollinia. There are various internal parasites, including nematodes and protozoans, and in captivity many of them die from bacteral troubles. Perhaps the ubiquitous angler needs also to be added to the list of earthworm enemies.

Distribution of American Earthworms; More Information Needed. The knowledge of turf-living forms of earthworms in the United States is very meagre. The commonest species is *Lumbricus terrestris,* introduced from Europe and known from Newfoundland, Massachusetts, Illinois, New

York, Mexico, Maine, Connecticut, Maryland, District of Columbia, Ohio, Michigan, Colorado and California. It doubtless occurs in many other states. *L. rubellus,* also from Europe, has been found in Newfoundland, California, Oregon, Washington and Michigan. *L. castaneus,* likewise from Europe, is known from New York and Canada, while *L. festivus,* another undesirable European immigrant, has been collected in Canada. *Helodrilus foetidus,* also a European species, is very common nearly everywhere in manure piles and compost heaps, which it helps to mix. *Helodrilus caliginosus* is probably the most abundant and certainly the most widely distributed species in cultivated land in the United States. *Helodrilus longicinctus* is known from lawns in central Illinois. *Helodrilus welchii* has been found in soil and only at Manhattan, Kansas. Most of the other American earthworms live in leaf-mold, very soggy places, or in rotten wood.

There is need of much more knowledge concerning the species that live in turf, as it is not unlikely that different kinds require different treatment.*

Eradication of Earthworms.

However interesting the structure and habits of the earthworm may be, the animal is not a favorite with golfers, mainly because of the little heaps of earthen pellets which it delights to erect so abundantly on the surface of a putting green. The skin of the earthworm is remarkably sensitive, and almost any substance that is at all irritable will cause the worms to come to the surface, even in bright sunlight, which the worms greatly dislike. Among the irritating substances that will thus cause worms to come out are vinegar and probably all weak acids; lime water or ammonium carbonate and probably all alkalies; kerosene emulsion; and besides many poisons such as corrosive sublimate and cyanide of sodium. In general, the poisons are most efficient as the animals are more or less rapidly killed and fewer of them return into their burrows after having emerged. How many of them perish that do come to the surface and then again return to their burrows, is wholly obscure, but doubtless varies wth the substance used.

Practically all the investigations on eradicating earthworms from turf have been with *Lumbricus terrestris,* and it is quite possible that other kinds of earthworms require different methods to eradicate.

There are many commercial worm killers on the market. Sixteen of these have been analyzed, so that their composition is fully known.

Of these 16 samples, 12 carry mowrah meal as the effective poison. Eight of these analyzed pure mowrah meal with a normal ash content ranging from 4½ per cent to 7 per cent. One sample (laboratory No. 37703), carried 27 per cent ash; 2 (laboratory numbers 37629 and 37372), 35 per cent ash; and 1 sample (laboratory No. 37300), was 40 per cent mowrah meal and 60 per cent sand.

Of the remaining four the analyses were as follows:

* To secure this knowledge we urge every golf club to send us half a dozen worms of each kind they find, packed alive in a small, tight box of soil. This material should disclose much more information about the abundance and identity of the soil earthworms in the different parts of the country. Address all packages to W. B. Lydenberg, Box 676, Eleventh Street Station, Washington, D. C.

Laboratory No. 37633: 82½ per cent corrosive sublimate, 17½ per cent ammonium chloride.

Laboratory No. 001614; 8½ per cent corrosive sublimate, 8½ per cent ammonium chloride; 83 per cent water.

Laboratory No. 001652: 8½ per cent corrosive sublimate, 51 per cent ammonium sulphate, 6½ per cent potassium nitrate (saltpeter), 28 per cent sodium nitrate, 6 per cent water.

Laboratory No. 29463: this was a water solution of sodium polysulphide, sodium thiosulphate, and a little sodium sulphate.

The most popular of these worm killers are those made of mahwa or mowrah meal, which is the ground pulp of the seeds of the mahwa tree (Madhuca) after the oil is extracted. Sometimes the worm killer is pure mowrah meal, but often more or less inert material like ash or sand is added. The price of mowrah meal purchased as worm killer is doubtless much higher than when bought as mowrah meal. Part of the popularity of this worm killer is due to the fact that it can be scattered dry over the green before applying water.

In view of the considerable number of different worm killers, an extensive series of experiments has been carried out to discover which worm killer is most effective; which kind is cheapest; and what type, dry or liquid, is more cheaply applied.

There can be no doubt that a dry substance is cheaper to apply. It is easier to scatter the material over the surface of the green dry and then apply the water than it is to mix up a solution and apply with buckets, spray pump, sprinkling cans or even with a special sprinkling cart. Dr. Harban informs us that it requires 1½ hours to treat a green with corrosive sublimate applied in solution but only about ½ hour to apply a poinson in powder form.

The experiments carried out in detail were planned to determine the efficacy of each worm killer used. The plots treated were in the Arlington turf garden and the units used were one-fourth of a square rod. Each killer was tested at different times on both cloudly and bright days on two different plots with fairly strong wind blowing. The results were recorded by the number of worms that came to the surface. Half or more of these died, depending on the amount of poison applied, and those that went back into the ground became very sluggish, apparently in a dying condition, or were dead at the end of 24 hours.

While it has been claimed that worms have not been brought out by the various poisons tried on extremely hot or cold days, or on windy days, because they were deeper down in the ground, yet on many occasions at the Arlington test plots an abundance of worms have been brought out by nearly all of the effectve poisons under all of these supposedly adverse conditions.

Up to this season most of the poisons have been applied in solution at the rate of 1 to 2 ounces to 60 gallons of water; but it has been found that much time can be saved by applying the poisons not already mixed with a filler, in dry sand or a mixture of sand and loam. The heavier poisons have been applied at the rate of ½ pound and 1 pound to 100 pounds of sand. The lighter and more bulky poisons, such as lead arsenite, hellebore, cyanamide, and derris root, at the rate of ¼ pound and ½ pounds to 100 pounds of sand. One hundred pounds of sand plus the poison was made to cover about 1,600 square feet. The various mowrah-meal preparations have been applied at the rate of 55 pounds to 1,000 square feet, and the polysulphides at the rate of 1 gallon to 70 gallons of water, using 100 gallons of the solution to 1,000 square feet of green. Poisons applied in sand are then watered in with hose, and the worms swept up. Little or no success has resulted from letting the rains wash the poison in, it probably being too greatly diluted.

No burning effect resulted with any of the above strengths of poison. Fertilizing effects claimed for various worm eradicators are open to serious question, and no poison used is sufficient to eradicate the worms for a season with one or even two applications.

A number of poisons brought out no worms, which raises the question as to whether they might have been killed so quickly in the ground that they did not have time to crawl out. On account of continued rainy weather recently, opportunity has not offered of digging up the ground and looking into this question, except in the case of two poisons which are reported below in detail.

The poisons tested from which no worms came to the surface were Bordeaux mixture, copper arsenate, copper sulfate, cyanamide, derris root (fish poison), hellebore, kerosene emulsion, lead arsenate (pulverized), permanganate of potash, and sodium arsenate.

Sodium cyanide.—No worms were obtained. The ground was dug up 24 hours after this application, to a depth of 12 inches, and all the worms were either dead or very sluggish and apparently in a dying condition. As this poison costs about 35 cents a pound wholesale for the commercial grade, it is one of the cheapest poisons available. Further experiments on this will be made under conditions with a known number of worms present, and report made later as to their condition at different depths and at various periods after application of the poison.

Bichloride of mercury (corrosive sublimate).—Numerous experiments with this poison, extending over three years, have produced from 15 to over 200 worms per quarter-rod plot, depending upon the atmospheric and soil conditions and the number of worms in the plot tested. The best results have been obtained by applying this in sand at the rate of 1 pound of bichloride of mercury to 100 pounds of sand and watering it in with the hose. Worms begin coming out almost immedately, and in from 10 to 15 seconds they are usually all out that are coming out. A few will crawl back. Soil removed from these plots to a depth of 18 inches at the end of 24 hours showed nearly all worms in a very sluggish and apparently dying condition. Probably few or none recover, and a few lively ones have been at the bottom of the soil taken out and probably came up from greater depths since the application of the poison. Accurate checks on this will be reported later. This poison seems to coagulate the mucous coating on the worms, and it is often left in strings behind them as they crawl along. When applied in bright sunshine this action seems to be more rapid, and it is apparently more difficult for the worms to get back into holes than on a cloudy day. On cloudy days a slightly higher average number of worms come out. This poison costs about 85 cents a pound wholesale and from 90 cents to $2.25 for treating the average green. The cost of the sand certainly would not bring the total cost of material for treatment over $1.50 to $3.50 for the average green, estimating the sand as around $3.00 per load (cubic yard), and in a 2 to 5-ton truck load even less. The labor of mixing is small per green. The various mowrah-meal, polysulphide, and other poisons cost from $15 to $20 for the material for a single green and the results from bichloride of mercury average equal to those from any commercial worm poison applied under the same conditions.

Mowrah meal with high ash or sand content (laboratory numbers 37372, 37300, and 37629).—These preparations added at the rate of 3½ pounds per one-quarter square rod gave from 17 to 40 worms per plot. Double this rate of application increased the number of worms to nearly double this figure. The worms came out in from 2 to 4 minutes.

Mowrah meal with low ash content (laboratory numbers 37299, 37371, 37568, 37590, 37706, 37630, and 37702).—One sample of low-ash meal (37706) used at the rate of 3½ pounds per plot gave the same number of worms per plot as the high-ash meal, but with a double application increased the number of worms by 8 worms. The other samples of low-ash meal gave from 34 to 73 worms with a single application, and with a double application increased them only to from 68 to 80 in from 1 to 3 minutes.

Corrosive sublimate and ammonium chloride (laboratory No. 001614).—This applied at the rate of 1 gallon of poison to 70 gallons of water and about 6 gallons of the solution to a quarter-rod plot brought out 116 to 218 worms under the same conditions as the corrosive sublimate alone in sand, which brought out from 118 to considerably over 200 worms on adjoining plots.

Polysulphide poison (laboratory number 29463).—This applied at the rate of 1 gallon to 70 gallons of water gave as low as 7 worms per plot in one application, while the same rate on other plots gave from 166 to 204 worms, in from 1 to 5 minutes.

Conclusions.

Most of the mowrah-meal worm killers are priced at $175 a ton, which means nearly $200 at the golf course. As it takes 150 pounds to treat an average green, the cost for material alone is $15 a green.

Corrosive sublimate is now quoted wholesale at 85 cents a pound. Two and one-half pounds in the dose for a 4,000-square-foot green. The poison will, therefore, cost on this basis $2.12 per green plus the cost of 250 pounds of sand or other filler. For the 18 holes the mowrah meal will cost $270; the corrosive sublimate, $38.25.

Corrosive sublimate is a violent poison and due care must be exercised in its use. All packages of the poison should be conspicuously labeled. If the sand-poison mixture is made up for future use, this should be labeled also. Corrosive sublimate corrodes metals rapidly and therefore it or its solution or sand mixture should not be put into metal containers. Perhaps these warnings are unnecessary, as corrosive sublimate has long been used as a worm killer; but it is well always to remember that it is a terrible poison.

Some effective poisons appear to kill the worms in the soil, although none come to the surface.

Platitudes on Golf Course Architecture

CAPT. C. H. ALISON

In planning a golf course there are no fixed rules to which it is compulsory to conform, and the variety which results is one of the greatest charms of the game. But many of the good courses resemble one another to some extent in general characteristics, and it may, therefore, be permissible to regard these as ideals at which to aim in designing a new course, and as standards by which to judge an old one. At the same time, the nature of a locality or the amount of money available will very likely render it impossible, in many cases, to achieve the ideals now suggested, and it by no means follows that the courses constructed under such circumstances will fail to provide interest and pleasure.

1.—Consider the object of your course. Ease of access is vital for the business man. A moderate course near the city may be more useful than a super-course in the Sahara desert. But if your course is for rich men with plenty of leisure, or for week-end and holiday use, accessibility is note quite so important.

2.—Obtain plenty of space. Many amusing courses have been planned on 100 acres or less, but it is better to have 130 acres, and still better to have 150 or 160. You can then have room to move about in, and sit about in, round the clubhouse. You can have a practice ground on which beginners can have lessons, without being hustled out of their senses. And you can have some large spaces between the holes, on which you can plant trees. You thus get the feeling of being in wild and open country, instead of in a small back garden, and your fairways need not resemble a number of parallel and rather narrow streets.

If you can afford the initial cost, get control of the land round your course. If its value increases, it is right that you, who have caused the increase, should obtain the benefit. If it is to be built over, it is desirable that you should have control of the manner of building, and of the garden architecture. In many cases you can obtain control cheaply before the course is started.

3.—Keep the parking space and caddies' shelter as much in the background as possible.

4.—If you have any planting to do, do it at the start. Trees take a long time to grow. It may be desirable to plant out the parking space and caddies' shelter, and to mask roads, unsightly buildings or railway embankments. It is also desirable to have trees near teeing grounds, and on any large, open space, provided that they will not block a desirable view. Trees cost little to plant, and very little to keep up. From a landscape point of view, you can get greater value from tree planting on a dull piece of land than from any other form of work.

5.—Have a practice putting green as near as possible to the first tee.

6.—Have two starting points, and let the second be the tenth tee if possible.

7.—The total length of your course may be anything from 6,000 to 6,500 yards. With heavy soil, which is liable to bake hard, you want more length than on light or sandy soil.

8.—As regards the length of individual holes, have from three to five short holes. Four is perhaps the best number. One of these should be really short, 140 or 150 yards or so. If you are going to have a lake or pond, have it at a short hole if you can. The duffer is more likely to carry it with a teed ball, and playing with an iron club. But do not construct a lake artificially unless you can have a stream running through it and have got an architect who is really good at landscape work. Even, then, remember to guard against mosquitoes.

Have at least two drive-and-pitch holes. Do not have more than one three-shot hole, unless you have natural features which favors the construction of two. Holes of this length are usually the dullest on the course. It is by no means necessary to have even one.

If you have four short holes, three drives and pitches, and one three shotter, you have ten remaining holes. Let seven of these be two full-shots for the good player under normal conditions, and the other three be rather shorter than this.

It is not possible to give yard measurements which would be universally applicable, as the nature of the soil, the direction of the prevailing wind, and the gradients have to be taken into account.

9.—Remember that it is desirable to keep the holes under all conditions at the length planned, length being reckoned not in yards but in strokes played by a good player. This ideal is usually termed "preserving the values." There are two chief ways of doing this. You can water the fairways, if you have got enough money. If you can not water the whole of the fairways you can do a good deal by watering them for a length of 50 yards, commencing at 150 yards and ending at 200 yards from the tee. And you can have plenty of teeing-grounds at different ranges. This latter method should be universally adopted, and at the longer two-shot holes the maximum and minimum length should differ by at least 50 yards.

The difficulty of preserving values is most noticeable on heavy soils, where the run may be enormous in summer, and almost nil in the spring and fall. But even on sandy soils the run varies with the weather, and the wind has to be taken into account. Elasticity of teeing-grounds is satisfactory as regards wind, but only partially satisfactory as regards alteration in the run of the ball.

10.—Do not have two short holes, two drive-and-pitch holes, or two three-shot holes consecutively. And do not have more than two long two-shot holes consecutively. Aim at a good distribution of length.

11.—Aim at having a fairly easy start on both loops of 9 holes. Let the last few holes be more difficult.

12.—A great deal of golf is played late in the evening. Therefore, if you can get equally good golf in that way, have the majority of your holes running north and south. But remember that a good hole running east and west is better than a bad hole running in any direction.

13.—Aim at perfect visibility for the approach-shot. When he is within range of the hole, the player should see the surface of the green. But a blind approach-shot, although never to be introduced deliberately, is less of a drawback when the shot is to be played with a brassie onto a large green, and when this green can be exactly located by means of outstanding landmarks.

14.—The surface of a tee should be level. But a tee should not be raised above the level of the surrounding ground, unless to obtain improved visibility or drainage, or to avoid the evil consequences of a sharp rise immediately in front.

15.—Greens should usually either have a tendency to slope upwards from front to back, or should have a plane base. As regards undulations, (a) It should be possible to cut holes over 60 per cent of the surface of a green. (b) As a rule, it should not be necessary for the player to aim outside the circumference of the hole when trying to hole out at a distance of 2 feet 6 inches. (c) The ball should not gain momentum after leaving the head of the club, unless there is ample space in which to lose the additional momentum before reaching the hole.

When in doubt, make a green flatter rather than more undulating. On a green, height is very slight in comparison with length and breadth. An indulation which rises 2 feet above the general level of the putting surface is very pronounced, and yet it may be only 1/45 part of the length of the green, or less. It is partly for this reason that plastocene models, although nice toys, are almost valueless in practical construction.

Make the size of the green depend on the length and character of the shot which should be played up to it.

16.—Hazards should be visible. In general, they should not penalize to the extent of more than one stroke, provided that the stroke out of them is properly played. They should not be so severe as to discourage bold play. In placing hazards it is vital to keep the course navigable for the duffer. It is perfectly possible to do this, and yet to render it interesting and testing for the first-class player.

17.—Regard landscape considerations as of primary importance.

The unpleasantly didatic phrases used in this article have been adopted solely to save space. The points put forward are elementary, and are merely intended for use by beginners as a basis for criticism and endeavor.

Sub-Irrigated Greens at the St. Louis Country Club

STERLING E. EDMUNDS

The chief problems that have confronted all green committees on golf courses located in the Mississippi Valley have come primarily from the variable conditions of moisture characteristic of this section. Courses in these states are not blessed by heavy dews and fogs, which contribute so much to the simplification of green keeping in some other parts of the country. Hence when sub-irrigation was agitated a decade or so ago as promising a solution of the moisture problem, it was eagerly seized upon and widely applied in these parts, particularly with respect to the construction of greens.

After adequate trial it is pertinent to ask, "Has sub-irrigation of putting greens fulfilled all of the hopes of green committees?"

The writer would not attempt to give a general answer, and such comments as are made have reference to experience with two courses near St. Louis, but mainly with reference to the St. Louis Country Club course.

When the St. Louis Country Club decided to move from its old home at Clayton, Missouri, in 1910, to its present location two miles west, the construction of the greens was considered a matter of importance equal to that of the clubhouse itself. All were agreed that they should be sub-irrigated. The course was laid by Mr. Charles B. Macdonald and the

Plan of sub-irrigation system of No. 12 putting green, St. Louis Country Club. The main tile are 6 inches in diameter and the laterals 4 inches

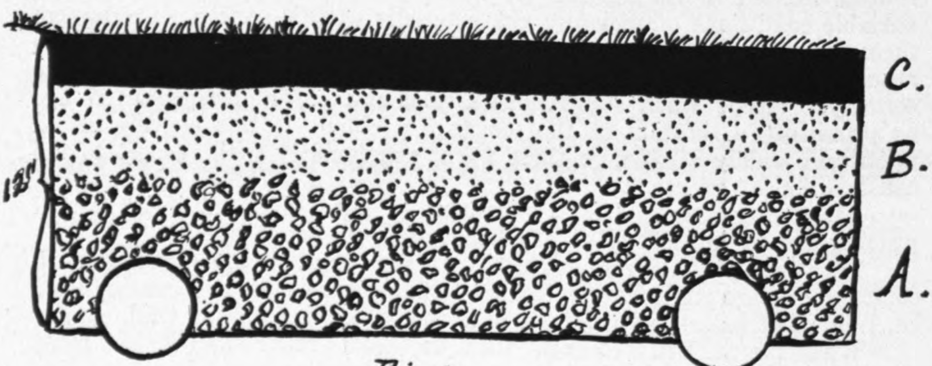


Fig. 2.

Cross-section of a subirrigated putting green, St. Louis Country Club, showing method of construction. (A), Layer of cinders 6 inches in depth. (B), Layer of clay 4 inches in depth. (C), A layer composed of peat with a small percentage of loam, 2 inches in depth.

golf architect, Seth J. Raynor, but the work of construction was left to local hands.

In excavating for the greens the clay subsoil was removed to a depth of 12 inches and the tile laid in grooves cut with a long hand-trowel. In the light of developments since that time it is agreed that there are undoubted advantages in a deeper bed, and in any new construction the beds would be excavated to a depth of 20 inches or more. In the laying of the tile in the Country Club greens 6-inch pipe was used to form the main line, with 4-inch tile laid as laterals. In some of the greens, the system took the form of a continuous one, winding its way back and forth in sinuous fashion, from the inlet to the outlet valve. As to the respective merits of these methods, an examination of the greens fails to reveal any advantage in the one over the other; yet as a practical proposition the effects of stoppage in the continuous system might involve more serious consequences than in the other.

After the laying of the tiles in grooves at the bottom of the excavations, they were covered with coarse cinders, forming a layer of 6 or 7 inches, in the nature of an auxiliary to the drainage system. Cinders were adopted in preference to sand because it was felt that they would stay in place and hold the tile in surer alignment. In addition, the merits of cinders had been proclaimed as a means of obviating the earthworm problem. This latter supposition has not proved correct in our experience, although the worm problem has never reached serious proportions on our course.

On top of the cinders a layer of earth was placed varying in depth from 3 to 4 inches. On top of this the seed bed of about 2 inches in depth was formed, consisting of a mixture of sand, earth, muck, humus, manure and some lime.

The seeds used were a mixture of New Zealand fescue, redtop, crested dog's tail, bluegrass, Rhode Island bent and yarrow. It is an interesting fact that in spite of this extensive variety of seed, which, with the exception of the bluegrass and yarrow, have been applied annually since, the bent grass alone has persisted with the yarrow. There is very little evidence of fescue and redtop. It would be logical to infer, therefore, that bent grasses are the appropriate ones for this section. At any rate we have acted upon this experience in adopting South German mixed bent as the single seed to be used in the future in the reseeding.

Our greens have been relatively free from weeds, due somewhat to their adequate protection against overwash from the fairways and the rough.

The sub-irrigation system is operated by admitting water into the tile and subsequently draining out such as has not seeped into the bed. Inasmuch as the tile is merely laid end to end, with no tight joints, they are liable to clogging and other disorders incident to getting out of alignment, sometimes requiring considerable disturbance to the green in providing a remedy. Furthermore a danger of some serious importance may possibly arise if the system is neglected, through standing water becoming harmful to the growth of grass.

On the whole, our sub-irrigation has been satisfactory, and in connection with it we have been able to maintain very fine greens. However, in view of tests that we have made with surface watering, we are not at all convinced that the same results can not be obtained without sub-irrigation if the bed is properly constructed, and drainage provided otherwise. This seems to have been proved on many golf courses.

Crab Grass

C. V. Piper and R. A. Oakley

Crab grass is perhaps the worst of all summer weeds on putting greens, but on the fairways it is in the main desirable even if the heavy turf keeps the ball from rolling much. Crab grass is a native of the Oriental tropics, but long ago was introduced into America. In Colonial days it was called crop grass, because it grew so abundantly in cropped lands, as between the rows of corn and cotton, in oat stubble, etc. It was then and still is cut for hay, furnishing perhaps more hay than any other plant in the cotton belt, but always as a volunteer growth on cropped lands. Perhaps the negro is responsible for the change of "crop" grass to "crab" grass. In middle latitudes in the United States the grass is often called "summer grass" and in New England "fall grass." Sometimes it goes under the name "finger grass." It is purely a warm-weather plant, not appearing until the days are really warm and being killed by the first freeze in fall.

Common or large crab grass has been blessed with quite a series of botanical names, thus *Panicum sanguinale, Paspalum sanguinale, Syntherisma sanguinalis, Digitaria sanguinalis,* besides some others. Present-day botanists use one or the other of the last two. Just why it was ever called "sanguinalis" (*bloody*) is obscure; but most golfers would say it is very appropriate. With the first touch of frost or during severe drought the leaves turn red, and it was probably such a specimen Linnaeus saw when he named it *Panicum sanguinale.*

Small or smooth crab grass (*Syntherisma humifusa* or *Digitaria humifusa*) is scarcely less abundant than its hairy relative. It comes later in the season, however. At Washington, D. C., fairways are covered with common crab grass from May until late August, but in September and October smooth crab grass becomes dominant. It rarely bothers on putting greens. In both crab grasses the branches are so weak that they become decumbent and then root at the joints. One plant of common crab grass may thus cover a round patch 3 feet in diameter, but rarely so large with smooth crab grass.

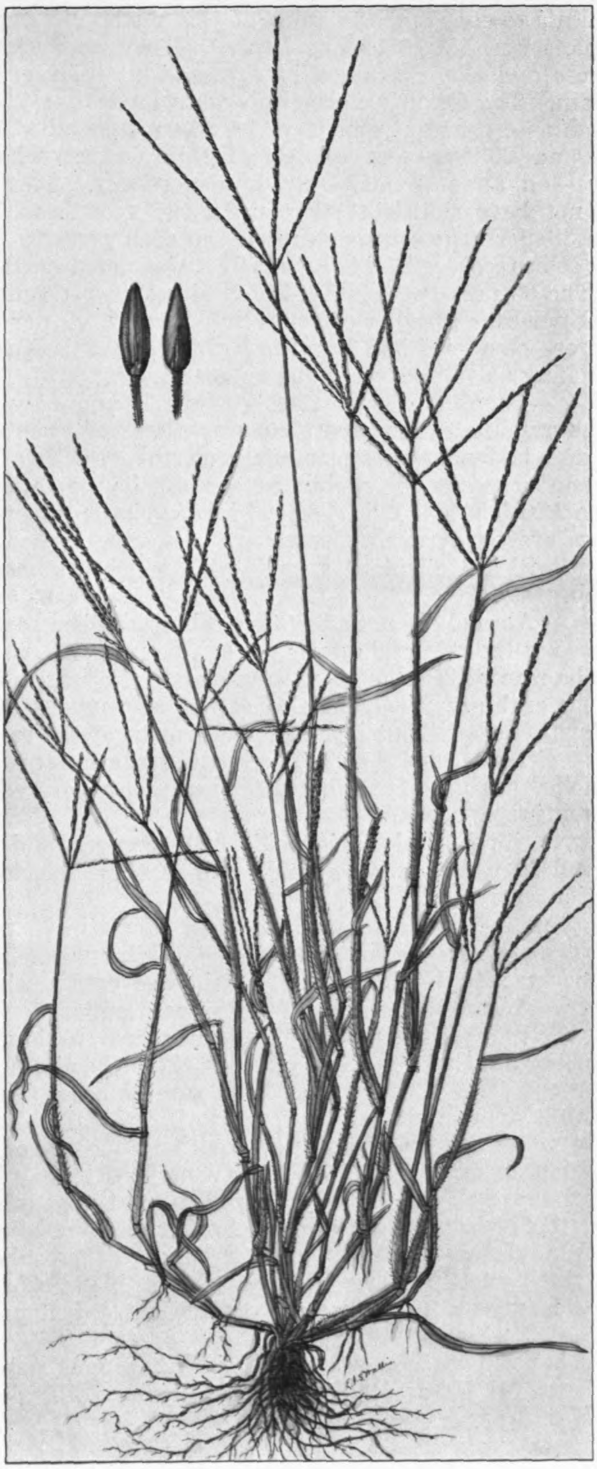
About Washington the two crab grasses make up most of the fairway turf throughout the summer and fall, but as they die from the cold the perennial grasses soon assert themselves and rarely seem at all injured. Around Philadelphia, curiously enough, crab grass often kills out large patches of perennial fairway grasses. Perhaps the difference may be due to longer and warmer periods after frost in Washington, but this is not at all clear.

The two kinds of crab grass are well illustrated in the accompanying figures.

Crab grass is most important from its troublesomeness on putting greens. Thus far hand-picking is the only really satisfactory way to save putting greens, albeit rather expensive. Extensive experiments have been carried out to find a cheaper means. Flame throwers seemed hopeful, but they certainly do not work on old crab grass plants. They will be tried on seedlings this season.

Poisons that would kill crab grass but not injure bents or fescue would be ideal. The following results do not appear hopeful, however:

During the season of 1916 and 1917 a number of plots on Arlington



Common or Large Crab Grass

Farm which were heavily infested with crab grass were treated with various chemicals to ascertain the value of this method in eradicating the weed. The plots were all 16 feet by 18 feet. They were heavily infested with crab grass and also contained bluegrass, white clover, and narrow-leafed plaintain. The following chemicals were used:

1. *Formalin.*—Formalin was used in three strengths, 10 per cent, 30 per cent and 60 per cent of formalin in water. The plots were sprayed twice—on June 14 and July 1, respectively. The 10 per cent solution did not have sufficient effect upon the growth to be of consequence. The 30 per cent solution caused the crab grass to turn slightly yellow, but it soon recovered. The same effect was noted on the rest of the vegetation. The 60 per cent solution killed about 10 per cent of the crab grass. A 100 per cent solution of formalin—namely, 40 per cent formaldehyde in water—was tried but found to be impractical because the chemical caused choking and blinding of the operator.

2. *Gasoline.*—Gasoline was sprayed on June 14 and July 1, using full strength. The gasoline evaporated almost as soon as it was applied with the sprayer and had no permanent effect on the growth of crab grass. When poured on by means of a sprinkling can, all the vegetation was killed.

3. *Carbon Bisulphide.*—This chemical is too volatile to permit spraying and the fumes are dangerous. Consequently it was deemed impractical, even though it will kill all plant growth with which it comes in contact, including crab grass.

4. *Alcohol.*—Alcohol did not affect the crab grass when sprayed. Wood alcohol was used at the rate of 8 quarts per square rod. At one time alcohol was used at the rate of 2 gallons per square rod. No injurious effect was observed on the crab grass. Grain alcohol was also used at the rate of 4 gallons per square rod without injuring the growth of the crab grass.

5. *Ether.*—Ether was used at 100 per cent strength, causing wilting of the plants touched, within a few minutes. They soon recovered and showed no permanent injury.

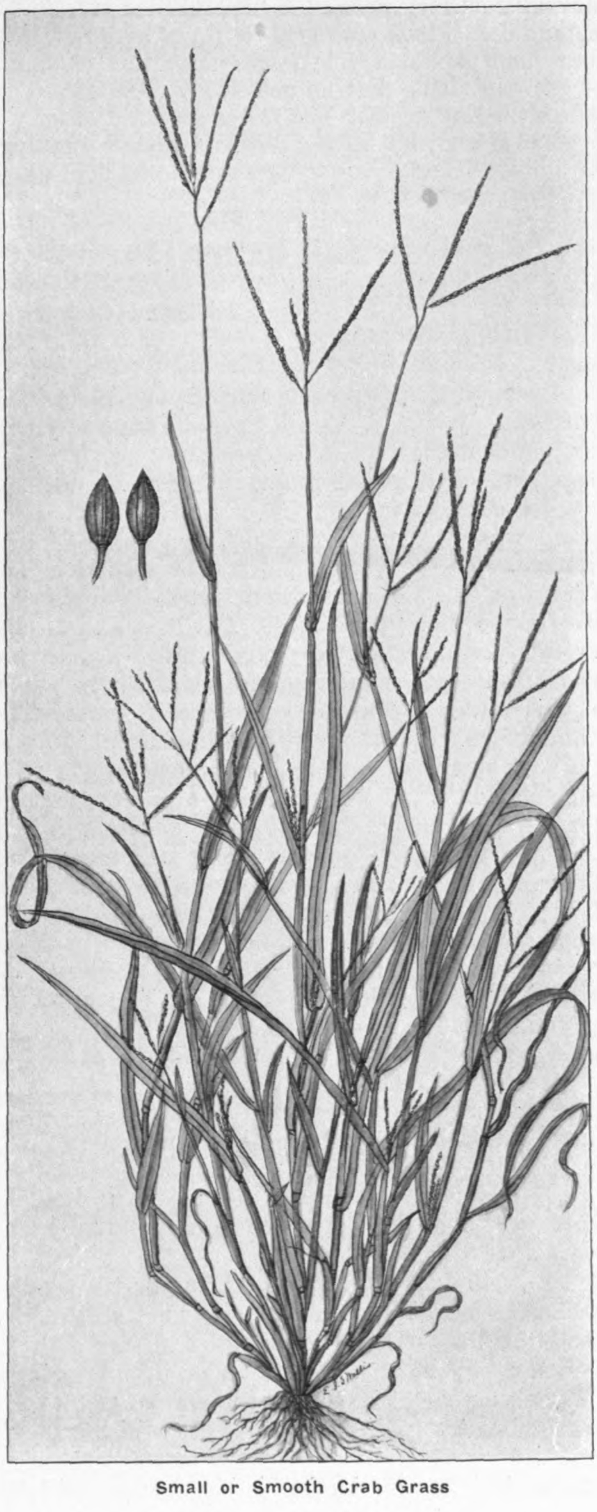
6. *Sulphuric Acid.*—Sulphuric acid, full strength and solutions of 50 per cent and 25 per cent, were used. All of these solutions killed all of the vegetation so treated.

7. *Nitric Acid.*—Nitric acid was used full strength, 50 per cent, and 25 per cent. The effects were similar to those of sulphuric acid.

8. *Hydrochloric Acid.*—Hydrochloric acid was used in the same manner as sulphuric acid with practically the same results.

On October 4, 1917, all the plots treated contained an abundant growth of crab grass, showing that the effect of all of these chemicals was not permanent in any one case. On June 22, 1920, several heavily infested plots of crab grass on a lawn adjoining the Council of National Defense Building were treated by pouring gasoline on the vegetation by means of a sprinkling can. In addition to crab grass, the lawn contained Bermuda grass and blue grass, but the crab grass was the predominant vegetation. All the vegetation on the areas was dead the following day. Observation from day to day showed that the crab grass gradually encroached upon the treated area, until on September 25, 1920, the crab grass had reasserted itself in such a manner as to become the predominant plant upon the areas treated.

One very hopeful method was to kill it by freezing, which does not injure the other grass but is deadly to crab. Various difficulties make the



Small or Smooth Crab Grass

scheme impracticable or very costly. A hopeful idea is to find a good grass that will withstand salt, which crab grass will not do. Several such grasses are known, but none of them yet found make fine enough turf. Crab grass will not grow in shade, but no genius has yet devised a satisfactory scheme to shade a putting green. The salt-grass solution of the problem is still the most hopeful one; but in the meantime hand weeding is effective, and, it may be added, necessary, if the green is to be kept good.

Dear Bill Letter II

Richland Center, N. Y.,
May 1, 1921.

DEAR BILL:

I'm glad to hear you finally came out of your trance and started to build your golf course yourself. You'll have the time of your life and I'll bet four bucks you beat the experts to death.

Don't forget, Bill, that a golf course is just like a railroad in one respect. They tell a story about asking an old-time railroad president on the witness stand what the first essential of a good roadbed was and he answered drainage. To the question what the second or next most important consideration was, he said more drainage; and still more drainage was the third. Just so with your course. Put it in and be liberal with it.

Whatever else you do, stick to your architect's plan and follow his advice. If you hired some regular portrait painter to get up a picture of your wife you wouldn't think of changing it yourself. You let the plans alone, and if you don't fancy anything speak to your architect about it and give him a chance to reason it out for you. He knows his profession and you don't. If he is making a mistake, let him alone, as he'll correct it. When you get through, your course will look like something and will reflect the individuality of your architect; otherwise it will show as much feeling and be as inspiring as a plate of goulash.

Say, Bill, keep your eye on the men working on the job. When you find a man who catches on and is taking an interest in the work, try to keep him for your regular gang. A good picked crew on a golf course can do more and better work than twice as many hit-or-miss clock-watchers, and you can afford to pay them liberally.

Why should you ask me how you can finish traps and bunkers that are not fully covered by your plans? Guess you haven't looked about you much while you have been playing golf all these years. Go look at some of the good bunker work on the course near you. A bad bunker stands out like a lighthouse in a fog. A good one asserts itself and looks "fearsome," as Sandy would say; but just the same it looks as though Nature left it there. The lines are smooth and flowing and it sort of melts as it were into the background.

Drainage, Bill, don't forget it. See that your traps and bunkers all drain. Get the surface drainage and use tile when necessary.

Don't just dig a hole and throw the dirt up for a back and call it a bunker. Get some pep and style in it. A good bunker is just as pretty as a green. While you are at it, do the job good. Get some sheep's fescue or any heavy bunchy stuff and sow it for whiskers. No bunker is right until its whiskers stick out on its back to warn the player that it's no nice place to get in. If your bunker is big enough, stick some bunches of fescue in the sand in the bottom just as though they grew there naturally. Did you ever notice a cave-in on the side of a hill or embankment or on the side of a dune on the shore? The next time you do, notice the tufts or bunches of rough grass.

Little did I think a year ago you would be eligible for the "Nut Club" by this time. No more happy days of golf for you. You'll have more interest in your turf and greens than in your shots. When you see a loose divot lying on the surface you'll feel that some criminal had done you a wrong that never can be forgiven.

Why, Bill, in a year you'll take more interest in a pile of horse manure than in the latest ball; but I'm not sure that you'll get less fun out of it than the chap who thinks of nothing but his game.

Go at it hard, old man. There's no sense wasting time half doing anything. If you are going to play a game, play it hard. There's a world of money wasted and damage done every year by members of green committees who think any half-wit can grow grass and who do not take the pains to study and find out what they are talking about. When your troubles bother you, take your pen in hand and write me. I may not know a lot, and a good deal of what I know may not be so, but I love to talk about it, and you'll get something out of it. A blind sow will pick up an acorn once in a while, and I'll be right occasionally.

Sorry to hear little Billie has been sick, but don't worry. You've had everything but religion yourself and got through.

Yours,

CHAUNCEY.

Questions aud 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.

1. *I would like to know what grasses you recommend for golf greens adapted to our soil, which is thin—some clay, but more sand. It does not hold moisture well. The club here would like to improve its greens. G. W. K., Richmond, Va.*

At Richmond you are near the southern limit of where bluegrass and redtop can be successfully grown on fairways, and about the northern limit of where Bermuda grass is satisfactory. The chances are that even if you seed your fairways to bluegrass and redtop, considerable Bermuda grass will come in, and white clover is practically certain to do so, also considerable Japan clover in summer—and crab grass, of course. Our advice, however, would be to seed the fairways to bluegrass and redtop in the proportion of 8 pounds of bluegrass to 1 pound of redtop. Your best time of seeding would be September 15. If you plant in the spring the preparation of the seed bed will encourage the crab grass enormously and most of your seeding of the perennial grasses will be destroyed. On the other hand you could easily plant the fairways to Bermuda grass this spring. Bermuda grass makes a good fairway, but the trouble is that it turns brown with the first frost in autumn. The turf during winter will be fairly good notwithstanding its brown color, but is unsightly. This can be obviated by seeding a Bermuda fairway in your latitude every fall to Italian ryegrass, seeding heavily, say 100 pounds to the acre. The Italian rye-grass will make beautiful turf throughout the winter and early spring, but with the beginning of summer will give way to the Bermuda grass, with which, in summer, there will be a good deal of crab grass and Japan clover.

2. *As chairman of the green committee of the above named club, can you give me any information on the following subject—sanding of greens. At the present time our course is in the best condition it has ever been in, and it is not yet the first of May. I have lightened up on the rolling, and at the present time the greens are extremely true and fast. Our turf is thin and rock is found almost every time a hole is cut. This spring I had all the greens seeded, topdressed, brushed, and rolled, keeping them a couple of weeks to give the seed a chance to get started and to get rid of the bare spots. Up here we are very liable to get a dry spell and our water supply is very weak, the usual thing under these conditions being that we get baked out. There are several men who want to sand the greens. In my opinion it seems this is not warranted as long as the greens are true and are fast enough not to need much rolling. The conditions are far different here on an inland course than at the Long Island courses; in fact, different from Arcola, a few miles away. Because something is good on the National, I fail to see why it should hold good here. G. L., New York.*

Your soil is mainly a sandy loam and it does not seem to us ordinarily advisable to top dress your greens with sand. The functions of sand are: (1) to smooth over the surface where it is not true or where the grass is thin, and (2) to lighten soils of a stiff nature. The second reason does not exist on your course, as we remember it. Possibly a few of your greens are made up of stiff clay soil, and on these regular sanding would be beneficial. Where, however, your greens are of a sandy loam type your best topdressing will be a rich compost of mushroom soil and rich soil mixed in equal proportions. The effect of this kind of topdressing will be to stimulate the growth of the grass, and incidentally it smoothes out any inequalities in the surface. From the general character of your soil we should think topdressing at least twice a year would be all to the good. In addition to its stimulating effect on the grass, we believe that this continued topdressing on your sandy loam soil, in places thin, will gradually increase its water-holding capacity and thus in a measure prevent the burning out of the grass during serious periods of drought. So far as rolling is concerned, this is always a matter to be exercised judiciously. On sandy and sandy loam soils there is rarely any trouble from compacting the soil too much, but on clays and clay loams this could easily be done by too heavy rolling.

3. *There is one point concerning which I would greatly value your opinion; that is, when sowing a green to red fescue or creeping bent, as the occasion may warrant, what would your idea be as to the quantity of seed necessary to produce a good turf in the minimum time? J. H. M., New York.*

We have consistently advised rather liberal quantities of seed to be used in seeding putting greens, as, after all, seed is one of the cheapest items in the preparation of a putting green and the lack of a sufficient stand is very annoying. We have commonly recommended 5 pounds of bent seed per 1000 square feet or 7 pounds of red fescue, providing the red fescue is of good quality. As red fescue seed usually germinates poorly it is much better to use 10 pounds.

4. *Please send us detailed plans and necessary seeds for turf experiment plots as described in Bulletin No. 3 of the Green Section. C. A. H., California.*

In regard to turf experimental plots, we have found that plots 8 by 8 are very convenient, as these are large enough to give a clear indication of the character of the turf. The plots should be given exactly the same care as is given the putting green—that is, if the experiments refer to putting green turf. Where we test out fertilizers we plant a long strip 8 feet wide to the same grass, then divide this crosswise into plots 8 feet square and test out different fertilizer treatments on each.

As we understand the problems in southern California at the present time, the main one is that of finding more desirable grasses both for the putting greens and fairways. In this connection we have a considerable number of grasses which should be tested out in this way. These are as follows:

Cynodon plectostachyus, Cynodon sp., and *Cynodon intermedius.* All three of these are closely related to Bermuda grass and none have been grown in this country heretofore.

Eremochloa ophiuroides (Centipede grass) and *Eremochloa leersioides* (Hunan grass). These two grasses are best suited for fairway purposes.

Osterdamia japonica (Palm Beach grass) and *Axonopus compressus* (carpet grass). These two grasses are likewise primarily for fairway purposes and in the plots should be kept clipped in the same manner as is the fairway.

We regard it highly desirable to test out all of these grasses carefully as we think one or more of them may prove valuable either for putting-green purposes or for fairway tests. We shall have seed of *Cynodon plectostachyus, Cynodon* sp., and carpet grass sent you. Of the others we shall have living grasses sent, to be planted out vegetatively, but they all grow rapidly and if small pieces of the plant are put a foot apart each way it should not be long before the whole area is thoroughly covered with turf.

In connection with Bermuda grass for putting greens, we would also like to recommend that you look over your putting greens carefully and wherever you find a superior piece of Bermuda grass select it out and plant an experimental plot with it. We are sure that a great deal can be done to improve the quality of Bermuda turf on putting greens by securing the best strains.

5. *Our course is now being built and is intended to be modern in every way. The putting greens are to be tile-drained, with a layer of cinders, and about 15 tons of well-rotted manure worked into the sub-soil, together with a properly made seed bed on top. Would you be kind enough to give us the opinion of the committee on the following points? The question of the use of porous tile or vitrified tile is now being considered by our green construction committee. The greater durability of the vitrified tile is important; but do you believe that we would get sufficient drainage through the joints of vitrified tiling? We have also to make a decision on whether or not we should incur the expense of about $6,000 for imported humus*

from New Jersey or use a very fine class of black loam for the three or four inches used for a seed bed. We have had ——— humus, sold by ———, analyzed in the ——— Agricultural College, and the nitrogen test is slightly over 1 per cent, as against the black loam above referred to, which tests .72 per cent nitrogen. The writer was informed, while in New York recently, by some of the seed houses, that it is possible to secure a good green without the use of imported humus, but as we are spending a great deal of money on our greens we are unwilling to take any more chances than are absolutely necessary. L. R. Y., Ontario.

With regard to your new course, we note that you intend to lay the tiles for the drainage system of your putting greens in a layer of cinders. Judging from the experience of other clubs we would be much inclined to advise against this. Cinder layers in putting greens have not been very satisfactory, and as they entail considerable expense it is quite evident to us that you would do well to disregard them. It has been said by many that they prevent the action of earthworms; but this is not true. Our observations lead us to the conclusion that earthworms work as well in greens having cinder layers as in greens that do not have them. Incidentally, we may say, Darwin reached a similar conclusion years ago. As to whether porous or vitrified tiles should be used for your drainage system, we would suggest porous tile, by all means. The forthcoming issue of the BULLETIN, which will be in your hands in a few days, devotes much space to humus-making materials and discusses peat or so-called commercial humus in considerable detail. Briefly, we advise the use of peat only where good manure or mushroom soil cannot be obtained, and in connection with the use of humus we urge careful composting and proper treatment generally. Since the whole subject is discussed in detail in the BULLETIN, which you will soon have, we think it unnecessary to go into detail here.

6. *We are establishing some new putting greens and one of them is adjacent to a place that makes hydrated lime, and when the west wind blows the dust from this lime-works lodges on the place where we contemplate making the green. Will we have trouble in establishing and maintaining a putting green if sown with creeping bent grass seed, which we have, or had we better use some other kind, such as red fescue or fine-leaved fescus? P. F. R., Pennsylvania.*

In our judgment the lodging of the lime dust will not do any particular harm to putting greens either of bent or of fescue. The most harm that can be anticipated would be that if the lime were large enough in quantity more weeds would tend to appear in the turf than if the lime had not blown on the greens. In the Taylor system of foundations for greens relatively large amounts of lime were put just beneath the surface. We have seen some very excellent greens notwithstanding this huge amount of lime, but we have seen as good or better greens where lime was not used. In other words, the main objection to lime in putting greens is that it does not give any benefit commensurate with its cost, and more often does more harm than good.