

## Rebuilding the Putting Green

By Kenneth Welton

Frequently areas of poor turf, particularly putting green turf, are maintained from year to year only with much worry and at great cost, when a study of the situation would at once reveal the hopelessness of the task and suggest a rebuilding program designed to eradicate completely the underlying trouble. This would not necessarily mean the loss of all the turf, for that which is in good condition can be relaid. Occasionally, however, new turf must be either laid or grown on the reconstructed bed.

Any consideration of rebuilding a putting green at once raises several questions: If present turf can not be maintained in good condition, how can it be expected that new turf will fare any better? If a new turf, produced from either seed or stolons, should deteriorate like the old turf which it replaces, would not a club be put to expense for nothing, and members to the inconvenience of playing a temporary green? It is true that little is gained by tearing up a green if an attempt is not made to determine the cause of failure and means to prevent repetition of the trouble in the future. There are numerous conditions which may justify the removal of turf from a green, among them being a poor soil bed, defective drainage, the use of unsuited grass, more or less permanent injury resulting from improper methods of maintenance, the dominance of weeds, and the injudicious use of chemicals. Frequently architectural considerations also call for the remodeling of a putting green even though its turf be of prime quality. In any case, where turf is removed it is highly desirable to plan beforehand for the improvement of the structural condition of the green in every possible respect while the operation of rebuilding is in progress.

Unwise cultural practices are no doubt responsible for much poor putting turf. Even on greens properly constructed and planted deplorable putting surfaces are found. On the other hand, putting greens with poor underlying soil, poor drainage, and poor strains of bent grass are often found kept in very fair shape in spite of these drawbacks, simply because the greenkeeper has recognized the defects and by special tactics has managed to preserve a passable turf but at an excessive cost.

Turf may be injured permanently by the improper use of chemicals. Putting greens are still to be found which suffer periodically from copper poisoning resulting from applications of Bordeaux mixture as a fungicide before the injurious effects of accumulations of copper in the soil had been discovered. Turf is indeed often injured beyond recovery by the careless use of fertilizers and fungicides. Neglect of annual weeding and the use of the wrong fertilizer may in time produce a turf consisting almost entirely of foreign grasses, clover, and weeds.

The standard of excellence of putting green turf has become very high in recent years. Players demand putting greens with even, close-mowed surfaces. Mower manufacturers have improved the design of their mowers and have supplied the means of cutting grass much closer than was possible years ago. Certain kinds of grasses, such as Kentucky bluegrass, fescue, redtop, and rye grass, which were common on greens years ago, are seldom found on putting greens today. There are, of course, exceptions to the rule, and occa-

sionally an old fescue putting green is found, due probably to the fact that some favorable strain of fescue was unwittingly sown, or perhaps due to some exceptional soil condition. Another reason for the occasional occurrence of bluegrass, fescue, redtop, or rye grass on putting greens today in spite of close cutting is that turf will stand varying periods of close cutting before dying. Wherever it has been the custom to sow large quantities of seed on putting greens from year to year, it is probable that seedlings have kept replacing the older turf as it has died.

Notwithstanding the occasional occurrence of bluegrass, fescue, and redtop on putting greens today, other grasses have become notable for their ability to better withstand the extremely close cutting now in demand. The most important of these are the various strains of bent grass in the North and of Bermuda grass in the South. Though of the same botanical species, it is clearly evident that in each case strains may differ widely as regards suitability for putting green turf. Some strains are coarse and some are fine. Some strains of creeping bent show a tendency to form an objectionable grain, and some are stringy and lie upon the surface and fail to produce the density of turf that is desired. Coarseness, grain, and stringiness may be overcome to a certain extent by cultural treatment. But far more important than variations such as these is the variation among strains in their resistance to disease. When a golf club is unfortunate enough to have putting greens of an objectionable strain of grass, the only quick and sure remedy is to remove the offending turf and replant.

That turf is greatly improved by moving is confirmed by the experience of many of our best greenkeepers. Mr. John Shannahan, the greenkeeper at Brae Burn, has from time to time lifted the turf on his greens and relaid it after improving the soil structure. The experience of Mr. Rockefeller, of the Inverness Club, at Toledo, has been similar to Mr. Shannahan's. Both of these experienced men have observed that turf has always been greatly invigorated by such treatment. Similar results have also been noted at the Arlington turf garden. Mr. Shannahan has always been careful when relaying his mixed bent turf to lay the best pieces on areas where the most putting may be expected. This is a wise precaution with any kind of grass. At Brae Burn the result has been to concentrate solid areas of velvet bent on the sections of the green where the hole is most often placed. It is not necessary to discard all the turf cut from a poor green. Any turf which can be used again should be relaid. Frequently several hundred feet of new turf will replace the weedy and poor turf. This, of course, applies only to greens which are not suffering from poisoned soil or which are not made up of the wrong kind of grass. When a club has been put to much inconvenience by the necessity of keeping players off a green for long periods due to its sod having been poorly laid, it is naturally hesitant of having any other greens torn up and poor sod-laying jobs repeated. However, there are many skillful greenkeepers who think nothing of resodding a green and having it in excellent condition, ready for play almost immediately.

The cost of rebuilding the soil bed of a green and replanting or resodding it is low in comparison with the improvements to be gained and the subsequent reduction in maintenance expenses. Figures will be presented later in this article on the cost of such work. When

grass on a green is not able to grow fast enough to compete with clover and weeds the annual expenditure for weeding alone will go a long way toward covering the cost of rebuilding it in order to remedy its inherent defects.

When a putting green is to be replanted the committee should give considerable thought to the future of the course. It may be they will wish to decide on a definite policy which, if carried out year after year, will gradually make the turf on all the greens of the same variety or strain of grass. Before selecting a new variety or strain the committee would do well to visit a demonstration turf garden on which a comparison can be made of the merits of various types of putting green grass under similar conditions. A list of such demonstration plots which have been established by the Green Section will be found in the January, 1929, number of the Bulletin. Also visits to courses upon which known strains of grass are in actual play will be of great



Cutting sod with a pulley hook-up. This arrangement is often a convenience when it is especially desirable to pull the sod cutter in a straight line. The pulley is moved from notch to notch on a plank held in place by a stake driven at either end. The notches on the plank are cut 1 foot apart, or the width of the sod cutter.

help in reaching a decision. With a turf composed of a weak grass susceptible to disease the consideration of the cost of necessary fungicides over and above that required with a healthy turf is of prime importance. It must also be remembered that turf on soils of poor physical structure entails endless maintenance expense even though its condition is rarely subject to the criticism of the players.

The comparatively long time required to produce good turf from either seed or stolons is perhaps the chief reason why a putting green is not rebuilt when conditions require rebuilding. The time saved in resodding a green, however, is frequently a sufficient inducement to clubs to resort to this method of renewing the turf notwithstanding the extra expense that is involved. When a green is sodded it may be fit for play within a week from the time the sod is laid, or even less in an emergency such as cited in another article in this number of the Bulletin. After sowing seed on a green it requires from 8 to 10 weeks of growing weather to produce a turf suitable for play.

Somewhat less time is required when stolons are planted, good turf being produced from stolons in from 6 to 8 weeks after planting. Aside from its producing turf a little sooner, the planting of stolons is often preferred to sowing grass seed for the reason that a better selection can be made of the strain of bent to be used, if in the North, or of the strain of Bermuda grass if in the South. The planting of stolons, however, is more costly than sowing seed.

A club should not be in too great a hurry to have sod lifted from a green. After the type of turf and the manner of returfing have been decided upon there are still other matters that need attention before the old sod is lifted. If the old sod is to be relaid on the same area it is well to make arrangements so the work can be done quickly in order that the sod may not be injured by being set aside for many days. If sod is to be moved from one place and relaid in another, the new bed should be prepared before the turf is moved from its original location. In either case all materials, equipment, and labor should be at hand before the sod is lifted.



Cutting sod without a pulley hook-up. Here the sod is on a rather hard-packed silt loam soil. The weight of several bags of sand is required to hold the cutting knife under the turf. The cutter is pulled directly, by a single horse. A steel bar is held in the soil ahead of the cutter to guide the implement by pressure against the draw-rope.

#### SOIL CONDITIONS ON GREENS IMPORTANT

It is true that the greenkeeper must be held responsible for the employment of proper methods of turf maintenance, including fertilizing, weeding, use of fungicides and insecticides, watering, rolling, brushing, cutting, and top-dressing; but he can not be blamed for conditions due to improper methods of construction practiced before he was placed in charge, or due to lack of adequate equipment or funds to correct drainage or other defects, provided he has brought these failings to the attention of his superiors.

The roots of plants can not function properly without an open, friable soil. An ideal soil for root growth is one of a crumbly texture. The farmer practices crop rotation in order to get his soil plowed and put under seasonal cultivation. This improves the physical con-

dition of the soil by making it more crumbly, thus facilitating the movement of water and air through the soil and permitting the roots of plants to perform their normal function of growth in search of moisture and food. Therefore the soil bed, no matter what else it may require, should at least be plowed and cultivated when for any reason the turf is removed.

Soil types are classified, more or less arbitrarily, according to their textural characteristics, which are governed by the relative proportions of the fine and coarse mechanical soil constituents. Roughly speaking, the word sand designates a predominance of coarse material or soil made up of large particles, while the word clay designates the predominance of fine material. Silt is finer than fine sands but coarser than clay. Loam is a more or less balanced mixture of both coarse and fine materials. Air and water can permeate readily through coarser materials, such as sand, but unless the finer materials, clays and silts, are rendered crumbly or granular they greatly restrict movement of both air and water.

A fertile soil contains considerable organic matter, such as decaying animal or vegetable remains, which assists in holding moisture and rendering available the inorganic plant foods in the soil, and also in adding to the plant food by its own decay. The farmer plows manure into his soil between crops, and also frequently plows under green crops and sod, to preserve the organic content of his soil. These particles of organic matter, further, when well mixed with the soils help to keep clay soils from becoming too tight by separating the particles. Pure sands require the addition of clay or silt and organic material in order to retain moisture and plant food. Clays and silts require sand and organic material in order to allow the air and moisture to filter through them and release the plant food.

For putting greens the loam in a top soil should be of the sandy type, since sandy loam is less liable to pack and hence is able to maintain an open structure in spite of the packing and trampling a green receives. A sandy loam will not become soggy but still will be resilient enough to hold a pitched shot, and, with occasional fertilizing, can be kept fertile enough to support a dense turf. An ideal top soil for a putting green could be described as one which, while damp, will readily crumble upon release after being squeezed tightly in the hand.

Golfers can quickly detect packed or puddled soil when the putting green is dry. The pitched ball bounds off a putting green with such soil as it would from a clay tennis court. The greenkeeper is compelled to keep this type of green continuously saturated to make it endurable to the player. For some time after being watered these greens are muddy, and a pitched ball may be found either partially buried in the turf or spotted with mud. The continuous watering of a green with such a soil only aggravates the condition, since the green will be played on while wet, and as a result the soil is still further packed or puddled. Upon examining a plug cut from such a green the turf is frequently found to be extremely shallow-rooted and can be easily peeled from the underlying hard soil due to the failure of the roots to penetrate the soil to any depth.

Layers of material vastly different from the prevailing soil type frequently disturb the natural rise and fall of soil water in a green. Top soil may be cut off from its supply of moisture from below due to a layer of coarse sand, gravel, or cinders. A layer of impervious clay

or a layer of peat may check the natural elimination of surface water and thus cause trouble. By examining a plug cut from a green with a hole cutter, layers of such materials are frequently discovered close to the surface. Many otherwise fine greens have had to be reconstructed due to the practice of laying down layers of material during construction or building up a layer by top-dressing with an undesirable material during the administration of a particular green committee. For example, heavy top-dressings of pure, coarse sand during one administration may form a layer which will subsequently hinder the rise of soil moisture to the turf, or a layer of peat just below the surface may practically cut the top soil off from the subsoil. Such layers are frequently the result of some ill-considered cultural program.

At certain times poor drainage will render a putting green almost unplayable, and it will gradually ruin some soils. With poor drainage it will be almost impossible to maintain perfect turf no matter how good the type of soil underlying the turf may be. The retention of water in a green for a long time after rains or artificial watering may be due to inadequate surface drainage, a heavy subsoil which pockets the water because it does not grade evenly away from a green, a high water table in the green caused by its lack of sufficient elevation above the surrounding terrain, or the percolation of seepage water from a surrounding elevation. With a heavy subsoil or a high water table the remedy is underground tile drainage. To carry off seepage water a ditch may be constructed or the tile laid on the upgrade of the green.

#### PREPARING THE TOP SOIL

Methods of building putting greens, including the preparation of soil for proper texture, the preparation of the soil bed, and drainage, are discussed at some length in the August, 1928, number of the Bulletin. The phase of the operation which most often causes failure when neglected is the preparation of a true soil bed—one that will not settle after being planted or sodded. The preparation of a settled, firm soil bed is of much more consequence than is the cutting of the sods of absolutely equal thickness. Uneven, bumpy surfaces in resodded greens, showing in some cases years after the work has been done, are usually wholly due to the improper preparation of the soil bed. Top-dressing will quickly eliminate small bumps and depressions occasioned by unevenness of sods at their joints, but sometimes, even after many applications, it can not entirely eliminate the relatively large inequalities of surface occasioned by uneven settling.

The procuring of a true, settled seed bed or sod bed is no secret. Nor does it necessarily require extended time. In rebuilding the surface of an old green having a settled subsoil, the freshly turned or mixed top soil can be settled in a day if necessary. If a green has settled in places for one reason or another, it will be found to be much quicker and more satisfactory in every way to lift the sod and fill in or grade the uneven places than to try to fill in deep depressions by top-dressing. It usually takes years to build up an inch or two on a putting green by top-dressing.

Top soils of any kind should not be buried when construction work is in progress but should be used in preparing the top soil of greens. The base or fill of an elevated green may be made of whatever soil is at hand, but if the fill is of heavy clay the subgrade should drain

evenly from the green in order to leave no pocketed areas below the surface. Clay soils will usually require tile drainage also. The top soil of a sandy loam should be from at least 4 inches to 6 or more inches in depth when settled. Well rotted manure, woods earth, peat, or humus can be used for supplying organic matter if deficient, and clay, silt, loam, or sand may be used for producing the proper soil structure. These materials should be added as needed to the existing top soil, and should be well mixed by plowing and disking before the green is planted.

Not only should the top soil be correctly prepared when a green is being rebuilt, but perfect drainage must be provided. If a green is poorly drained, a good soil structure will eventually be ruined; packing and puddling will occur, and when the soil is dry it will become hard and baked and will not allow air to circulate freely through it. Putting greens not properly constructed as regards drainage and top soil are liable to cause maintenance trouble at any time. The surface of the green should have ample slope to carry off water which falls on it. The green should also be protected from both surface wash and seepage. Grassy hollows and tile lines sunk on hillsides to a depth the elevation of which is below that of the lowest elevation of the putting surface are the accepted methods of preventing surface wash and seepage.



Removing sod at the Arlington turf garden to make room for new experimental plantings. The sod was cut with the pulley hook-up, rolled, and laid aside.

If the soil is not sandy, construction work on putting greens, or for that matter on any part of a golf course, should not be attempted when the soil is saturated. Working saturated soil destroys the soil texture by packing or puddling the soil. It is often costly to refrain from working wet soil, especially when a course is in the process of construction; but this cost is small compared to the subsequent cost of maintaining turf on puddled soil.

It is necessary to have the subsoil or fill of a putting green completely settled before preparing the top soil, and it is of great importance to have the top soil thoroughly settled before any planting is done. Newly prepared top soil should therefore be handled only when it is dry and the organic material mixed in it should be thoroughly pulverized and uniformly distributed. If the soil is dry a roller can be passed over the green from time to time to assist in breaking clods of earth and settling the soil as it is prepared. After a finely pulverized, settled, dry soil bed is prepared, the green may be



left to settle naturally. This natural settling will depend mostly on the rainfall. If time is a factor the area should be well soaked artificially to hasten the settling.

When a green is saturated a great deal of damage may be done by working or trampling it. In such case it is necessary to wait until the soil has lost its free water before laying sod. If the drainage has been attended to it will be a matter of only a day before the top soil will be dried out to a sufficient depth to permit hand work.

After the final settling of the soil has been accomplished by watering, the surface should be gone over and finally trued with hand rakes, and then lightly rolled before sowing or sodding.

#### COST FIGURES

*Preparing the Top Soil.*—Figures have been obtained on the cost of preparing top soil of putting greens. They differ widely, however, due to the differences in the various types of soil with which the work was done, notwithstanding the actual operations in all cases were similar. In one extreme case, where a good top soil was prepared by working sand and manure into a heavy clay soil, the cost was necessarily above the average. In this case the clay base was of such a character that after sand and manure had been plowed in, it was deemed advisable to dig and turn the whole green to a depth of 10 inches, by hand, in order more thoroughly to mix the materials. This operation included the loading, spreading, and handling of 30 tons of sand and 40 yards of well rotted manure. The area of 8,000 square feet was plowed, disked, dug, graded, and raked at a cost of \$190, which does not include the cost of the sand and manure delivered to the property. In another case, on a silt loam soil, the job was done at a much lower figure. In this case no sand was required, the only material mixed into the top soil being 4 yards of manure to each 1,000 square feet. The soil was plowed to a depth of 6 inches, the manure was spread and disked in to a depth of 4 inches, the area was dragged with a spike-toothed harrow, and some hand leveling and raking were done. The cost of this, not including the cost of the manure delivered to the property, was \$12 for each 1,000 square feet. Of this amount \$5 was required for loading and hauling the manure from piles at some distance from the green. With average clay and silt loam soils, about 3 yards of sand and an equal quantity of manure, for each 1,000 square feet, seemed to be the quantities of material most commonly added in reconditioning old putting greens. With sandy loams the sand was replaced with extra manure or other organic material. The average depth of plowing these materials fell short of 6 inches, and the cost of hauling the material, plowing, disk-ing, harrowing, and raking by hand averaged \$14.65 for 1,000 square feet. This figure can be reduced considerably if it is possible to have sand and manure hauled to the grounds at the proper time and dumped on the area where the soil is being prepared, thus saving the necessity of reloading the material. On firm, packed soils a further saving may be effected in the mixing of material to a proper depth, by plowing and disk-ing the area before spreading the manure and sand. In this case the area should again be plowed in order to turn under the sand and manure, and the mixing can then be done to the proper depth with little trouble.



*Planting and Maintaining a Sod Nursery.*—In order to replace turf on a putting green in the shortest possible time it is necessary to sod. This means that the club must grow its own sod unless good sod can be purchased at a fair price.

The sod nursery itself requires the same care and attention as a putting green. The soil bed of a sod nursery should be prepared with as much care as the soil bed of a putting green. Drainage must be satisfactorily provided. Of still greater importance is the provision of a soil structure suitable for putting green turf, since the soil clinging to the roots of the sod must eventually be transferred to the putting green. The sod must be adequately watered, cut, top-dressed, weeded, and fertilized. Care should be used also to keep the sod as pure as possible, as sometimes the sod must remain in the nursery for years before it is required for use, and during this time it is subject to invasion by undesirable kinds or strains of grasses. The expense of maintaining a sod nursery is therefore an item that must receive consideration.

Figures collected from a number of golf clubs which have planted and maintained large areas of creeping bent sod indicate that it costs from \$400 to \$500 an acre to prepare and plant a sod nursery and maintain it for one year. These figures cover cost of top-dressing material, watering, fertilizing, weeding, mowing, and applying top-dressing, but do not cover cost of the stolons required to plant the nursery.

Once the sod is established, the cost of maintaining it in turf, although considerable, is not nearly as much as the cost of maintaining an equal area of turf on a putting green. The sod should nevertheless be kept free from weeds and should be kept cut close to prevent the turf's becoming coarse; it need not, however, be cut as frequently as a putting green, nor top-dressed as frequently. On a putting green a true putting surface is required, which in turn calls for more labor. Figures obtained indicate that it costs from \$200 to \$300 a year to maintain an acre of creeping bent sod. The cost of maintaining velvet bent sod or sod produced from seed would not be as great, since there would be less need for top-dressing.

*Lifting and Laying Sod.*—When sod is to be moved from small areas it is usually necessary to cut the sod with hand tools. With areas of 1,000 square feet or more it is more economical to use a sod cutter, which may be drawn by a tractor, horse, or man. Figures collected from a number of golf clubs that have recently done sodding and kept accurate cost accounts, indicate that the average cost of cutting 1,000 square feet of sod with a sod cutter, lifting it, and setting it nearby is \$7.70. If it is likely that the sod, after being cut, must remain as much as several days before being relaid, it is advisable not to pile one sod upon another but to spread each sod out, grass exposed, in some shady place. Sod thus handled will often keep for several weeks if it is watered from time to time. There is little difference in the expense involved in either spreading sod out or piling it up. Cost figures obtained at the Arlington turf garden in cutting, lifting, moving, and relaying 2,000 square feet of sod, very closely approximate the average obtained from data collected from golf clubs.

Sod may be laid comparatively cheaply on fairways and even on tees, as in such cases there is no need for a putting surface. Sod may

also be laid at little expense on putting greens provided there is no necessity for getting the green into play in a short time. When, however, great care is required in relaying sod, the cost amounts to about \$14 for 1,000 square feet, or nearly double the cost of lifting sod. When a green must present a fair putting surface and be ready for play within a week or so after it is sodded, a soil bed must first be prepared that will not settle to any extent, and when being laid each piece of sod must receive individual attention, corners must be packed or soil removed here and there and, in fact, the whole area must be made as level as possible to the eye before anything but a light tamper has been put on it. When sods are laid carelessly and made level by pounding and force, the results are only temporary; the whole sodded area must instead be laid with care, so that the sods lie level naturally; for then, when top-dressed, wet down, and rolled, the chances are good that there will be no heaving or readjustment of the sods to bring raised places and hollows into evidence.

Sod will become established and grow much more quickly and vigorously if fertilizer is applied to the soil bed before the sod is laid. If the soil requires lime, this should be worked in, ground limestone being preferable to burnt lime in such a case. A good complete fertilizer should then be applied and raked into the soil just previous to sodding. At this time it is more important to supply phosphorus and potash than it is to supply nitrogen, since the nitrogen can easily be applied in a soluble state after the turf is laid, but not so the less soluble elements phosphorus and potash.

*Relative Costs of Planting Seed and Stolons.*—There is no difference in the cost of preparing the soil bed for either seed or stolons, but there is a difference in cost arising from the higher cost of stolons over seed and the added top-dressing material and labor required. If seed is used, the seed is raked into the germinating layer, rolled, and watered. If stolons are used, the chopped stolons must be carefully distributed and must then be covered with top soil at the rate of 1 yard to 1,000 square feet, and then rolled and watered. The first growth from the stolons must later be clipped and allowed to remain on the green. The area is then again top-dressed at the rate of 1 yard to 1,000 square feet. Everything considered, the cost of material and labor necessary to seed a green, apart from the cost of watering until a stand is obtained, is about \$7 for 1,000 square feet, as against about \$30 for 1,000 square feet required to plant stolons. The cost of sowing seed can be controlled to an insignificant extent by the cost of the seed; while the cost of planting stolons may be reduced as much as \$5 or \$6 for 1,000 square feet depending on the cost of the necessary top-dressing material. An additional saving can be effected in planting stolons if the stock is home-grown. The cost of raising stolons in nurseries varies widely, due to the type of soil, freedom from weeds, and fertilizer and water requirements. In any event a saving can be effected by a club in growing its own stolons, should it wish to prepare beforehand for the time when stolons will be required for replanting purposes.

Ten square feet of stolons, costing, say, \$1.50, will plant 1,100 or more running feet of nursery row. These nursery rows can, with a little care, be made to spread to a width of 4 feet in one year. Eleven hundred feet of rows 4 feet wide will plant an acre in bent sod. The cost of purchasing this quantity of stolons (approximately 4,400 square feet), including freight, might vary from \$600 to \$1,000.

**Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information upon it.**

**Dr. Samuel Johnson.**