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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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EDITORIAL

Purchasing for a Green Committee

It may be not inaccurate to say that roughly one-third to one-half of a golf club's revenue is expended on maintenance. Someone must purchase the labor and material. Shall it be the greenkeeper or the chairman of the greens?

Common sense would seem to indicate that the chairman of the greens should at least have his hand on all purchases. He ought to know or take the pains to inform himself as to the quality and prices of materials and the amount required for use.

The greenkeeper may be ever so honest and competent and his judgment may be entitled to the greatest respect, but the money to be spent belongs to the club, and it is the duty of the committee to see that it is honestly and effectively spent.

There are dealers in materials of all sorts who will get business, if they can, by bribery, either by payment of commissions or by favors, cigars, loans, or what not.

The Federal Trade Commission has felt obliged to condemn vigorously such practices in many cases. An honest greenkeeper would not think of accepting a commission or a favor and would instantly inform his chairman if one was offered. A greenkeeper who accepted a commission without the full knowledge and consent of his committee would expect to be discharged if his offense were discovered.

It is the positive duty of a green committee to know as much as possible about the business it has charge of; and why should not the chairman, or some one on the committee, see that purchases are properly made?

Any good purchasing agent gets samples and prices because he knows there will be a new purchasing agent on the job if he does not get a dollar's worth for every dollar. He sees to it that the prejudices, whims, and personal interests of those who use or work with the materials he buys do not lead him to pay high prices or to secure poor quality.

A green committee should handle its purchases for its club exactly as a member handles the purchases in his business.

The dealer who is directly or surreptitiously dishonest soon finds out that the committee is applying sound business methods, and either looks for some easier victim or gets down to brass tacks. Only by keeping in touch with purchases can a committee know what is going on.

If fertilizer or seed is to be bought there should be definite information as to kind and quality; besides, the quantity should be figured with accuracy, based on so many acres or square yards to be treated and a fixed quantity to the acre or yard. Why buy a lot of stuff and have it left over to deteriorate? And why buy less than enough? If you want seed, you can get it either full of weeds and chaff, or clean; and you can get it with or without "bunk." Get samples and prices. Submit the samples to expert tests as to identity and germination. The honest seedsman who expects to stay in the business and hopes to sell the same customer twice will be glad to have his seed so tested.

Every committee should know and take into consideration the treatment given the course in previous years, and a definite policy should be

carried out, which, of course, is impossible if control of purchases is not maintained.

Equipment such as mowers must be renewed from year to year, and should be purchased only after careful study. It goes without saying that the type and make should not be changed every year to meet mere whims and fancies.

In employing labor the same principles apply. A fair rate should be paid, but loafers or lazy favorites should not be tolerated. It is only by close personal contact with purchases that green committees can see that materials are of good quality and get a dollar's worth for a dollar.

The labor expense incident to proper maintenance is the largest item and must be given careful attention, but it is believed that economy is not always to be realized by putting workmen on a common labor basis. If the work is properly arranged so that employment can be given to trained men during a large part of the year, it is obvious that these men, because of their training and experience, should not be classed as common unskilled labor, and it would seem that they should be entitled to from ten to twenty per cent. more than common labor in the vicinity. Manufacturers can figure the cost of training or "breaking in" employees to do a particular job; so it would seem that a man who has been trained is worth more to a green committee than a common laborer.

The buying is not all. The materials should be weighed, counted, or checked on receipt.

True, a business man who happens to be on a green committee cannot look after all the details himself, but he should see to it that this is honestly and properly done by some one; and if it is known that such a man is on the job and giving the supervision he should, a wholesome restraint will be felt by those who might be dishonest. Business is business, whether conducted for money or pleasure, and it becomes foolishness when neglected.

Ammonium Sulphate

C. V. Piper and R. A. Oakley

A recent article in the daily press regarding the effects of ammonium sulphate on turf grasses as determined by experiments continued through twenty years at the Rhode Island Experiment Station has created much interest. The article referred to was brief, and emphasized particularly the effect of ammonium sulphate in banishing weeds. Broadly speaking, the article was not inaccurate; but for better understanding there are certain details that need clarification.

The Rhode Island experiments are noteworthy and rich in significance to golf courses—certainly for the New England states, and probably for all the northern tier of states except in the semi-arid region. Detailed accounts of the way in which they were conducted and the results secured have been published from time to time, but particularly in the bulletins and reports of the Rhode Island Experiment Station.

The soil at Kingston, Rhode Island, is a well-drained loam of good texture but "acid" or "sour"—that is, it turns blue litmus paper red. The natural grass growing in the old pastures in the vicinity is mainly

Rhode Island bent, which in fact is the dominant grass on well-drained soils in New England and in parts of New York. In places, however, practically pure stands of fescue may be found. Both of those grasses thrive well in acid soils.

The experimental turf plots consisted of 19 plots divided into three nearly equal series. One plot of each series was seeded to the same grass or grass mixture, namely, bluegrass, redtop, Rhode Island bent, red fescue, and seven grass seed mixtures; so there was one plot of each grass in every series. One series was treated with an acid fertilizer—namely, ammonium sulphate, acid phosphate, and muriate of potash; the second with a neutral fertilizer—consisting of nitrate of soda, acid phosphate, ground bone, and muriate of potash; the third with an alkaline fertilizer—containing nitrate of soda, Thomas slag phosphate, and muriate of potash. No lime was used. The fertilizers were applied so as to furnish equal amounts of plant food. A formula for the acid fertilizer is 250 pounds sulphate of ammonia, 400 pounds acid phosphate, and 250 pounds muriate of potash per acre; or about two pounds of the mixture for each 100 square feet.

After some years the most striking result was that all of the alkaline fertilizer plots were very weedy; the neutral fertilizer plots were much better; but the acid fertilizer plots were practically free of weeds, including crab grass. None of the grasses on the most acid plots succeeded well except the bents and the fescues; these remained pure in the acid fertilizer plots but were very weedy in those treated with alkaline chemicals. Bluegrass tended to persist on the alkaline plots. Rhode Island bent invaded and captured all the acid plots that had been seeded to other grasses, and on such plots treated with acid fertilizer the turf became equal to that on plots where the bent was originally sown. The fescues spread but little into adjacent plots, perhaps because there was little fescue near the plots to produce seed.

Two conclusions are especially clear from the Rhode Island experiments: first, the bents (Rhode Island, and creeping or carpet) and red fescue are by far the best turf grasses for the conditions; and second, alkaline fertilizers bring about the invasion of numerous weeds in the turf of all these grasses. On the plots treated with acid fertilizers there was a gradual increase in the acidity of the soil, and there can be little doubt that this secures a weedless lawn of the grasses mentioned.

In 1916 the acid fertilizer plots were very acid, the calcium oxide requirement being 6200 pounds per acre foot; the alkaline fertilizer plots were much less acid, with a lime requirement of 3800 pounds per acre foot.

There is good reason to believe that similar results can be secured on all northern soils that are naturally acid. Where soils are neutral or alkaline in reaction it is apparently not easy to change them to an acid condition by any method yet known; at least efforts in this direction at Arlington Farm, Virginia, have thus far not proved successful. Frequent applications of ammonium sulphate was one of the methods tried at Arlington. The experiments are being continued, as all the evidence points to the desirability of an acid condition of putting greens to grow bent or fescue turf of the best quality. One of the new methods being tried is to mix relatively large quantities of ammonium sulphate in the soil before sowing the grass. Theoretically at least this should give results much sooner than the necessarily small surface applications to the turf.

Ammonium sulphate may be used in place of sodium nitrate in fertilizing putting greens, but the same care is necessary in its use, as am-

monium sulphate will burn grass quite as readily as does sodium nitrate. It is recommended that it be used at the maximum rate of five pounds to each 1000 square feet. It may be applied by pulverizing thoroughly and mixing with ten times its bulk of sand. After scattering the material, the green should be watered thoroughly. Or the ammonium sulphate may be dissolved at the rate of one pound to ten gallons of water and sprinkled on the green, but this should be succeeded by a thorough watering afterwards. Such applications can be made at frequent intervals, if desired.

Ammonium sulphate has long been used in England to a much greater extent than in this country. Many English writers have commented on its tendency to make soils acid, and various English authorities claim that its continued use will eradicate white clover. It is noteworthy that there was practically no white clover on the acid plots at Rhode Island, while it promptly invaded those treated with alkaline fertilizers. Experiments at Arlington indicate clearly that eradication of white clover in a neutral soil is not to be secured in a single season by numerous surface applications of ammonium sulphate, but it is very likely that in time such a result will ensue.

The one conclusion that stands out most prominently from the Rhode Island experiments is to avoid the use of lime or any other alkaline fertilizer for bents or fescues, as this tends to encourage the invasion of undesirable plants. Both bent and fescue can be grown on soils heavily limed and make good turf. Such greens composed of bent are illustrated by the Taylor greens at Sunnybrook and at Columbia, and by the beautiful fescue fairways and greens at the Links. But there are numerous examples on various courses of equally good greens on which lime has never been used. There is actually no good evidence pointing to the use of lime having improved the turf of bents or fescues. The weed factor alone is an excellent reason to avoid using lime, at least for these grasses.

Green-Building in Midwinter at Washington, D. C.

DR. WALTER S. HARBAN

The building of a putting green in the midwinter in this latitude stands as a novel achievement. The long, mild dry spell of weather in February prompted the green committee of the Columbia Country Club to make the attempt, and accordingly on Monday, February 14, grading was started, and by the following Saturday the last piece of sod was put in place. The entire work was conducted under most favorable weather conditions and the results promise to be eminently successful. It may be of interest to describe the methods employed in the construction of this green as well as many others heretofore built on the course that have proved to be satisfactory and more or less economical.

GRADING

When much grading is to be done, as was the case in this instance, an ample compact force is desirable. In the grading of this green we use one plow-team, four-wheel scoops, and two snap-teams—in all, seven

teams, or fourteen horses, manned by twelve men under one foreman. In two days' time the rough grading was completed and this force was laid off. The wheel-scoops, especially where the earth has to be brought some distance, are most expeditious in handling the work. When fully loaded by the assistance of the snap-teams, one-half a yard of earth is put in place with each load; and besides the trampling of the horses and the wheels of the scoops constantly passing over the new dump, pack the soil more thoroughly than any other means. The rough-finishing work was accomplished with one team and two men. First the grades and undulations were established by means of a drag-scoop, a spike-tooth harrow, and a wooden drag. The entire surface was then deeply worked up by means of a 7-tooth garden expansion cultivator drawn by one horse, worked many ways across the green. This work required one and one-half days and the green was then ready for top soil and fertilizer. It will be noted that no cinders, stone, or tile were put under the green. Occasionally, when hill-seepage may require it, we use tile set two feet deep all around that part of the green, giving a free outlet, but we never separate the upper soil from the lower by the introduction of a foreign layer.

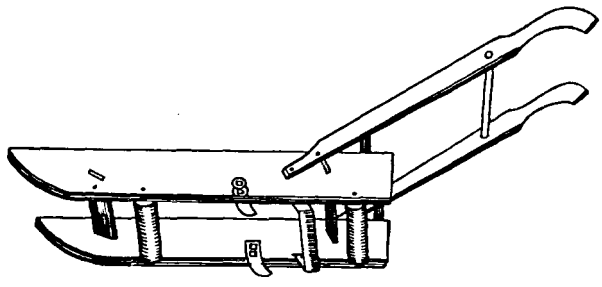


Fig. 1

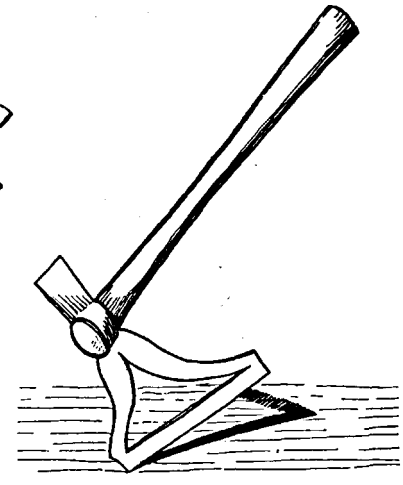


Fig. 2

Our natural soil is a fine quality of reddish clay, and when well broken up with sand and manure forms as desirable a soil for a green as can be imagined, possessing both the quality to let the water into the ground and capacity of holding moisture, as well as the humus introduced to sustain the turf for many years.

Ten dump-wagon loads of sharp sand and a like amount of well pulverized mushroom soil were now spread on the surface. By means of the cultivator and harrow the manure and sand was well incorporated in the soil. After repeated harrowings, draggings and rollings, the surface was raked carefully to make it smooth, and rolled and raked until true and firm. Before applying the sod, a dressing composed of two parts of sand and one of coal soot was spread lightly over the finished surface, and 400 pounds of bone meal were sown broadcast. After a final gentle raking the green was ready for the sod.

Lifting the Sod

As the turf to be lifted was on a nearly flat surface, the horse sod-cutter (Fig. 1) was used. The blade was set to cut 12 inches wide and 2 inches deep. It was drawn by means of a horse attached to a long rope, so that the sod was lifted in ribbons the entire length of the green without trampling or injury. By means of an implement made for this purpose, the ribbons were chopped into one-foot lengths for easy handling (Fig. 2). The sod, being cut regularly at 2 inches in thickness, was uniform and did not require trimming.

Laying the Sod.

Care should be taken not to disturb the smooth surface of the new green. Therefore a line of boards should be laid for the wheelbarrows, as well as for the men to walk upon. A rope or cord is stretched across the green, in order that the first strip of sods may be laid straight, the two straight sides of sod cut by the machine should be parallel to the rope. If the sod has been cut carefully the squares should be the same width and lie in even strips. The chopped end will necessarily be on the bevel, and care should be taken that the sods are laid as they are lifted and carefully lapped so as not to leave any exposed surfaces. Work in straight lines all the way across the green. Two or more men can work on the same walk. Each man can conveniently lay two or more rows. The sods should be laid without special care; that is, no attempt should be made to have them close together. Spaces of from one-eighth to one-quarter of an inch will be found ideal, as they leave room for the sod to spread under packing and rolling without danger of buckling later. Should any narrow gaps remain, they will be filled by the final dressing. Ten men lifted, handled, and laid in one day the sod for this green, which is 85 by 100 feet. It can literally be said that "the next day it snowed," as the following morning six inches of snow covered the ground, and it remained for one week, much to the satisfaction and delight of the committee.

Two weeks later, when the soil was sufficiently dry to permit of rolling, the turves were pressed down to a true surface by means of a heavy roller, 34 inches in length and weighing 1400 pounds, drawn slowly by man-power so as not to push or disturb the turves, as the new roots had already grown to a depth of one inch or more. A heavy dressing composed of one part of mushroom soil, one of sand, and one of coal soot was then spread upon the surface and after several hours, when thoroughly dried by the wind and sun, was dragged in all directions with a brush made of three ordinary hickory stable-brooms spliced together, two broom handles set into them like shafts. This implement will be found useful and more efficacious than the ordinary birch brush in spreading all dressing. By March 11 the grass on this green had grown to such length that it had to be cut to preserve the texture; it was then rolled with a large sectional roller weighing less than 500 pounds.

Care should be taken not to roll turf when the ground is wet, and this is especially true in spring and summer. After a green has been trued by heavy rolling once or twice in early spring, a light wooden roller is all that is needed thereafter. A newly turfed green should be dressed or brushed several times and never allowed to become completely dry in summer or before the roots have penetrated deeply.

A green built and finished as above applies only where the turf is to be laid. When it is to be seeded or vegetatively planted an entirely different seed surface should be laid—which, however, is another story.

Cost

The cost amounted to $424.75. The rough grading alone cost $265.00, or nearly two-thirds of the entire expense.

Rough-grading (2 days)	$265.00
Mushroom soil	37.50
Sand	11.25
Bone meal	15.00
Labor, including use of our own team	96.00
	$424.75

Rolling the Turf

C. V. Piper and R. A. Oakley

Ten years ago rolling was used on most golf courses to excess. Perhaps in consequence of bad results that ensued on some courses, the tendency in recent years has been not to use the roller enough. Every northern golf course requires a good rolling early in the spring as soon as the ground is fairly dry and the grass has begun to grow. This is to compact the surface soil, which has become very loose as a result of freezing and thawing, as well as to smooth out the unevenness. The loosening or heaving effect of freezing and thawing is much more pronounced on clayey soils than on sandy soils.

Generally speaking, excess of rolling is practically impossible on sandy or sandy loam soils, provided the rolling be done when the ground is not actually wet. On clay soils and even on clay loams it is possible to compact the soils too much for the best growth of grasses. Particularly is this liable to be the case if the roller is used when the ground is wet.

A safe rule to follow is, never use a roller when the ground is wet. This does not mean use it when the ground is dry. The best time is when the soil is just slightly moist.

Where the fairways are well turfed, damage from rolling, even on clay soils, is rare. It can occur if a heavy roller be used when the ground is wet; but it is doubtful if it ever occurs on sandy soils.

On putting greens nice judgment is necessary, depending on the soil texture, on the degree of moistness, and on the density of the turf. A heavy rolling in spring is nearly always necessary. Thereafter rather frequent light rollings are better than occasional heavy rollings.

South German Mixed Bent Seed Described

By F. H. HILLMAN, Assistant Botanist, Seed Laboratory, U. S. Dept. of Agriculture

The importance to the golf course of the proper seed and the uncertainties and disappointments experienced in its purchase, justify a description of the seed which has been most sought and, as an available article, is the most desirable seed now obtainable. This is the imported seed which now bears the name "South German mixed bent" and which for many years prior to the world war was handled by the trade under the names "Agrostis stolonifera," "Creeping bent," "German bent" and various combinations of these names. "Creeping bent" and "German creeping bent" appear to be the names in common use at the present time.

As the name implies, this seed is imported from Europe, sometimes from Germany, but more frequently from Holland, Belgium or England. The origin of the seed, however, is southern Germany.

The uncertainty and disappointment connected with the purchase and use of this seed have resulted chiefly from the use of redtop as an adulterant of, or a substitute for, the bent seed. This has been possible in the past because of the difficulty and improbability of detection. Studies upon this group of seeds within recent years have made it possible to distinguish the several kinds of seeds involved and thus prevent the sowing of undesirable seed.

The nature of the South German mixed bent seed may best be understood by considering the several kinds of seed which constitute the fine bent seed from different sources.

The name "bent" is applied to the different species and varieties of species of the genus Agrostis of the family of grasses. Of the twenty-five or more species of Agrostis known to prevail in this country, but three of them are commonly of interest in connection with turf making, while another kind from Europe is coming to be recognized as having an important bearing on the question of the most desirable golf turf. Of the four kinds referred to, one is the common agricultural redtop (*Agrostis alba*) sometimes called "white bent." Another is the Rhode Island bent of New England (*Agrostis tenuis*) often referred to as *Agrostis vulgaris.* Another is velvet bent (*Agrostis canina*), and the fourth a species having pronounced creeping habit, is now called carpet bent. Its proper technical name is at present undecided. While this grass is closely allied to, if not identical with *Agrostis stolonifera,* the very limited occurrence of its seed in commercial bent seed does not justify the application of this name to the German bent seed.

In addition to understanding the kinds of Agrostis seeds connected with the bent seeds handled commercially, it is important to know their commercial sources. Redtop seed is produced chiefly in southern Illinois, which is the source of the American commercial seed even though it may have been returned to this country in commercial quantity from Europe. Rhode Island bent is produced chiefly in Rhode Island. Seed of the same grass is produced commercially in New Zealand where it is called "colonial bent" and "brown bent." Again it is produced in south-

ern Germany and comes to us in the German bent seed, but we have no English name in common use referring to this seed as coming from Germany. Velvet bent seed comes only from Germany and only as an ingredient of mixed seed, never as a single kind, as redtop and seed of other grasses. The occurrence of this grass in this country is confined to places where the imported bent seed has been sown or their vicinity. Carpet bent is known only where German bent seed has been used. Its seed is not available commercially as an individual kind.

South German mixed bent seed is likely to contain as ingredients each of the kinds named above. Redtop seed varies in quantity from a mere trace to five or ten per cent. of the actual seed of the bulk. Its presence to this extent is merely incidental to its growth with the other bents and thus is unavoidable. Seed of *Agrostis tenuis* (identical with Rhode Island bent) is the most abundant ingredient of the South German mixed bent seed and generally constitutes three-fourths or more of the actual seed. The other ingredient appearing in quantity is the velvet bent. In some lots this amounts to 40 to 50 per cent. of the total seed. Fifteen to thirty per cent. is the usual proportion, but some lots appear to contain not more than 5 to 10 per cent. Since velvet bent is, to some extent, a creeping plant, the presence of this seed appears to be the chief excuse for the commercial use of the name "creeping bent" as applied to the South German mixed bent seed. Seed of carpet bent is known to be present in at least some lots of the German bent, but it is not certain that it occurs in all lots. Its seed can be distinguished from that of the other bents referred to, but only by careful, expert examination. Owing to its very small quantity and relative unimportance in consequence, search for its presence in the usual sample of the German bent seed is not made.

Stated briefly, the important characteristics of the South German mixed bent seed are the small proportion of redtop, the large proportion of seed identical with Rhode Island bent, the usually large proportion of velvet bent which comes only in the South German mixture, and the possible presence of seed of carpet bent. This mixture may be contrasted with the Rhode Island bent of the trade which consists of the Rhode Island bent and a variable proportion of redtop; and with the New Zealand colonial bent of the trade which consists of *Agrostis tenuis* only thus differing from the commercial Rhode Island bent only in the absence of the redtop.

The important thing to consider in the purchase of fine bent seed is to avoid adulteration by the use of redtop seed. Some lots sold as fine bent have been found to consist largely of redtop, while other lots have consisted wholly of this seed.

Owing to the minute size of fine bent seed, thorough cleaning of the seed is not done as a rule and in consequence it is very chaffy. The only exception to this we have observed has been in some of the South German mixed bent seed shipped from England, where most of the chaff had been removed.

Important significance is to be attached to the character of the chaff of the fine bent seed. Seed that is well matured readily falls away from the chaff, which, in turn, separates into individual scales which constitutes the bulk of what is termed "chaff" in this seed (see fig. 4, c). On the other hand, poorly developed seed does not fall apart and the chaff has the appearance shown in fig. 4, a and b. Seed covered by the chaff in this way is practically worthless. It may be said that very little of this condition prevails in the South German mixed bent seed.

Many kinds of weed and other grass seeds are found in seed of the fine bents from all sources, but none is sufficiently serious to command attention. They are very helpful to the seed analyst, however, in determining the source of the seed.

Enlarged illustrations of the three important kinds of bent seed are presented for comparison. It will be seen that seeds of redtop are slightly larger than those of either of the other kinds. Some of the seeds of Rhode

Redtop (Agrostis alba) Rhode Island bent (Agrostis tenuis) Velvet bent (Agrostis canina) Chaff of bent grass

a and b, side and edge views of poorly developed chaffy seed. **c,** the chaffy scales separating, as in well developed seed.

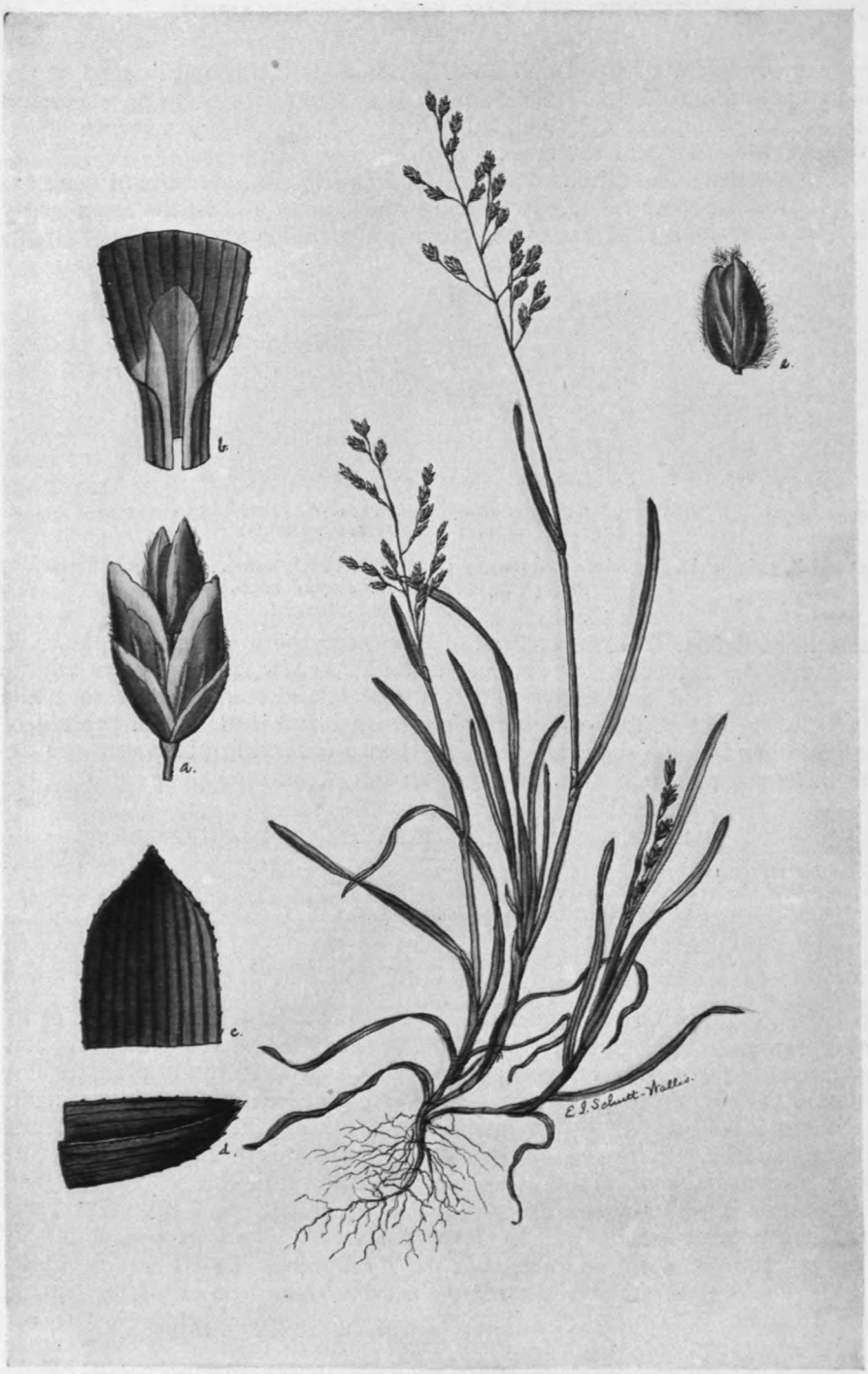
Island bent bear an awn, or bristle, from near the broad end of the seed. Many of the velvet bent seeds bear a similar bristle from near the middle of the seed. Seeds of redtop and of Rhode Island bent are smooth, while those of velvet bent are minutely roughened and dull. With the aid of a good hand lens (not a reading glass) any observing purchaser can determine the presence of a large proportion of redtop.

Annual Bluegrass *(Poa annua)*

C. V. Piper and R. A. Oakley

In early spring perhaps no other grass is as much the subject of inquiry as the subject of this sketch. At this time of the year it is conspicuous in lawns and on putting greens as well as in shady places where most other grasses do not thrive. On putting greens it commonly appears in autumn, and indeed in the latitude of Washington, D. C., often blooms before winter. In the early spring it grows rapidly and blooms before any other turf grass. When once established it volunteers year after year, increasing in abundance. In spring it is often the most abundant grass in some putting greens and in shady lawns. It vanishes completely by mid-summer, at least as far north as Washington, D. C., but in Philadelphia and northward some plants may be found at any time during the summer.

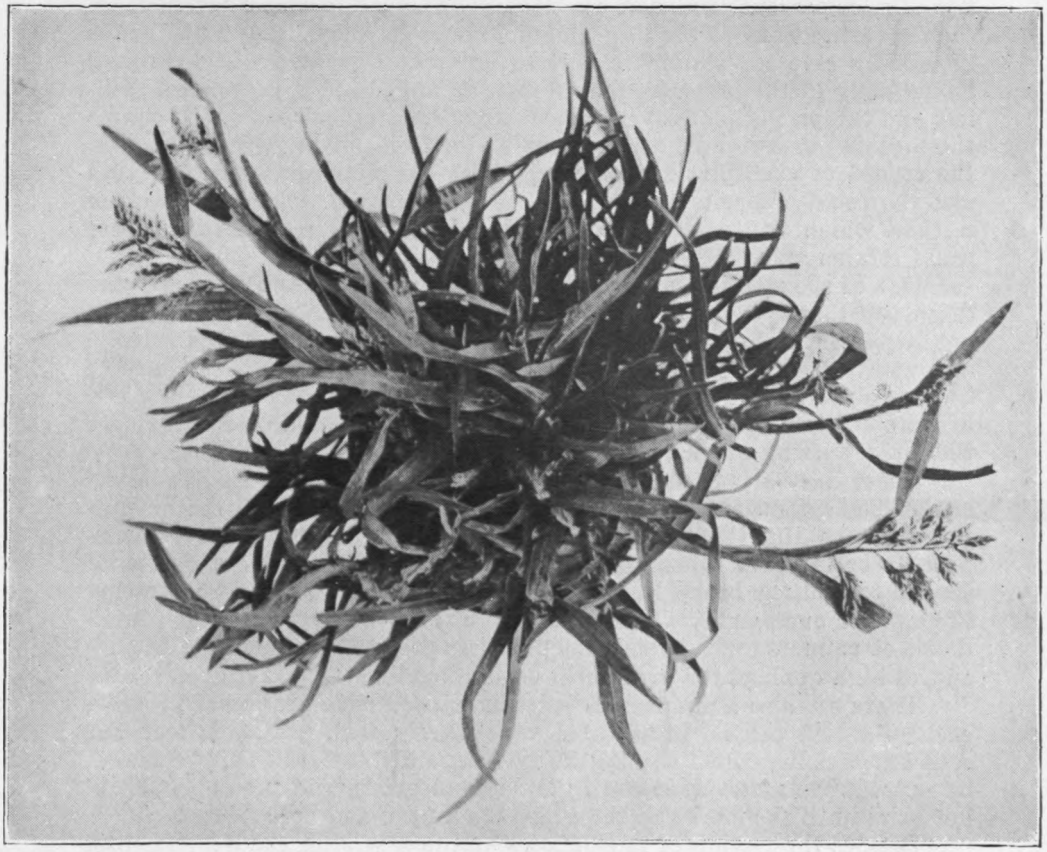
Poa annua, the scientific name being quite as familiar as its common name, is easily distinguishable by its small tufts, fibrous roots, bright green not at all bluish color, soft texture, and the cross crumpling of the leaves near the base. The grass is native to Europe, but it now occurs practically everywhere in the United States.



Annual Bluegrass (Poa annua Linnaeus)

Plant in bloom, natural size: *a*, spikelet with four florets, enlarged; *e*, a single floret, enlarged; *c*, *d*, the boat shaped tip of the leaf, enlarged; *b*, the ligule, where the blade and sheath join enlarged.

As a putting grass *Poa annua* is not without merit, at least in some latitudes. When abundant enough to make a solid turf, its putting quality is most excellent but a little slow. If only scattered plants occur in the turf, it is sometimes objectionable, as it may make the putting surface uneven. No matter how closely the grass is cut it will still blossom and make seeds at the very surface of the ground. As the grass nears maturity it gradually becomes paler, partly due to the abundant flowers, and is then not so attractive.



A young plant of Annual Bluegrass just as it begins to bloom in Spring

On the whole the grass is to be considered desirable rather than a weed. Certainly it would be very expensive to keep it out of greens altogether, and surely its demerits if any are not sufficient to justify the attempt.

Seed of annual bluegrass has occasionally been obtainable in the trade, but usually containing much other grass seed harvested with it.

Turf Experiment Plots at Golf Courses

C. V. Piper and R. A. Oakley

There is still a boundless field for investigations to select the best strains of turf grasses and to determine the most satisfactory way to grow them in nearly every part of the United States. At the present time such investigations are being made at only two or three places, most notably those at Arlington Farm, Virginia. It must be evident that the work at only a few places cannot solve the problems for the whole country. Under present conditions the most promising opportunity to increase such investigations to the desirable degree is for every golf club that is financially able to establish a turf experimental garden. At Arlington Farm many of the plots are 8 by 8 feet, arranged in checker-board fashion, and this size of plot is very satisfactory for most purposes. Of course these plots must receive all the care given to a putting green; besides, the record of each plot must be kept with complete notes on each, and also the relative merits of each need to be compared. There is no other method which will so surely advance knowledge in regard to the best grass strains and the best methods.

One of the striking advances made by the work at Arlington was the discovery that creeping bent consists of many strains of very different qualities. Several of the best of these have been propagated vegetatively, and with this material putting greens of an absolutely pure strain have been established. It can be said without exaggeration that the 9th green at Potomac and the 9th at Columbia, both planted in this manner, are the finest putting greens, so far as turf is concerned, in existence.

There are various other grasses in which similar results can be accomplished. Thus in the South, Bermuda grass is the usual one on putting greens. But there are numerous strains of Bermuda, some incomparably better than others. It is well worth while to test out dozens of strains to find the best. Bermuda grass is easily multiplied by planting in rows for one season, when the resultant crop will give a great abunddance of runners and "roots" for planting greens. If the strain is pure and of high quality, the green will be so likewise.

There are also a number of little known southern grasses of promise, each of which can be propagated vegetatively with ease. To wait for seed supplies may involve long delay—certainly the seed supply cannot be expected to materialize until the demand exists, and the demand will not exist until the merits of the grass are known and appreciated.

Besides the testing of new grasses and new strains, the experimental plots can be made to answer all sorts of questions regarding soils and fertilizers. In short, it furnishes a means to find the best methods for any particular locality, but likewise applicable to places with similar climate and soils.

While putting-green grasses only have been considered above, the same experimental methods apply to grasses for the fairway or the rough.

The knowledge thus gained is real knowledge and will tend to do away with the foolish practice of testing on a large scale every new grass or new fertilizer that some enthusiast or some interested party suggests. In short, it is using horse sense in connection with grass problems. The necessary work is not inexpensive but is well within the means of the more prosperous and enterprising golf clubs.

The Green Committee is anxious that as many clubs as are able to undertake this kind of investigation engage in the work. It will be glad to give detailed plans to follow and will secure all the necessary grasses or seeds. Beyond this there is full opportunity to test out, if desired, all the ideas that club members are sure to suggest. In this way, the fellow who believes that lime will cure all grass ills, as well as the one who thinks that orchard grass will make good putting greens, can be satisfied and no harm done to the course. But, much more important, some things that will greatly improve the turf on each course will pretty surely be discovered. Please consider this matter prayerfully and realize that your club can, by this means, help itself as well as the other clubs, nearly every one of which will be able to contribute something new of value to you. Let us all get after these puzzling grass problems on an adequate basis and cut out the foolish and wasteful practices that still prevail.

The Use and Abuse of Lime

C. V. Piper and R. A. Oakley

There is still room for difference in opinion regarding the desirability of using lime on golf courses, but the weight of the present evidence is that, as good or better results are secured without lime as by its use, certainly so in the case of bents and fescues and probably so in the case of most other turf grasses.

The vast amount of agricultural literature dealing with the use of lime, and some enticing rhetorical statements such as "lime sweetens the soil," have conspired to lead many people to believe that lime is a corrective for all the ills of soil and of turf. It is this belief that leads many misguided victims to scatter lime on their half bare lawns every spring with the simple faith that this will in some way insure a dense cover of green velvet sward. Year after year they do the same thing, with exactly the same results as if they had not used the lime—a course lawn of crab grass in summer and a cover of ghastly gray-brown dead turf in winter. But their faith never seems to weaken; and indeed against such faith no reason can prevail.

The facts regarding the effects of lime on soils and crops are fairly well ascertained, but there is less agreement on the theoretical explanations of the facts. There are four very definite effects of lime:

1. Lime tends to improve the texture of clay soils by making them more crumbly. This can easily be demonstrated with small samples of soil; but it must not be forgotten that an application of one ton of lime per acre is only two-fifths of an ounce to a square foot. Of course a spoonful of lime does not go far in changing the texture of a cubic foot of soil.

2. Lime, being alkaline, tends to make the soil likewise. If the soil has an acid reaction, a sufficient amount of lime will make it neutral, while more will make it alkaline. The amount of lime needed to make one acre of soil neutral is called its *lime requirement*. The lime requirement of some soils is as much as 10 tons per acre.

3. Lime has a very pronounced effect in stimulating the growth of alfalfa and clover. Indeed, on many soils these plants can not be successfully grown without the use of lime. To a less degree this is true of other crop plants. The effect is probably due both to the lime itself as plant food and to the changed reaction of the soil.

4. Lime increases the nitrification of organic matter in the soil, and thus indirectly supplies more nitrogen to crop plants. Continued use of lime will soon exhaust the humus unless this is replaced; or in the words of the farmer, "the soil is burned out."

Let us consider these four effects in reference to golf courses.

While lime changes somewhat the texture of soil, this can be done more effectively and often more cheaply by other means, as mixing sand and humus in clay soils, clay and humus in sandy soils, etc.

Sweetening the soil or changing it from a sour condition sounds very alluring; but the best turf grasses thrive in sour soils, while many of the worst turf weeds do not. Sour soils are not necessarily ill drained. Good drainage is always desirable. Clovers, plantain, buckhorn, and other undesirable turf weeds seem to increase where lime is used.

Lime indirectly furnishes nitrogen from humus. Yes. But the humus is desirable to keep the soil springy, and it is much better to use nitrogenous fertilizers than to burn up your humus to get the nitrogen indirectly. The farmer, in his rotations, plows under vegetable matter each year; but this is practically out of the question under permanent turf.

It should be apparent from the above that the matter of growing good turf is quite different from the farmer's rotation of crops. It does not follow that because lime is desirable on a farm it should be good on a golf course.

There are many examples on golf courses where lime has been used freely and good turf even of bents and fescues secured both on the fairways and on the putting greens. But there are numerous courses that have never used lime on which as good or better turf has been secured. More than one golf course that has given up the use of lime has never found any reason to regret the change.

Bluegrass is one of the grasses that is commonly believed to be a lime-lover, mainly because of the wonderful bluegrass that is so characteristic of calcareous soils. But calcareous soils are notoriously rich soils, and it is at least equally probable that the fine bluegrass turf is due to the high quality of the soil and not to the lime specifically. At any rate bluegrass sward of high quality can be found on many soils very poor in lime, especially if they are rich soils.

To secure further evidence on the subject it would be well if many golf clubs would test the matter both on putting greens and fairways. On one selected putting green treat one-half of the green each year with lime, using burned lime at the rate of five pounds to each 100 square feet or ground limestone at double this rate. In the same way treat a 50-foot cross section of a fairway in the same manner. Of course, all other treatments need to be the same both for the limed and unlimed portions. At the end of three years it should be possible to determine clearly whether the lime has resulted in improvement or otherwise. It is worth while for every club to test out this matter, but until the evidence shows clearly in favor of lime, it is best both on the grounds of economy and doubts as to beneficial results, not to use it generally.

One desirable use of lime on a golf course is in composting peat. Peats are often very toxic. Composting with about 10 per cent. of lime for several months usually brings about a desirable form of humus material. When a box of such material will grow good grass seedlings it is ready to use, but not before. Never use peat or muck unless you determine first that it will grow good grass as tested in a box sample. Forest leaf-mold is practically always desirable.

Correction—Through an unfortunate error there is published a misleading statement in Dr. Harban's article on "Winter Work on the Golf Course" printed in the preceding issue. In line 12 the author is made to state that the club was "led to the permanent employment of a dozen or more of the most desirable men." The Doctor really wrote "a half dozen," but the copyist omitted the word "half." The greenkeeping at Columbia has been exceedingly efficient, and this was accomplished with a small force of men, not the large one that the error indicated.—Ed.

Questions and Answers

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

1. *How early is it wise to treat putting greens for earthworms? W. S. F.*

Here at Washington earthworms begin to work as soon as the frost is out of the ground. This year they were very active by February 14. It is quite likely that this habit of the worms becoming active even before the grass begins to grow is its normal behavior. Arguing from theory it has seemed that a worm-killer applied while the ground was still very moist would not penetrate well, but it seemed best to test the matter. Accordingly, on March 2 an area 3 by 5 feet was treated with corrosive sublimate in solution of the ordinary strength, one-half ounce to 15 gallons of water, applying three gallons of the solution. The solution soaked into the wet soil readily. Twelve worms appeared in 15 seconds and 20 by the end of one minute. This is about six times as many as is usually secured in our experience. Half of the worms were 2 to 3 inches long, the remainder 5 to 7 inches long.

It would seem, therefore, that worming might be done with great advantage just as soon as the frost is well out of the ground, even if the soil is still very moist. An extensive series of experiments is being carried out and will be reported on soon.

2. *Is a layer of cinders or rubble under a putting green desirable? H. A. L.*

Several clubs have built greens with such a layer, with the idea that it would furnish good drainage and also prevent earthworms from infesting the soil. The latter idea seems to be wholly fallacious as in at least one instance where an 8-inch layer of cinders is only one foot from the surface, the green is just as much troubled by worms as are others without a cinder layer. For drainage, tiles are to be preferred. Cinder layers in time become clogged with soil and fail to function. The clubs that have tried cinder or rubble layers are not enthusiastic about them, at least none have as yet given favorable reports. If any club has gotten as good or better results with cinders as with tile, it should publish its experience in the Bulletin. Theoretically there is a rather serious objection to such artificial layers as they completely destroy the normal structure of a soil as regards capillarity. The free movements of water in a soil both up and down are desirable characteristics of a well-drained soil.

3. *Is one foot of top soil enough on a putting green? H. A. L.*

Good results are often secured with only six inches of top soil but one foot is much better. On putting greens the soils should be as good as the club can well afford in order to insure permanent turf of high quality. The ideal soil for a putting green is about the same as a good rich garden loam or clay loam.

4. *How can winter-killing be prevented? J. C. S.*

It is very questionable whether any of the northern turf grasses are ever killed by low temperature alone. Where areas of grasses are found dead in spring, it seems always to be correlated with very poor drainage. On such spots the water-logging not only deprives the soil and the roots of air, but results in sheets of surface ice being formed, which still more excludes the air. Ice sheets on well drained soil seldom if ever cause injury even if they last several weeks, but on water-logged spots grasses as well as trees are often killed. Good drainage is the best insurance against winter-killing.

5. *Is twenty per cent of sand enough to mix with a stiff soil for putting greens? H. C. L.*

This amount of sand should help greatly but probably twice as much is desirable if the clay is decidedly stiff. Humus material also helps greatly in ameliorating clay. The end to be achieved is to get the soil in a loamy condition, a matter rather easily determined by observation but practically impossible to state in terms of percentages. Some clays are much more sticky than others and consequently require more admixture of other materials to put into a really desirable form.

6. *Is dynamiting of the soil desirable? H. A. L.*

If the subsoil is impermeable or if there is a definite hardpan layer the use of dynamite to blast holes in which to plant trees is advisable. To thus blast the subsoil on fairways or even under a putting green would seem rarely or never to be desirable, or on a larger scale economical. If better drainage is the end sought, tile is best to use. If the land is underlaid at a depth of one foot or so by an impermeable subsoil it is not particularly desirable for golfing purposes. Fair turf can be grown on such land if the surface soil is one foot deep or even six inches deep, but it will suffer severely during periods of drought.

7. *With a very limited amount of funds available, what fertilizers should be purchased to use on our putting greens? E. J. M.*

Barnyard or stable manure, either well rotted or else composted with other substances like sod, is the safest and most effective fertilizer for use on putting greens, and if available at all, usually the cheapest. Manure has the great virtue of being "fool-proof," that is, it is easy for anyone to get good results by its use, and almost impossible to do any harm. If manure can not be secured, the organic fertilizers are the next best, especially bone meal, but fish-scrap and tankage are also excellent.

8. *Parts of our golf course are full of crawfish. How may they be eradicated? H. A. L.*

Crawfish live only in very wet soil. The best remedy is good drainage. If for any reason some places cannot be drained sufficiently well, the crawfish may be destroyed by systematic poisoning. Carbon bisulphide is most satisfactory. If a little of this liquid is put in a crawfish

hole and the opening tightly plugged with earth, the animal will be killed by the gas that the chemical forms. An oiler with a long spout is excellent to apply the poison. One squirt of the liquid is sufficient. Many other chemicals are more or less useful, but carbon bisulphide is known to be very effective.

9. *Our town has about* 12,000 *people and we are struggling to maintain a nine-hole course. Can you advise how other clubs in towns of about this size finance and maintain their clubs? E. J. M.*

The Green Committee is particularly interested in the problems that confront golf clubs in small cities, and is collecting information from clubs that have been successful with the view to aiding others that are similarly situated. It will assist the committee greatly in its task if each club in town of 25,000 people or less will tell us how it solved its problems; and particularly the financial details as to sources of revenue and to costs of maintenance both of the course and of the club house. The stories of successes, and indeed of failures, ought to be of great assistance to every club that does not have a large city for its support.

10. *How can we keep our tees in good condition? They are always ragged or cut-up. E. J. M.*

If tees were given a fraction of the attention devoted to putting greens they could be enormously improved over the present average. Practically total neglect or else good attention once a year is the usual treatment given to tees. It is not enough. One little scheme that will preserve the grass on the tee for those who wish to use it is to have the tee plates at the extreme front and have the first yard of the tee bare. Ninety per cent. of the players to gain this yard will tee on the bare place, and thus reduce divoting to a minimum. Perhaps the best way to cover bare spots formed in the turf on the tee is by inserting a piece of sod when necessary. Indeed resodding all or most of a tee every spring is a method used on some courses.

If any one has discovered how to keep grassed tees perfect, we want him to give us his method.

11. *Can you give us the names of seedsmen who can supply genuine South German bent seed? W. H. S.*

A good many lots of such seed have reached the market recently. Names of dealers will be sent on request. It must be understood that such information does not imply a guarantee by the Service Bureau. Seeds should never be purchased until a sample has been secured and verified. Seedsmen as well as others are sometimes mistaken or deceived as to the quality and identity of bent seeds.

12. *Please tell us about Mascarene grass, Zoysia tenuifolia, which we believe has a great future for putting greens. O. H. L.*

Mascarene grass is a subtropical species that is adapted only to Florida and a narrow strip along the Gulf Coast where the temperature rarely falls below 15° Fahr. It is an exceedingly dwarf grass forming a dense sward never over two inches deep. The rootstocks are very numerous, as large as a goose-quill, and buckle so that the turf is thrown up into little billows, a matter that can be corrected by frequent rolling. The leaves are very stiff and wiry so that the putting surface is slow. It may prove to be an excellent grass for tees, a matter that has not yet been

tested. It is a beautiful grass to cover hard walks and it seems to enjoy continual trampling. In Miami, Florida, there is such a walk built of coquina limestone, covered with a perfect green carpet of Mascarene grass that is a triumph of horticultural beauty. The grass is worth careful testing by southern golf courses, but not for putting greens. It must be propagated vegetatively as no seed is available.

Analyses of Soils

Chemical analyses of soils are practically of little if indeed of any direct value. At the present time few institutions will make such analyses without charge. While chemical analyses of soils are not without value in certain kinds of investigations, it is only in exceptional cases that an expert can determine from an analysis what fertilizers or other treatments are desirable. Inasmuch as soil analyses do not contain information of value in proportion to their cost, they can be left out of consideration by green committees.

Soils

Whenever a question is asked regarding turf growing, the character of the soil should always be indicated. Soils may conveniently be classified as clays, silts, clay loams, silt loams, loams, sandy loams, fine sands, coarse sands, in accordance with the size of the ultimate particles. It is well also to state the color: black, brown, chocolate, red, yellow, gray, or white. Any type of soil may contain more or less gravel. The dead vegetable matter, humus, may be present in abundance or scant; in mucks and peats it makes up nearly all the soil. Drainage is also an important factor in soils. The quality of a soil is also indicated by the average yields that farmers get with staple crops, such as corn, wheat, and potatoes. Such a description as the following answers all necessary requirements: Our soil is a brown sandly loam, well drained and considered by farmers to be fairly productive.

Learn to Know the Turf Grasses at Sight

All of the turf grasses can readily be recognized, especially with aid of a lens, when you once know their characters. It is easer to do when the grasses are in bloom, but all can be identified even on a putting green. Every grass "fan" ought to get familiar with all the good grasses as well as the bad ones. One of our famous visitors of last year conceived the idea that the putting-green grass we use is crab-grass. He had heard the name but did not know the plant. Each issue of the Bulletin will contain illustrations and detailed description of some grass of interest to golfers.

Gullies.

On rolling golf courses gullies not infrequently cause trouble, but once they can be filled and covered with deep-rooted grass, the trouble rarely recurs. In deep gullies boulders may be thrown in the bottom and will help considerably. Above the boulders a brush intermixed with soil will do much to prevent washing while the grass is getting established. Probably the best of all grasses in the north for sowing in gullies is orchard grass. It is very deep-rooted and the larger tufts will prevent most swiftly running surface water from eroding the soil. It is best not to cut the grass, as if left tall it will collect any soil or silt in the water and gradually build up the level of the land. The sooner gullies are attended to the better.

If a gully lies across a fairway it is best to fill to the degree desired, compacting the soil thoroughly, and then to sod the surface.