in a square mile of the average dense cloud, and even if some artificial means were found to cause the aggregation and fall of the infinitesimal drops of which rain is composed, calculation shows that only a trifling amount of precipitation would result, because there is not much water in such a cloud.

QUESTIONS AND ANSWERS

All questions sent to the Green Section will be answered in a letter to the writer as promptly as possible. The more interesting of these questions, with concise answers, will appear in this column. 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 Section.

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

Responsibilities of a green-committee member.—I have recently been appointed as a member of the green committee of our club and should appreciate such information as you may be able to furnish with regard to the duties of such a position. (Pennsylvania.)

ANSWER.—It is customary for the chairman of the committee to shoulder all the duties and to consult his committee only when he contemplates some drastic change in procedure and needs moral or perhaps financial support. It is probable that this one-man-committee custom is, after all, the best, since the greenkeeper thus receives orders from only one man and therefore not conflicting advice from different sources. The members of the committee, if they care to be active, should advise their chairman, but in no case bother the greenkeeper. It will avoid confusion and be much fairer if the greenkeeper receives the wishes of the committee through its designated spokesman, the chairman. Also the green committee should protect the man whom they trust to care for the course (the greenkeeper), from all possible interference of unauthorized advisors. It is lamentably the custom with some clubs to permit any club member to hamper the greenkeeper with suggestions concerning his duties, a procedure which is certain to antagonize him. Suggestions, criticisms, and complaints on matters of course maintenance should be received from club members by members of the green committee only. The committee should advertise the fact that the purpose of the green committee is to effect a close liaison between the club members and the greenkeeper. Worthwhile suggestions should be welcomed and action should be taken on constructive criticisms; but the opinions of the membership as interpreted and investigated by the green committee should be passed on to the greenkeeper only by its official spokesman, the chairman of the committee. If the greenkeeper is keeping a fine course at an expense which compares favorably with that of other courses of a similar type, the chairman will probably be active only when the yearly budget is being made up, and the greenkeeper will have need of the committee only when something unusual occurs or is about to happen. If the greenkeeper does not seem to understand

his business it will then be the duty of the green committee to investigate. The committee should check up on costs and on the cultural practices being followed, and should study the subject sufficiently to be able to form an opinion as to whether or not the greenkeeper is keeping himself well posted on the scientific as well as the practical phases of his business. The committee should also be able to determine whether or not he has his job organized and is getting the most out of his labor. They should also determine whether or not he uses discretion in making purchases for the course. And most important of all, they should ascertain whether or not the course can be put in shape to please the majority of the members, and, if it can, why that has not been done. The facts may show that the greenkeeper has been handicapped by his previous committee and that with the support of the new committee, which has studied his problems, he can quickly show results. On the other hand, should the investigation by the new committee show that the greenkeeper is hopelessly out of date, extravagant with the club's money, and not particularly ambitious to give the players the most for their money, it may be the duty of the committee to secure a better man for the job. Additional suggestions on this subject may be found in the following numbers of the Bulletin: September, 1923, page 230; October, 1924, page 234; December, 1926, page 254; February, 1929, page 30.

Effect of nitrogenous fertilizers when applied to turf during hot weather.—I have read a good many articles during the last six months, some of them prepared by men of national repute in their line, on the dangers of applying fertilizers with high nitrogenous content in the hot summer months, basing their advice not on opinion but on fact. One would be apt to gather from these articles that fertilizers high in nitrogenous content would, under such conditions, do more harm than good. I recognize, of course, that such fertilizers have to be used with extreme care; but at the same time I am unable to see how, if you apply no nitrogen through the summer months, you can make up for the loss incurred by grass due to constant close cutting. It would seem that theoretically the ideal fertilizing plan would be to bring one's greens to perfection in the late spring, with the grass not forced but strong and vigorous, and then to hold that balance, varying treatments with weather conditions. Such a plan would call for replacing in exact amount the various chemicals lost. In such a case nitrogen would certainly be required. If such a plan is theoretically sound it would seem to be not a matter of withholding nitrogen for fear of injury to the grass, but of learning the correct amount to be applied and correct method of application. Condemning its use because of its constant misuse is not the best method of encouraging cautious experiments. If my understanding in this matter is not sound I should appreciate your advice. (Pennsylvania.)

ANSWER.—Reports have recently appeared from many reputable turf experts warning against the overfeeding of turf with nitrogen during the hot months. We are in accord with this advice, since there is ample reason to suspect that a soft, lush grass is not hardy enough in hot weather to withstand various fungous diseases or physiological changes to which the plant is subjected. Often there is sufficient nitrogen being released by soil micro-organisms from

material already in the soil to attend to the needs of turf grasses during the hottest months of the summer. Most soils on putting greens would be fertile enough to support the grass during hot weather without other than very light feeding with nitrogenous fertilizers. The grass grows rather slowly in such seasons and does not require much plant food. Furthermore it is better to have the turf go off color a little than to have it a luxuriant green and hence liable to infections or injury common to turf in humid hot weather. We are in perfect accord with you that theoretically the ideal fertilizing plan would be to have the greens in perfect condition in the late spring, with the grass of normal vigor. The fertilizing of the grass should be reduced in the late spring. This is what horticulturists call hardening off. It would not be advisable to have a fast-growing, soft grass enter the hot summer. You are perfectly correct in doubting that fertilizers high in nitrogen are particularly dangerous. If greenkeepers would study the needs of the grass, correct amounts could be used according to requirements; and if soft growth were not forced during hot weather we think there would be less trouble with turf.

Preventive measures in brown-patch control; use of power sprayer for applying mercury compounds.—Our greens are creeping bent planted from stolons and contain also much annual bluegrass. Last season they suffered from brown-patch much less than the greens on several neighboring courses, a fact which we attribute to our having reduced the quantity of water and fertilizer applied to the greens. As an additional preventive measure this spring we limed the greens. Several of our neighboring courses use a power sprayer for applying mercury preparations in brown-patch control, considering this the best method of application. We are wondering whether, in view of the measures we have taken to prevent extensive injury from brown-patch, it would be advisable for us to go to the expense of purchasing a power sprayer for use in brown-patch control. The apparatus would cost about $900. In case we should purchase a sprayer, which of the mercury compounds could be safely used in it? (Pennsylvania.)

ANSWER.—Any of the mercury compounds may be used in a power sprayer provided the tank contains a good agitator for keeping the mixture thoroughly churned during the application. There is a great deal to be said in favor of a power sprayer for applying mercury compounds. We do not regard it as the best means for applying those chemicals, but it is perhaps the most rapid means and is entirely satisfactory. There are several methods, which may be classified as best, though under somewhat different conditions. If by your method of handling the greens you find it is unnecessary to make frequent applications of mercury preparations it would perhaps not pay you to invest in an expensive spray outfit. If you can maintain your greens by the method you have used without relying on mercury treatments, we would advise you to continue with those methods. Chemical means of controlling disease we regard as emergency treatments. The situation is similar to that of human disease. There are persons who, in spite of everything they do to keep well, require frequent advice from physicians and frequent use of medicine, while there are others who, apparently without much effort, keep in good

health without resort to medicine. Proper balance of food, exercise, and attention to other hygienic measures go far in preserving health. Where it has been found that it is necessary to apply mercury fungicides frequently in order to prevent damage from brown-patch, the power sprayer is undoubtedly the best means of application, since it does the work so much more quickly, and the overhead of the original cost is not such a big item.

Endurance of nitrogen in the soil.—We have been offered a 4-12-4 fertilizer, at a fancy price, the nitrates in which are claimed to have nine distinct stages in the process of becoming available as plant food. Could we procure a similar fertilizer at less cost by mixing the constituents ourselves? (California.)

ANSWER.—The fertilizer to which you refer undoubtedly has merit, but we consider its price as out of proportion to its value. As far as we have been able to ascertain, there is no foundation for the claim that nitrogen becomes more beneficial to plants as the number of stages in its process of becoming available increases. It is true that nitrogen in some forms of fertilizer is available much more slowly than in other forms. However, under certain climatic conditions a fertilizer which is rated as slowly available may disintegrate very rapidly and thus be available to the plants in a relatively short time regardless of any number of "distinct stages" that may be involved in the process. We contradict any claim that nitrogen in any fertilizer will produce quick growth and at the same time have lasting qualities, unless it is applied in large quantities. Nitrogen in a form that is slowly available to the plant is of no use to the plant in its early stages. Our experience with golf course turf is that nitrogen can be applied more economically and more advantageously in relatively small quantities at frequent intervals than in larger quantities at less frequent intervals with a view to creating a reservoir of nitrogen in the soil. Before purchasing any quantity of the fertilizer which you mention we suggest that you get in touch with some reputable fertilizer dealer in your vicinity and compare the price of this fertilizer with his price on a fertilizer of a similar formula, or preferably one having a higher proportion of nitrogen. In the formula you mention the ratio of nitrogen to phosphorus and potash is very low for turf production. If it contained more nitrogen, regardless of the method of its becoming available, you would probably find the grass would respond much more promptly. If you want a lasting fertilizer you can buy it in several forms. If you want a quickly acting fertilizer you can get it in different forms also, which we are sure would cost you less than the material to which you refer.

Neutralizing the alkalinity of lime in sand used in compost.—An analysis of three samples of sand available for use in compost for top-dressing our bent greens shows the lime (oxide of calcium) content to be respectively as follows: 6.52 per cent, 7.82 per cent, and 9.59 per cent. Our compost consists of top soil, sand, and fertilizer. Is the lime content too high in any of these samples? What is the highest percentage of lime in sand that can be safely used on bent turf? (New York.)

ANSWER.—One part of burned lime (oxide of calcium) is equivalent to 1.78 parts of limestone (carbonate of calcium.) The sand

containing the lowest percentage of oxide of calcium, 6.52 per cent, therefore carries the alkaline equivalent of 11.6 per cent of limestone. One ton of this sand would accordingly contain the equivalent of 232 pounds of limestone. In case this sand constituted one-third of the material in your compost, one ton of compost would contain 77 1/3 pounds of limestone. It takes about 65 pounds of sulphate of ammonia to neutralize the alkalinity of 100 pounds of limestone. Therefore it would require about 50 pounds of sulphate of ammonia to neutralize the alkalinity of the sand in one ton of your compost, one-third of which was made up of your sand of 6.52 per cent lime. It is doubtful that greens ever receive this quantity of sulphate of ammonia between successive top-dressings, and therefore the continued use of this sand without the addition of sufficient sulphate of ammonia would tend to make the soil of your greens increasingly alkaline.

Value and use of muck.—We have a large supply of muck soil on our course and it would be advantageous if we could use more of it than we have been using. In employing it for top-dressing our greens and approaches we have found that it bakes extremely hard in warm weather. We believe also that it tends to make the soil sour. It seems to prevent the grass from knitting properly in spots on our approaches and fairways. When we mix the muck with sharp sand, it looks like loam but feels heavier on account of the clay it contains. Our fairways are naturally quite sandy. When mixed with sand and used on our greens the muck makes the greens hard and very fast. After we work it into the turf it seems to cake at the roots of the grass. We have used no material to assist in the decomposition of the muck and are trying to get the correct proportion of the right material to add to it in order to develop its real growing value. We are top-dressing our fairways with manure where this muck has been used, in the hope of encouraging a better growth of grass. The grass which has come up under treatment with fertilizer is very good. Samples of this muck soil have been sent to analysts, who have commended its value and advised us that it was well supplied with plant food. What do you think of adding to each ton of manure 75 pounds of muriate of potash and 75 pounds of 16 per cent acid phosphate in order to improve its value? Could this mixture be added to the manure that we might use for decomposing the muck? Can this type of soil be safely used in the delicate work on a golf course? (Massachusetts.)

ANSWER.—Except for perhaps a very thin top layer, muck found in beds or deep layers is usually quite inert and has comparatively little plant food value until it is mixed with soil, aerated, and otherwise broken down. This breaking down is caused for the most part by microscopic organisms in the soil. These organisms do not work in the muck as it is found in its native environment. By simply mixing the muck with sharp sand and spreading it on the surface, the soil would change its composition very little and the combination would be liable to give results such as you describe. We are very much in favor of composting muck before using it on the golf course. The compost pile should be built up in alternating layers of your natural soil, fresh manure, and muck. Top soil can be prepared from muck by plowing it and disking in from 10 to 20 tons of manure to

the acre. In your locality the addition of several tons of lime to the acre would also be beneficial. A muck bed so prepared and frequently plowed and disked would become quite fertile and would be in good condition for mixing with soil. There are few cases in which it would be advisable to use material so rich in organic matter as muck, in its pure state, even after being treated in the manner we describe. In its native condition muck contains very little phosphorus and potash. With the addition of manure some phosphorus and potash are added and the phosphorus and potash already contained in the muck are rendered more available. However, you would improve your muck considerably by the addition of muriate of potash and acid phosphate, as you suggest. In composting the muck, 75 pounds of acid phosphate and 45 pounds of muriate of potash could be added to each ton of muck as it is laid down in the compost pile. The addition of nitrogen also greatly improves northern mucks, and in this respect if you should desire faster decomposition and more nitrogen it would be advisable to add about 50 pounds of sulphate of ammonia or nitrate of soda to each ton of muck. The compost pile should then be allowed to heat and should be turned several times. If the pile were mixed in the manner we describe, the addition of sand might not be necessary. However, after decomposition has taken place and the layers of the pile have been thoroughly mixed by frequent turning, you would be able to judge whether the addition of some sharp sand would improve the texture of the compost. Such a compost pile should be ideal for use on putting greens.

Estimated cost of building a green and planting it with bent stolons.—Have you figures suitable for a small club as to what it should cost to build and plant a green from creeping bent stolons? Our soil is mostly sandy. (Minnesota.)

ANSWER.—One hundred square feet of creeping bent sod should furnish sufficient stolons for planting an area of 1,000 square feet. This quantity of stolons would cost about $15 plus freight. To grade and shape a green of about 6,000 square feet with only a slight elevation above ground level, would cost from $100 to $200 provided the fill could be scraped from a trap built adjacent to the green; if the fill had to be loaded and hauled it would cost nearly three times that amount. If the top soil is quite sandy it would be wise to change its texture to that of a sandy loam by adding such materials as clay, loam, or humus, together with manure. From 20 to 40 cubic yards of clay, loam, or humus would probably suffice, and from 10 to 20 tons of well-rotted manure would be beneficial. These materials could be hauled, spread, and mixed with the top soil on the green at a cost of from 40 to 60 cents a yard, exclusive of cost of delivery to your property. Six yards of sifted soil would be required to top-dress the stolons at the time of planting. If the top soil of the green were properly prepared, money could be saved by skimming this quantity of soil from the green and sifting it close by, which would cost about $2 a yard; otherwise sifted soil from the compost pile could be used, at such cost as might be involved. Shredding, cutting, and broadcasting stolons would cost from $15 to $20, these figures covering also the cost of covering the stolons after they are broadcast. It is not likely that tile-draining would be necessary with a sandy subsoil, such as you have.

The total cost of this work should amount to between $275 and $550 when scrapers are used, and between $475 and $950 when fill has to be hauled.

How frequently to water bent greens.—Will you kindly inform us how much greens just planted with the Washington strain of bent stolons should be watered? Some advise wetting every three or four days, other advise soaking the greens every day. (New Jersey.)

ANSWER.—The amount of water required by turf depends largely on soil and weather conditions. The ordinary practice on putting greens is to water as often as necessary to keep the soil moist. Usually in dry weather it is necessary to water every day to keep bent in the best condition. Three-day or four-day intervals apparently are too long for most soils. Many defects of a golf course are caused, or at least greatly exaggerated, by excessive watering. There is a decided difference between moist soil favorable to plant growth and the water-soaked condition one frequently finds on greens. The best way to determine whether a green is getting the right amount of water is to cut into the turf occasionally to see whether the soil is soaked or dried out. Your attention is invited to the July, 1928, number of the Bulletin, in which the subject of watering is fully discussed.

Ridding putting greens of pearlwort.—A weed called pearlwort has invaded the greens on our course. This weed is first noticeable when a number of plants of it are found crowded together in the shape of a small circle. Later these patches spread so that ultimately large areas of grass are crowded out. Is there any method of keeping pearlwort under control? (Washington.)

ANSWER.—This weed is very common on some courses, particularly on poorly drained greens. Brown-patch frequently kills pearlwort, since it is more susceptible to this disease than most of the turf grasses. If it is only found in a few scattered areas on the green it will be easy to remove it by hand. When it is pretty thoroughly distributed over the green it would be justifiable to make a general treatment on the green. Pearlwort is more easily burned with sulphate of ammonia than turf grasses are, so that by applying sufficient sulphate to slightly burn the turf the pearlwort will be badly injured. Such treatments repeated from time to time will entirely kill out pearlwort but will not injure the greens, since the grass will quickly recover after each treatment.

Controlling earthworms with arsenate of lead.—My lawn is badly infested with earthworms. I have heard that these pests can be controlled with arsenate of lead. What advice can you give me as to the use of this chemical for the purpose? (Illinois.)

ANSWER.—On most soils arsenate of lead will prevent worms from being active at the surface. The chemical should be applied at the rate of 5 pounds to 1,000 square feet. It is well to mix it with dry soil in order to increase the bulk and thus insure a more even distribution. It should be broadcast evenly over the turf, after which it is well to drag a mat over the surface so as to work the chemical down to the soil by brushing it from the grass blades. An application of arsenate of lead will keep out worms for considerably over a year on some soils, but it may be required more often on others.

The books which help you most are those which make you think the most. The hardest way of learning is by easy reading: every man that tries it finds it so.

—Theodore Parker.