be top-dressed with sand, as the loam or clay-loam soil is by all odds the best.

The average quality of Bermuda grass greens will be enormously improved when clubs build their greens with loam or clay-loam soils for the surface six or eight inches, and use only the Atlanta strain for planting.

In regions where frosts occur the Bermuda grass becomes unsightly in winter. A good green surface can be maintained all winter, however, by sowing redtop or Italian rye-grass on top of the Bermuda grass sod about one month before the first frost. The redtop is preferable. Both it and Italian rye-grass will grow all winter in mild climates, and disappear in the hot weather of spring, when the Bermuda is again vigorous.

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. Choosing between carpet bent and velvet bent.—Which grass, carpet bent or velvet bent, in your opinion, is the better grass for the putting-green all the year round?—(Maryland.)

Carpet bent and velvet bent both make exquisite greens, the latter being the finer in texture. Carpet bent succeeds better than velvet bent in the latitude of Washington and is not quite so susceptible to brown-patch. On some courses in New England, however, velvet bent has dominated and pure greens of this grass may be seen. Under New England conditions we would strive for pure velvet bent greens, because it makes the finest of all turf. Farther southward we should prefer the carpet bent.

2. Planting putting-greens by the vegetative method.—In planting our turf garden, our idea was to produce a complete putting-green surface ready for transplanting and then remove it directly onto a green in exactly the same way that any sod is handled, and not to produce stolons to be planted in a bare green and to be allowed to spread of their own accord; that is, our plan was to grow fine turf off the course, and then transplant it to the place where it was needed. While this might cost a little more, the convenience to the players would certainly be worth the additional expense. With this in view, we cut out mats from the fairways and putting-greens, and had them cut up into divots about one inch square and set out just as one would set out onion plants in a vegetable garden, in rows about twelve inches apart, and individual divots twelve inches apart. The idea in setting these so closely together was that as soon as each of them had spread six or seven inches from its original center we would have a complete turf. Are we right? Will we get what we are striving for?—(Missouri.)

The idea you have in mind is entirely practicable and one that we have used in experimental plots. When you have grown your sod it can be transferred to a putting-green and be ready to play upon in a very few days. We doubt, however, if the method of planting the sod garden is nearly as good as that of using chopped-up runners, as recommended in the July, 1921, BULLETIN. By your method you are sure to have many strains of bent instead of one pure strain. Furthermore it requires a longer time for the sod to knit in a solid whole by your method than by the other. At Inverness very beautiful turf was grown by the chopped-up-runner method

and the sod later transferred to a green. Several other clubs have now adopted the same plan.

3. Improving fairway turf which has been invaded by moss; disking; top-dressing; fertilizing.—Our course of nine holes was constructed about six years ago. The land is moderately rolling and, as we believe, well drained all over. The soil is a sandy loam, and had previously produced very good crops of corn and hay. Neighboring farms now produce wheat, oats, and corn to good advantage. Our greens, which were seeded to Chewings fescue, are remarkably good, but we are concerned about our fairways, which, after having been reasonably well prepared, were sown to bluegrass and redtop, but which are now very tufty in many places, the redtop, which dominates, growing in little bunches, leaving cuppy places between. There is a good deal of moss in different places in the fairways, and from reading your BULLETIN I am of the opinion that this is due to poverty of the soil. We have ordered a disking machine with small blades running close together set on a slight angle, which we plan to pull back of our tractor in the early spring for the purpose of cutting through these tufts or bunches of grass, and incidentally to make a seed bed. We then expect to seed the fairways again with bluegrass and redtop in about equal proportions, and roll. We expect to disk crosswise on hilly places to prevent the seed from washing. Last fall we scattered crushed limestone over the entire fairways, about two tons to the acre, but did not apply any of this to the greens. The particular question we wish to ask is, can we not use sulfate of ammonia, or something not too expensive, in the spring when we are doing this other work, to enrich the soil so as to get rid of this mossy condition?—(Indiana.)

If your fairways were seeded to redtop and bluegrass and you obtained a thin, bunchy stand, it would indicate to us very poor soil. Your plan to disk the turf on the fairway ought to be beneficial if it can be done without tearing up the turf. However, we are inclined to think you will get the best results by top-dressing your fairway with rich soil or with compost. This is a little expensive on account of the large quantity of material necessary unless you have it conveniently at hand. The next best thing to this is to top-dress with a fertilizer, and we would suggest you use an organic fertilizer and scatter it over the fairway just about the time the grass begins to show signs of new growth. We would suggest that you use bone-meal or fish-scrap, although there is no objection to using sulfate of ammonia. The organic fertilizers are, however, very effective and much more lasting than the chemical fertilizers, and there is no possible danger of doing harm by not being sufficiently careful in applying them. We are interested in what you say with regard to the appearance of moss between the tufts of grass. If you will send us a small sample of the moss we may be able to indicate in part where your trouble lies.

4. Ice remaining on turf.—The Peripatetic Golfer says, don't worry if you see an inch of solid ice over a putting-green, as it will do no harm if the drainage is good, but if the drainage is bad it can never be a good green anyway. Please explain how a green can be covered with ice if both the surface and subterranean drainages are good?—(Minnesota.)

A so-called ice-storm may cover a whole golf course with a sheet of ice even if the topography be very rolling. In the case the Peripatetic Golfer had in mind, the sheet of ice was due to the alternate thawing and freezing of snow which in January and February, 1919, covered the courses about Washington for a period of seven or eight weeks. On one golf course, for fear the greens would be killed, an attempt was made to break the ice and remove it, but this process was so injurious to the turf that it was abandoned. When the ice finally melted the turf was found not to be injured at all.

5. **Green construction: soil preparation; drainage.**—We are inclosing you a rough sketch representing our No. 2 and No. 18 greens, with which we are having considerable trouble. These greens have been reconstructed several times in the past six or seven years. The last reconstruction took place about four years ago, and at that time the reconstruction was the surface where the sketch shows as 10 inches of black loamy dirt. For about a year it appeared to us that the greens were entirely too porous, and two years ago we added on top the clay soil, as designated, which was 26 inches at the height running down to a point meeting the fairway. During the past two years we naturally have developed a few inches of good soil from fertilizers and top-dressing, but we are still without a good stand of grass and cannot develop a good smooth putting surface. We believe that it will be necessary entirely to reconstruct these two greens in the fall, although it may not be necessary, but we would appreciate it very much if you could advise us or give us any information which might help us in properly developing these two greens.—(Missouri.)

While we would not like to say definitely that the construction has been responsible for your poor turf, we certainly would advise strongly against following the definite-layer type of construction in the future. Experience has made us very much opposed to construction of this type. We have tried it, and have seen a great many greens that have been built in this way, and we do not regard the method as satisfactory. In our judgment the ideal soil for a putting-green is a good, rich, deep clay loam, well drained in both surface and subsurface. If your soil is not of this character we would suggest that you use liberal quantities of well-rotted manure or mushroom soil as described in BULLETIN No. 4, Volume I. The best practical way to incorporate this with the soil is to plow or spade it in thoroughly. If your soil is a heavy clay loam, lighten it with sand or good soil of a lighter texture. This can best be done by working the sand or light soil. Definite layers apparently interfere with the normal processes which take place in soil. We would abandon cinders and crushed limestone and would mix the sand and loam thoroughly with the clay, provided, of course, the clay is the natural soil; if loam is the natural soil it is quite probable that it will not need modifying except probably with manure. We note that your greens are tile-drained. This is doubtless necessary. If there is any doubt whatever about the underdrainage, tile should be used. Many think that because a green does not overwash or has good surface drainage, it is well drained. It frequently happens that a green is flanked by a hill and gets a considerable amount of seepage, which renders the use of tile absolutely necessary. You cannot be too careful in regard to ample drainage.

6. **Possible variance in effect of fertilizers on different turf grasses growing in mixture.**—The opinion has been expressed that in growing turf grasses in mixture, a fertilizer that will be beneficial to one grass will be detrimental to another grass in the mixture. Is there any truth in this statement?—(California.)

The reactions of the different turf grasses to fertilizers are apparently not greatly different and we doubt very much that you would secure any results such as you suggest.

7. **The use of muck and lake-bottom soil; composting it with stable manure: redtop, fescues, and bents for northern putting-greens; rate of seeding redtop.**—In constructing 9 of our putting-greens last spring we used a top-soil which we mixed up as follows: 70 per cent muck, 20 per cent black dirt or clay loam, and 10 per cent sharp sand. We did not incorporate any fertilizer, but in the fall applied 150 pounds of hydrated lime with a top-dressing of muck, clay loam, and sand in about the same proportions as used in constructing the greens. In May we sowed 50 per cent redtop and 50 per cent Chewings fescue, 125 pounds to the green, averaging in size 80 by 80 feet. Owing to a very hard summer for

want of rain and the great and continued heat, we could do nothing to bring forward what seed germinated. We covered the greens with hay to protect them, but all to no purpose; and not until after the fall seeding did we get any growth; and still the lack of rain was a great handicap. We saw no signs of the fescue coming up except for a few blades here and there; but the redtop was excellent and formed a dense growth, but later, toward the end of November, turned yellow and thinned out and generally looked sickly. We accordingly decided to experiment with the use of acid phosphate, nitrate of soda, and muriate of potash, on patches of about two yards square on different parts of the green, with different compositions of the above fertilizers, and found a very great change by using the three in equal proportions, the grass on the treated plots becoming of good color and healthy. What I desire is to get a condition of soil which will not bind and will allow a ball being pitched right up to the hole and staying "put" without the necessity of having the green, as heretofore, in a sodden condition. I would also like to know what grasses will thrive on a soil such as we have here. We also have available for use about 1,500 loads of the top surface of the bottom of one of our lakes.—(Minnesota.)

The chief difficulty in using muck is the inert condition of the material. Muck is liberally supplied with plant food, but the food is locked up or unavailable for plant use. Plants will thrive in it only after it has decayed. This decay is effected by the introduction of microscopic life, which is best accomplished by the application of stable manure. If you had used several loads of stable manure in preparing this mixture we believe you would have had much better results. As regards commercial fertilizers to be used on the greens you have constructed, we would invite your attention to the article on this subject in the October, 1921, BULLETIN. Ammonium sulfate is to be preferred to sodium nitrate in that the former discourages the growth of clovers and certain weeds while, at the same time, encouraging the development of the bent and fescues. We would also advise you to compost your muck and clay loam with stable manure, and the more stable manure you put in the compost pile, the better. After the mixture becomes thoroughly pulverized through composting we would then advise your using it as a top-dressing. In the meantime the use of commercial fertilizers will keep the grass growing until the plant food in the soil is liberated.

In regard to seeding putting-greens, we consider that you used too much redtop for best results. We recommend as a maximum rate 5 pounds to 1,000 square feet. If the fescue you used had been of reasonably good germination it would have been better not to have used any redtop at all. Redtop makes a very vigorous growth at the start and gives the appearance of being a very fine putting-green grass, but it afterwards becomes coarse and the turf open and poor. We believe, however, that the bents will give you a much better turf than the fescues.

In regard to the top-surface soil you have taken from the bottom of one of your lakes, we would strongly advise you to compost this with stable manure before using.

8. **Ridding sand greens of weeds.**—We desire to kill all the vegetation within a space of about 12 feet around our sand greens. Salt or creosote have been suggested to us for this purpose. Is there anything better?—(New Mexico.)

Where oiled sand greens are used, as described on page 109 of the Bulletin for 1921, there is no difficulty in regard to weeds. If sand greens without oil are used, salt is the cheapest thing to keep out weeds.