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