

at least a foot below the lower tile in order to collect sediment. Outlets of tile lines should be well protected to keep them from being broken loose, crushed, or plugged up. Some stone or cement work is usually necessary to protect outlets properly.

In fairways, $2\frac{1}{2}$ to 3 feet is probably the best depth at which to lay tile, provided sufficient drop may be gained. At such a depth in clay soils the laterals would probably need to be from 20 to 30 feet apart. In sandy and muck soils laterals may be placed twice this distance apart.

In putting greens tile should be laid at a depth of $1\frac{1}{2}$ to 2 feet in clay soil and 2 to $2\frac{1}{2}$ feet in sandy soil. The laterals in clay soils should be from 15 to 20 feet apart, and in sandy soils from 30 to 40 feet. In draining putting greens it is well to have a fall of at least 1 inch in 20 feet. On putting greens the herringbone system of laying tile is most popular. In this system the main is laid through the lowest portion of the green and the laterals are staggered into the main; that is, no two opposite laterals enter the main at the same point. If the slope of the green is in one general direction, it is best to have the main run in that direction and the laterals enter at angles from each side. In order to guard against the crumbling in of the ditches or the sinking of the fill, it is advisable, in putting greens, to pack the tile with cinders alone, without using coarser material, to within 8 inches of the top in clay soils and 1 foot of the top in sandy soils. It is also a safeguard in putting greens of sandy soil to pack an inverted tough sod over each joint.

The water system should be installed when the land is torn up in process of grading. For details of the water system attention is invited to THE BULLETIN for July, 1928.

PREPARING THE SEED BED

As before stated, it is well to plow as much land as necessary as soon as it can be conveniently worked. If land is broken in the spring, a spring planting of field peas or soy beans can be made in the North, or velvet beans in the South. This crop should be plowed under in the summer in time to let it settle a bit before seeding of the fairways is commenced. If a fairway is not to be seeded to grass in the fall it can be planted to hairy vetch and thus be provided with a green-manure crop to be plowed under in the spring. Land that has not been put under a green-manure crop should be cultivated during the summer.

After the topsoil has been replaced where necessary and all tile and water lines have been covered, the ground will be ready for its final preparation for sowing. When land that has had a green-manure crop plowed in has settled a bit, it, as well as the fallow land, should be disked and harrowed at frequent intervals up to the time of planting. The cultivation will not only keep out weeds and improve soil texture but will prepare a fine mulch for seeding, provided the land is not worked while wet. If fertilizers are to be used they should be worked into the soil before seeding.

Often in heavy soils the best way to open them up is to incorporate vegetable matter with the soil. Applications of strawy manures are best for this purpose. In applying manure to soil in preparation for golf turf there is no need to put the manure in deep. It is better to have it incorporated with the soil where it will do the most good.

The best way of accomplishing this is to spread the manure on the land after it has been plowed and cultivated, and harrow it into the soil. On some soils a spring-tooth harrow is better than a disk harrow for this purpose. In applying commercial fertilizers* it is advisable to work these into the soil only with the smoothing or spike-tooth harrow. These fertilizers are more or less soluble and are easily leached, and the young turf seedlings will receive more benefit from them if they are near the surface than if worked deep into the soil.

After the land has been plowed, disked, and harrowed, there will usually be some trash to clear away, such as roots, sticks, and stones. In picking up stones it is most economical to remove only those large enough to interfere with cultivation until the final working for seeding. This work should be carefully organized and supervised, since a few men sent out occasionally to pick up stones seldom do economical clean-up work. It is expensive to pick stones from a field and then



Cultivating fairways with the disk harrow.

disk, since other stones are turned up by the next disking. At times stones are so plentiful that their disposal becomes a serious problem. It is often found that where large quantities of stone are available they may be used to advantage in building foundations for greens or tees. In such cases these foundations are packed with small stone, gravel, or earth, and allowed to settle before good topsoil is added. Another use for stones is in drainage work.

Soil can be put into proper condition to receive seed by dragging with a smoothing harrow, cultipacker, brush drag, or other device calculated to make as fine a surface mulch as possible. It is not always necessary to hand-rake ground for seeding. Hand-raking of fairways just before seeding need seldom be done if the field is cleared of stone and trash and a proper mulch has been prepared by cultivation. However, if it is found necessary to rake the fairways before seeding, it is well to seed before the last raking so that the seed will have the benefit of being mixed with the soil by hand tools. Even if some piles of rubbish have accumulated during this raking it need not affect the seeding. A handful of seed can be thrown where rubbish has been piled.

* The rates of application of the various fairway fertilizers are contained in the table on page 112 of THE BULLETIN of June, 1928.