CHAPTER XIV

Experimental Work on Golf Courses

Scarcely any two golf courses are sufficiently similar so that one may confidently affirm that the methods found satisfactory on one will apply to the other. Nearly every golf course is confronted with turf-growing problems that it must solve for itself.

The experience in golf course management has not resulted in much increase of accurate knowledge so far as turf-growing is concerned. Every putting-green on a golf course has in most cases been subjected to so many kinds of treatment that it is impossible for any one to determine just which factors were good and which were bad. Add to this that the exact record of the history and treatment of a particular piece of turf is rarely preserved by any golf club, and it is not difficult to understand why there is so great difference of opinion as to what is desirable and what undesirable in growing turf in a particular region.

Even with so simple a matter as the effect of liming on different turf grasses, there is wide divergence of belief. In such matters opinion is of no value unless backed by the results of definite experiments. On most putting-greens either all the area was limed or else none of it was limed. In either case there is no opportunity to draw definite conclusions because there is no basis for comparison.

Every field experiment either with turf plants or others, to be of definite value, must contrast a particular treatment with the absence of that particular treatment, the latter serving as a check to determine the value of the treatment. Furthermore, the experiment to be useful must be simple. For example, if a plot be treated with lime alone and checked by a similar plot without lime, a clear and definite conclusion may be drawn; but if the first plot be treated with both lime and fertilizer, it will be impossible to determine to which of the two the effect secured was due.

In the accompanying two diagrams are plans for two simple types of experiments involving problems of interest and importance to every golf course. Similar experiments are easily planned to bear on any problem that presents itself. It cannot be emphasized too strongly that only such definite experiments will really answer any problem or question for any particular club. Soils and climatic conditions vary so greatly that there can rarely be full assurance that the results secured in one place apply generally. From the standpoint of economy alone, every golf club should experiment in a small, but definite, way to learn which methods are satisfactory and which unsatisfactory under its conditions. Until this is done, its greens committee will be continuously in doubt because the counsel it receives will be so diverse. Most of the advice given in such cases is mere opinion, but of the sort that nothing but careful experiments can shake.

When different fertilizers are compared, the best experimental method is to use them in quantities so that the amount of the element tested is the same for each plot; or so that the amounts of each of the three essential elements — nitrogen, phosphorus, and potash — are the same. For many commercial fertilizers these proportions are shown in the accompanying table, from which one may determine the amount of each to use where fertilizers are to be compared. Thus ten pounds nitrate of soda, eight pounds sulfate of ammonia, thirteen pounds tankage, and twenty-three pounds cottonseed-meal each contain equivalent amounts of nitrogen.

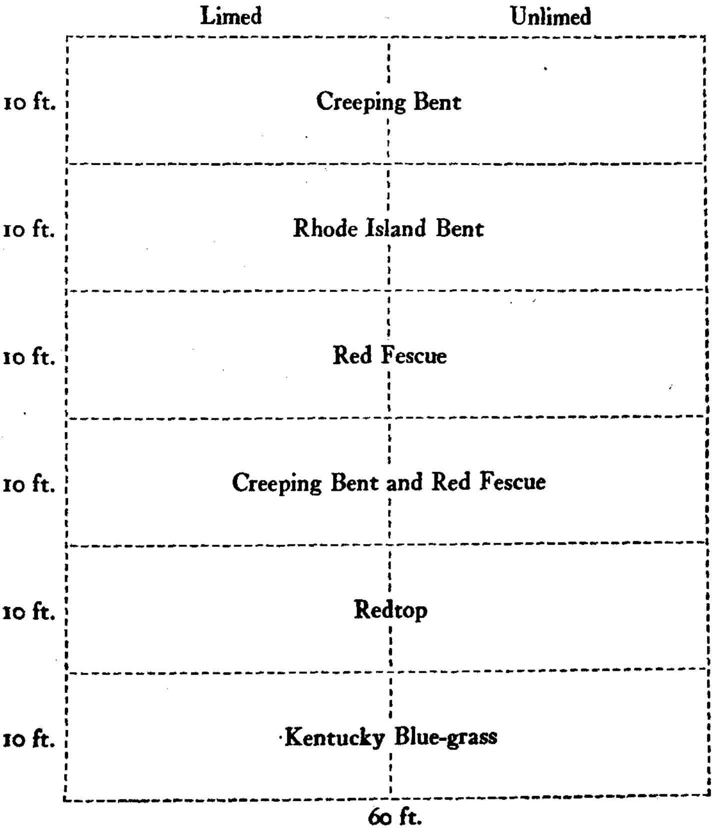

Diagram of a simple experiment to determine the effects of lime on a series of turf grasses, the soil treatment to be identical except that on one-half of each grass plot ground limestone is to be applied at the rate of two tons to the acre, either before the grasses are sown or afterwards as a top-dressing.

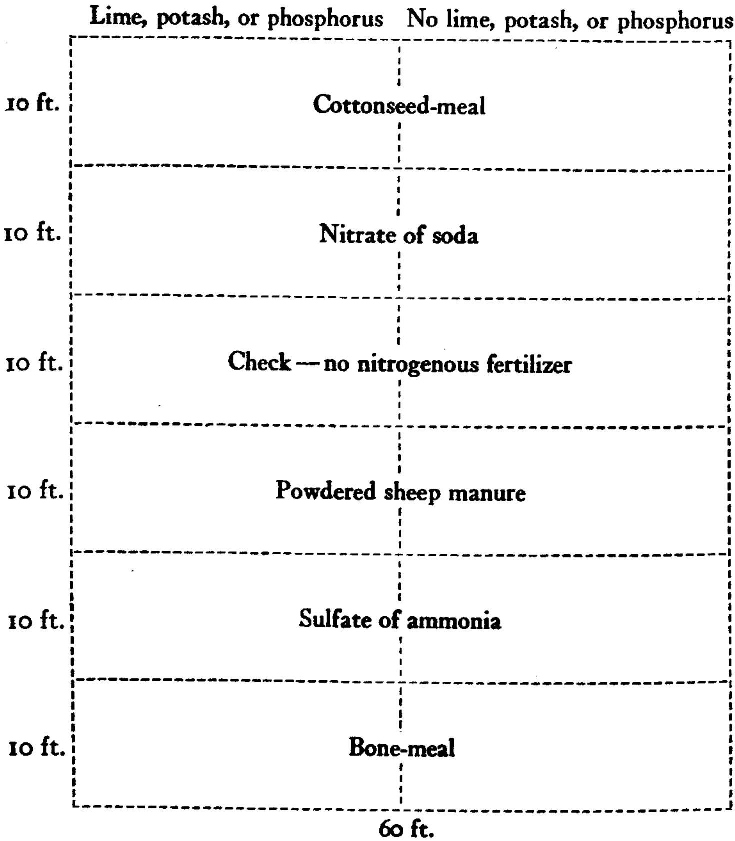

Diagram of a plot of Creeping Bent turf on which various nitrogenous fertilizers are being tested, the fertilizers being applied at the same time in amounts to give equal quantities of nitrogen. If desired, one-half of this plot could be treated with lime, phosphoric acid, or muriate of potash to determine the effect of this alone and combined with each of the others.

The comparative testing of complete fertilizers, those containing nitrogen, phosphorus, and potash, is less simple. In case one wishes to compare the relative efficiencies of several kinds of mixed fertilizers on grass, one should consult the chemist of the state experiment station, as otherwise unsuspected errors and consequent false conclusions may be reached.

TABLE SHOWING AVERAGE PERCENTAGE OF NITROGEN, PHOSPHORIC ACID, AND POTASH IN VARIOUS FERTILIZERS

Fertilizer	Nitrogen	Phosphoric Acid	Potash
	Per cent	*Per cent*	*Per cent*
Nitrate of soda	16		
Sulfate of ammonia	20		
Cottonseed-meal	7	1.5	2
Bone-meal—raw	4	20	
Bone-meal—steamed	2	25	
Sheep manure	.95	.35	1
Dried blood	13	1	.8
Tankage	12	1	
Hoof-and-horn-meal	13	5.5	
Com. grade acid phosphate		14–16	
Muriate of potash			44–57
Sulfate of potash			47–52

NOTABLE FINE TURF INVESTIGATIONS

Olcott's turf-garden.—In the testing and selection of fine turf grasses, a notable body of work was conducted by J. B. Olcott at South Manchester, Connecticut, under the auspices of the Connecticut Experiment Station. This work was carried on from 1885 until the time of Olcott's death in 1910. The appearance of this notable grass turf-garden is shown on Plate XIX. Olcott's method was the simple one of continued search for plants that approached his ideal of perfection. In the course of his labors he visited hundreds of localities in America and Europe, as well as Hawaii, New Zealand, and Australia. Whenever or wherever he found a piece of turf that appealed to his taste, he carried it to his home where it was patiently propagated until enough was secured to plant a plot large enough to judge of its merits in comparison with others. In some plots grasses were grown from seed, but Olcott found that most of these showed much variation between individual plants, even when grown from a supposedly pure strain, so that eventually he propagated all his turf grasses by division, never allowing them to produce seed. During the life of its creator, the Olcott turf grass garden was one of wonderful interest. It contained nearly 500 strains of grasses, the choice out of the thousands that had been tested. The plots of turf were mostly about four feet square, but a few much larger, every plot being grown by the

PLATE XIX. — A view of the Olcott grass turf garden at South Manchester, Connecticut.

vegetative division of a single original plant. Viewed as a whole it resembled a great checkerboard of different tints of green. Each plot received all the care that expert gardening skill and passionate devotion could give. This involved frequent clippings, trimming of the border so that one grass would not invade adjacent plots, and particularly hand-weeding, as some weed seeds were always being carried by the wind or otherwise to the garden. For weeding purposes, Olcott devised many ingenious tools. Each plot represented, therefore, the best possible turf that the particular strain of grass could produce. Olcott soon reached the conclusion that no other grasses could produce in New England turf of higher quality than did Creeping Bent and Red Fescue. Between these two grasses it is hard to decide, as in each there are strains that vary from pure pale apple green to the deepest emerald green. To the hand Red Fescue feels rather stiff and wiry, whereas Creeping Bent is soft, but each will produce a turf that under foot feels like soft velvet carpet. The dark green strains appeal to most persons as the ideal color for lawns, and the very dark green strain of Red Fescue makes probably the most beautiful turf of all temperate zone grasses.

While Olcott possessed the genius to select the grasses and grow to perfection the finest turf that had ever been produced, he lacked the ability to induce persons who could afford it to grow such lawns about their houses. Or perhaps the time had not come to interest the American public in his idea.

After Olcott's death the finest pieces of his turves were purchased by F. W. Taylor and transplanted to his home at Highland, near Philadelphia, where they furnished the basis of much of Taylor's subsequent work.

The Fred W. Taylor method of making putting-greens. — In many ways the most extensive and remarkable series of turf experiments ever undertaken were conducted by Fred W. Taylor on his home grounds near Philadelphia. These experiments were begun in 1904 and were continued until Taylor's death in 1915. Just before his death, Taylor prepared a series of articles in which were set forth some of his results and the conclusions he had drawn from his work. The articles were published in the "American Golfer," December, 1914, to June, 1915, inclusive, and in "Country Life in America."

Taylor, whose work on scientific management is well known to all, believed thoroughly in standardization, and, being an enthusiastic golfer and a keen student of the game, soon realized the lack of system practiced in the making of putting-greens. Purely from the love of the sport, he undertook his experiments with the firm belief that greens could be made in much the same way that an article is manufactured in a machine shop or factory. He believed that careful study would reveal the specific requirements for fine turf, and that these requirements could be met by the use of standardized materials. It may be said in passing that, at the outset at least, he greatly underestimated the importance of the factors affecting turf production which cannot be controlled.

The results of Taylor's preliminary experiments, which involved hundreds of plots and tests, led him to the basic conclusions which many other investigators have reached, that the chief essentials for good turf are good seed of suitable grasses, a good medium for the germination of the seed and the development of the seedlings, and fertile soil having a high water-holding capacity, and at the same time providing perfect drainage. With these conclusions fairly in mind, Taylor sought to construct the ideal green by selecting his grasses and actually building a medium upon which they were to be grown.

Among the first experiments which he conducted were those in which various germinating media were tested. He finally selected peat moss, a material that is imported in quantities from Holland, and which is also found abundantly in this country. To twelve parts of shredded peat moss he added one part of powdered bone, and with these he mixed the grass seed at the rate of 2000 to 5000 to 1. He found that when such a mixture is saturated with water and spread on a properly prepared surface, a uniform and thoroughly satisfactory stand of grass resulted.

This germinating medium possesses several valuable qualities. It has a high water-holding capacity, it does not compact, and is sufficiently open to admit of a free circulation of air. Furthermore, it is practically sterile so far as weed seeds are concerned and, on the other hand, contains enough nourishment for the seedlings. His method of seeding greatly reduces the quantity of seed necessary to secure a stand, but this pecuniary advantage was more than offset by the increased cost.

The germinating layer, as Taylor called it, embodied a new application of old principles to the seeding of putting-greens, and was, perhaps, the most important feature that developed from his investigations. His experiments with soil layers and mixtures were almost without number. He hoped by testing the physical properties of various elementary soil substances to be able to construct a soil that would supply the optimum quantity of water to the grass plants at all times, and also contain plant-food at the proper depth.

Wicks of soil leading from a constant water supply up to a moisture-holding layer, rich in plant-food, were tested, but many important modifications were necessary in the subsoil feature before he hit upon a combination that suited him. However, the water-holding food layer was developed early in the history of his tests. In this connection Taylor finally decided to use two layers, which he termed the upper and lower blanket layers, the former resting upon the latter and lying immediately under the germinating layer. The upper blanket layer varied from nine-sixteenths inch to one and one-sixteenth inches in thickness, and was composed of twelve parts by volume of shredded peat moss, six parts by volume of powdered limestone, and one part by volume of powdered bone. The lower blanket layer was three-fourths inch in thickness and was composed as follows: Shredded peat moss by volume, twelve parts; Powdered limestone by volume, twenty-one parts; Cow manure by volume, five parts; Bone cracked to one-fourth inch size by volume, three parts; Powdered bone by volume, one part. Other combinations were used in making the blanket layers, but Taylor considered this the best. In his opinion the upper layer had two important functions, namely, to promote rapid growth of the young plants, and to provide a springy surface, properly to check the ball on the approach shot. His chief reason for making a difference in the composition of the two layers was to provide suitable firmness. He believed these two layers to be almost ideal for the development of the surface roots, and for furnishing proper texture to the green.

Taylor conducted a great many tests before he found a subsoil that met with his requirements. Early in his experiments it became necessary to abandon the idea of sand or soil wicks to conduct water from a constant supply to the blanket layers. He also found it necessary to abandon the idea of a subsoil in which the greatest and deepest root development would take place, since the grass on such soils would not stand heat and drought. Clay, on the other hand, he considered too impermeable, so he finally decided upon combined water-holding and permeability in one structure. Briefly, his foundation, or subsoil, was composed of alternate layers of two different compositions. It was intended at first to place these layers vertically, but this he

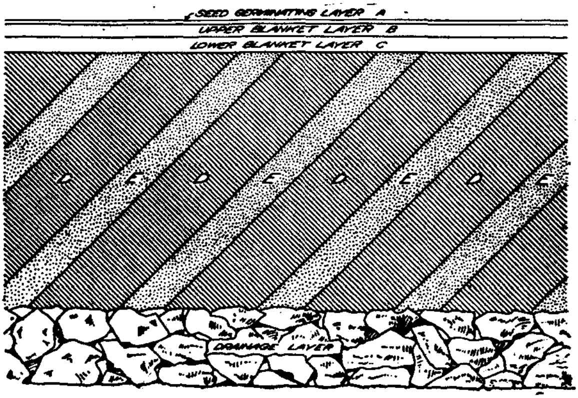

FIG. 50. — Diagrammatic cross-section of the soil layers of a putting-green constructed according to the method most approved by F. W. Taylor.

found to be impracticable, so he conceived the idea of laying them at an angle of about forty-five degrees, and on account of the diagonal position he called the layers "slants." The so-called moisture and food slant was composed of a mixture of three parts clay and one part cow manure, and was about three inches in thickness. The other slant was composed of decayed peat moss, chopped in a feed chopper and mixed with cow manure at the rate of nine parts of the former to one of the latter. This slant was called the deep-rooting layer, and was one and one-half inches in thickness. For convenience of laying, the materials for these slants were mixed and molded into rectangular slabs of suitable dimensions. When placed in position they had a vertical depth of twelve inches. (Fig. 50.)

The slants, in Taylor's opinion, furnished an excellent medium for the development of grass roots, for supplying food to the plants, and for absorbing and holding moisture; in addition to these qualities, they provided excellent drainage. With a twelve-inch slant section, followed by a lower three-fourth inch blanket layer, then an upper blanket layer from nine-sixteenth inch to one and one-sixteenth inches, and finally a three-sixteenths inch germinating layer on the surface, all of which contained large quantities of peat and manure, it readily will be seen that the soil of Taylor's greens was composed very largely of organic matter which, together with the other materials and the methods of construction, made the building of a green after his plan unusually expensive. According to his own estimates the cost of constructing a green of average size would be approximately \$2500. However, he did not consider this prohibitive and, in fact, believed his method, in the last analysis, to be an economical one.

In discussing the requirements of a putting-green, he says in one of his articles on the subject: "The most important element is, of course, the soil which will ultimately allow the roots to go deep below the surface. If you have a natural soil of this sort, then I look upon germinating the proper number of seeds per square inch in the peat moss germinating layer as the next most important. Third comes the upper peat moss and limestone blanket layer, and fourth, the lower blanket layer. So much can be accomplished at a small cost through the use of peat moss germinating and blanket layers that no new green should be built without them. The writer places these three elements ahead of the artificially slanted layer soil because their cost is insignificant compared with the latter. If, however, fine results are desired within a few years after making a green, all of these elements are necessary. At the end of six years after making one of our greens, the original cost, plus the annual expense of maintaining it, will be less than that of a green under the usual way."

Even a casual glance at Taylor's method of green construction reveals several unique features, some of which are not in accord with the orthodox views on the subject. For example, the germinating and blanket layers contain large quantities of bone and pulverized limestone. Bone is objected to by many because of its influence on White Clover, and lime is thought to be prejudicial to the best development of the bent grasses and Red Fescue. Such a large percentage of organic matter as Taylor's plan calls for is commonly objected to on the ground that it decomposes, causing uneven settling, and also on other grounds.

It is not intended here to enter into a defense or a criticism of Taylor's method. Fortunately he personally supervised the making of four greens according to this method on a new course near Philadelphia, and many new greens in other parts of the country have been built after it, so that it will in time develop its own advantages and weaknesses. This opportunity, however, cannot be missed to express appreciation of the motive which prompted Taylor's work, and of its value in stimulating much needed critical turf investigations.