



Golf Course Construction from the Greenkeeper's Standpoint

By EDWARD B. DEARIE, JR.
Noted Chicago Greenkeeper and Golf Course Architect

CHAPTER IV—*Drainage on the Golf Course*

SATISFACTORY drainage has much to do with the perfection of an attractive golf course. The importance of adequate drainage to any golf club, which desires a well-kept course and contented members, cannot be overestimated. The wrath of golfers, who are kept off "their" course until the ground has dried after every rain storm usually is quite forceful. Their opinions of the club management, Green chairman and greenkeeper generally are expressed in very plain language.

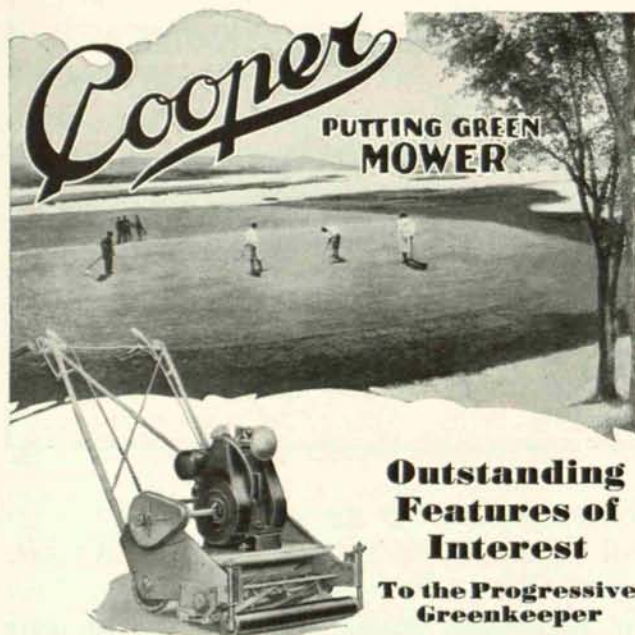
Standing water and miniature ponds, where the design of the course calls for dry surfaces, are most uninviting. Not only is the damp-

ness unpleasant but the accompanying mud is still worse. Under such conditions it is necessary for the course to be closed to play and for the aggravated golfers to await the pleasure of Old Sol.

While some sections of this country are blessed—or cursed—with rainy seasons during which rain may be anticipated and prepared for, other portions of the country are likely to be visited with rain almost any time. The severity of the downpour, also, is uncontrollable. The "weather man" has an annoying habit of ignoring tournament plans. Often a sudden shower will either postpone a match



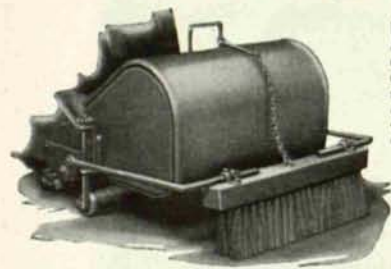
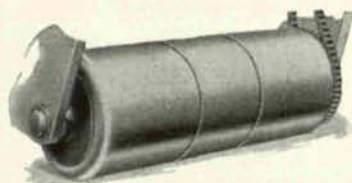
BRAE BURN'S NO. 12—163 YARD UPHILL SHOT. THE BUNKERING HERE IS SEVERE



To maintain perfect greens as demanded by present-day golfers, perfect cutting of the grass, frequent rolling of the turf, aerating of the soil, brushing in top dressing and brushing off worm casts and other refuse, are necessary operations which require considerable care if the surface of the green is not to be injured. The ever-increasing popularity of the Cooper Putting Green Mower is due to the fact that it eliminates manual labor from greenkeeping and under its own power performs these various operations efficiently and quickly.

The high-speed, seven-blade reel trims the turf to perfection; the smooth sectional aluminum roller with differential action for easy turning, supplies traction and provides with each cutting that gentle rolling action that levels without packing; finger tip control and independent operation of blade reel and traction roller make the mower extremely easy to handle. The light but strong steel and aluminum alloy construction, Briggs & Stratton motor and grease packed gears with ball and roller bearings throughout are Cooper features that insure longer life and trouble free service.

Of particular importance is the fact that this mower has the famous quick-detachable "drop-out" reel and bed plate unit pioneered by Cooper. Both roller and reel are chain driven and the latter can be operated in reverse for self-sharpening. Additional investment in a transport cart for this mower is unnecessary.



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er dampen the ardor of contestants and gallery.

Championship courses, however, are most carefully drained and soon dry after the storm and are ready for play again in a short time. Land, which is improperly drained, may remain water soaked for days or weeks. In the middle of the playing season, when the popularity of the game is at its height, such a condition is intolerable.

Besides the inconvenience of stagnant water and sticky mud to golfers, there is still a more important reason for adequate golf course drainage—its effect upon the turf. Too much water is just as injurious to grass as not enough. When grass cannot breathe properly, it suffocates and soon dies. Turf is not injured by a blanket of snow because it is more or less porous and permits free circulation of air. However, it is likely to be drowned under storm water from fall or winter rains which later freezes and covers it with a coffin of ice. Thawing snows have a tendency to freeze unless the water is quickly drained. Improperly constructed fairways, which are not graded so as to permit the surface water to flow off, and unsatisfactorily drained courses, are not likely to have much well-appearing turf in the springtime.

Storm Water Drowns Bacteria

SOIL may be ever so fertile but, if it is not properly drained, it is unsuitable for the growth of turf. Storm water not only drowns the necessary soil bacteria but affects the porosity or ventilation of the ground. Mineral salts and fertilizer elements are dissolved in stagnant water and are washed away. Such soil changes are highly undesirable for turf growth.

The importance of adequate drainage in satisfactory golf course maintenance is being recognized more and more. There is scarcely a country club which, either willingly or unwillingly, is not obliged to give the subject consideration. Plans for new courses should always include provisions for drainage.

Drainage has a direct effect upon maintenance expenses. Reseedings, refertilizations and other expensive items of cost in many cases may be traced to poor drainage. This relationship is so close that it cannot be ignored. An adequate drainage system is an investment

which will pay dividends in reduced cost of maintenance and in general satisfaction.

Like other investments of magnitude, the installation of a drainage system on a golf course requires the most careful consideration. As each piece of property has its own individual topography and soil characteristics, each site must be studied separately. The best advice can only be given by an engineer well qualified by experience in the particular field of golf course drainage and soil physics.

Drainage has many technical aspects beyond merely providing for the elimination of surplus surface water. If it were merely a problem of laying necessary drainage lines to drain off accumulated water, the laying out of a drainage system would not be so complicated. There are many other things to be considered, none of which should be neglected.

Two Phases of Drainage

THERE are two distinct phases of drainage—surface and underground. Both are equally important. Underground drainage cannot be observed but its effects are soon apparent.

Soil varies greatly in texture and composition. Some types of soil, such as sand, permit free seepage of water without hinderance; other types, like clay, do not permit ready drainage. A knowledge of soil physics can only be obtained from observation. Naturally, such knowledge is possessed by very few.

The flow of water underground depends upon the texture of the soil and other important factors. This direction of underground flow may be vertical, horizontal or obliquely downward. At the surface, capillary action of the soil even draws underground water upwards. The direction and rate of flow of the downward drainage requires the most careful study in order to ascertain the underground lines at which water is likely to accumulate. When these lines have been located, it is comparatively easy to install tile lines at the proper levels and to arrange for the water's disposal.

The drainage of surrounding property also must be considered. In some cases, golf courses drain naturally and satisfactorily into lower areas thru the underground stream. However, such instances are somewhat rare. More common are instances where drainage water from



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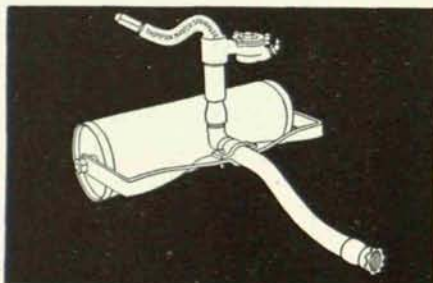
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higher levels flows down upon golf course property either above or below the surface. In the former case, surface drainage can be restrained at will but in the latter case the flow of the underground stream cannot be prohibited and there is no remedy, except provisions to take care of it. These considerations should have been given attention in the selection of the site.

The topography of a golf course with its natural or artificial mounds and hollows is certain to call for surface drainage. The slope of fairways, greens, bunkers and traps determines the direction in which they will drain. Unless their centers contain saucer-like depressions, greens usually may be drained without difficulty. However, care must be taken to prevent storm water from running down the sides and accumulating in the traps or pits.

Locate an Outlet First

ONE of the first things to be done in laying out a drainage system for a golf course is to locate a drainage outlet. A topographical map of the property is of great assistance. A glance at it will reveal which areas are the lowest, and the most suitable of these can be considered for the drainage outlet. In many cases low areas will be found in the central portion of the property which may be converted into an attractive lake or lagoon. This simplifies the problem but does not solve it. Preparations must be made thru dams or weirs to control the excess water and to pump it to a permanent disposal.

Generally, the natural drainage outlet to a golf course is upon neighboring property. Neighbors have a tendency to be very unneighborly when it comes to drainage. Frequently permission to make arrangements for drainage will be denied even when the adjacent property will be injured in no way. Sometimes the most stubborn mulish obstinance will be encountered—usually with the expectation of forcing a cash settlement. This is another possibility that should have been considered in selecting the site. Lawsuits to determine drainage rights are long and costly. Before acquiring property for a golf course it should be inspected by a competent drainage engineer.

If arrangements cannot be made to drain the

property upon the adjacent land, permission must be secured from the city, county or state officials to lay sewer lines along the highways to a satisfactory point of disposal. In some sections of the country storm water may be dumped into open ditches. However, in many places such ditches must be either covered or protected. In some cases the water must be taken a considerable distance to a river or lake, or some definite outlet.

When the drainage outlet has been determined, plans must be made to direct both the surface and underground water to that point as efficiently and economically as possible. Lines of hard burnt shale tile have been found the most satisfactory.

Not Necessary to Seal Joints

IN most soils it is not necessary to seal the joints of the pipe as it is desirable that they should be open to admit more water. In some soils, however, it is necessary to seal the joints with Ric-Wil filter tape. Otherwise, the water will draw too great a quantity of sand or fine soil into the tile line. While it is desirable to backfill the drainage trenches with gravel, which will permit the ready seepage of water, this is not practical except occasionally. However, most soils, except clay, may be used for backfilling, provided a layer of cinders or gravel is placed just above the tile line.

The placing and spacing of the tile lines require the most careful forethought. It is the character of the subsoil, rather than that of the surface soil, which determines the rate at which water moves towards and into the tile drains. Tile lines must be placed at right angles to this underground flow and at such depths that the underground water will not only seep into them but will also flow into them horizontally or obliquely. In order to determine the depth and location of these lines the drainage engineer needs a thoro knowledge of the subsoil and all of its characteristics.

The surface water, too, must be directed into the tile lines. This is accomplished thru the construction of catch basins at strategic spots on the course. These catch the surface water and direct it into the tile lines. These inlets average about three feet in diameter. Their depth varies according to the depth of



Returns Handsome Dividends On New Fairway Seedings

The belief that two to three years are required to produce good fairways is wrong.

It is true that sparse turf once obtained is difficult and expensive to improve, and often deters prospective members from joining new clubs.

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Milorganite has been used prior to seeding with conspicuous success on more outstanding courses than any other fertilizer.

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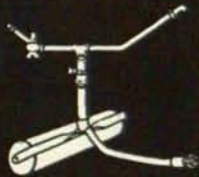
We are prepared to make soil examinations and specific recommendations.

For further information address

The Sewerage Commission

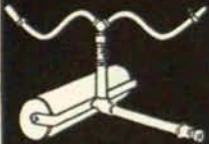
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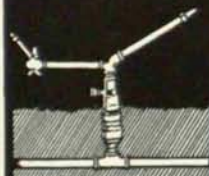
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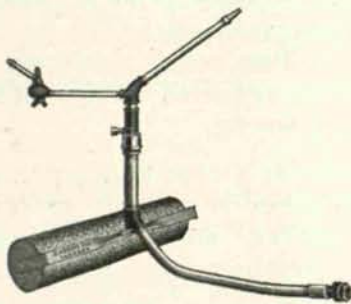
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the tile line below the surface. In fact, the bottom of the catch basin should be about three feet below the tile line in order to provide a receptacle in which to catch silt, sand or dirt and prevent it from settling into the tile line. These basins should be cleaned out at least every season.

One or More Trunk Lines

THE usual drainage system consists of one or more trunk lines, varying in size from eight to twelve inches in diameter, and a number of four-inch or six-inch laterals. The use of smaller tile than four-inch is not practical as the smaller size would obstruct the flow.

Tile lines must be laid with the greatest care. A slope of two inches to a hundred feet is sufficient for the larger sizes while a slope of three inches to a hundred feet is necessary for the smaller sizes. This grade can be increased to bring the end of the system on a level with the drainage outlet. However, if the end of the system falls below the drainage outlet, a pump must be installed. Grades should be taken every hundred feet and every effort should be made to keep the tile lines at the proper levels.

The expense of installing a drainage system is considerable and it is very important that it should function properly. This means that it must have been properly designed and honestly installed. As nearly all of the work is underground, where it cannot be seen, there is a chance for slovenly, negligent work. Before the backfilling is commenced, all tile lines should be carefully and conscientiously inspected by a competent drainage engineer. The work should not be paid for until the club has some assurance that the system will function.

The growing season, which sometimes limits the golf season, is prolonged by adequate drainage. Drained land is from ten to fifteen degrees warmer than undrained land, which makes the drained soil freeze later and thaw earlier. It is only possible, through drainage to keep an abundance of oxygen in the soil, so indispensable to the life of the turf. This element is necessary before the necessary chemical changes can take place in the soil. Naturally,

(Continued on page 32)

Steaming Loam

By PAUL G. WANBERG
Weston Country Club, Weston, Mass.

I have heard the process of steaming loam criticized by different authorities on turf and greenkeeping. Others I have talked with feel much the same as I do about this steaming process, but cannot get their club members or chairmen interested.

My experience with this steaming of loam covers only four years or seasons, but I have in this short period seen a marked difference in the cleanliness of my greens. Before we started steaming loam it was necessary for me to have men weeding greens; this is an eyesore, and we have now eliminated such worries!

I have given this process of steaming a strict test, and have found by experimenting that 99% of all weed seed are killed. I also believe that most of the weed seed are planted with the compost dressing and a very small amount is blown on the greens from the fairways and rough.

I cannot say that this sterilization process has made our greens immune from brown-patch, as I have my troubles during that season, but I believe it helps, as the attacks are never serious.

In the steaming of loam it is necessary to have a good equipment, and to make it as economically as possible. We have an upright boiler (housed in), capable of 200 pounds steam pressure, but 80 pounds is all that is required to start the steaming or cooking. The box I have built to hold the loam has a cement floor and a waterproof cover; this is essential as the loam is left in the box two or three days to cool and dry. There are five six-foot lengths of inch and quarter pipe leading from a header with holes about every inch through which the steam is forced. In order to steam four yards of loam and get results, about two hours' time is required.

The cost of steaming for the season is very small considering that it is not necessary to have men on my greens weeding. There is always plenty of dead wood in cleaning up a golf course, sufficient to fire the boiler each season.

Those interested in this steaming process of sterilization of compost can inspect our plant at Weston at any time.

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When play gets under way earlier in the season, north or south, you are reasonably sure to find the fairways and greens drained by Armco Perforated Iron Pipe. Many of the preferred, best-conditioned courses, where scores are not jeopardized by casual water and soft, pulpy ground, depend on this product to give year in, year out trouble-free water disposal. As rain falls it is carried off.

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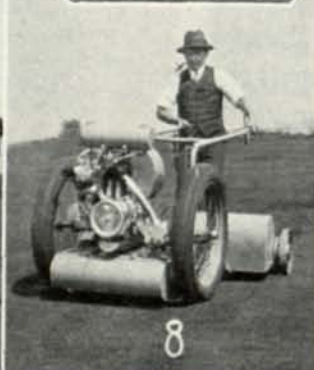
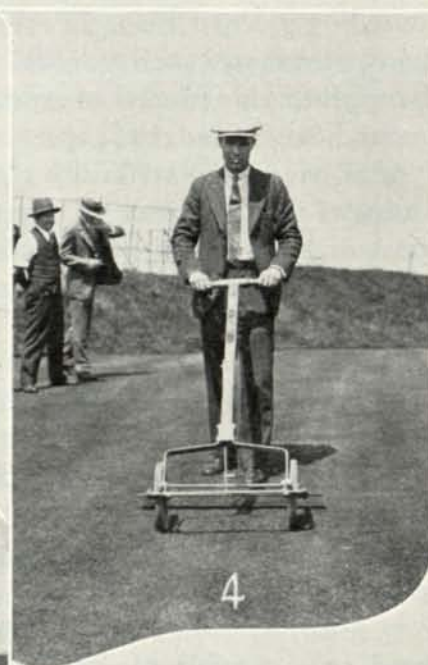
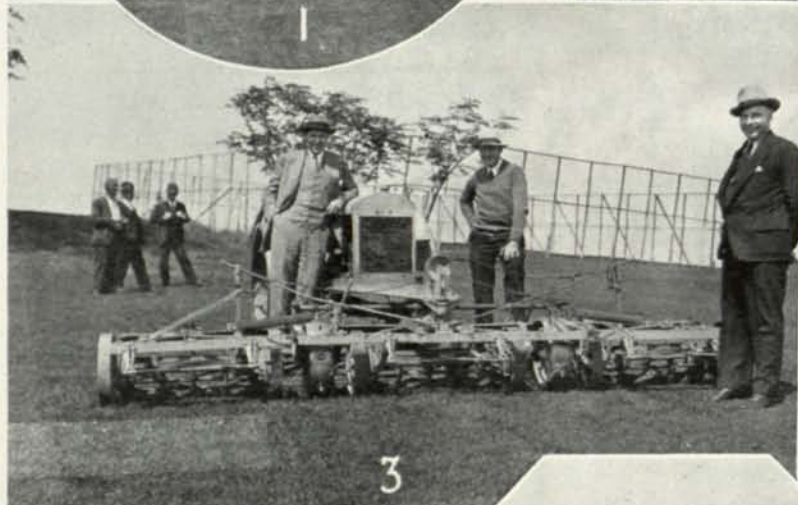
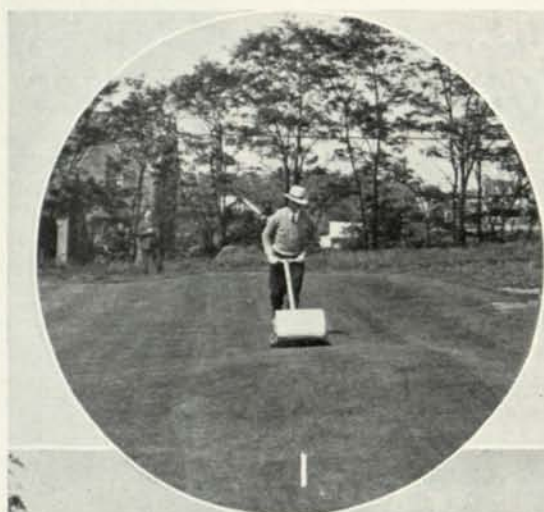
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Equipment Demonstration at Pittsburgh



MACHINERY MEN DO STUNTS AT JOHN QUAILL'S HIGHLAND COURSE

No. 1—John Quail pushing a Toro mower; No. 2—Group of greenkeepers at equipment demonstration; No. 3—Toro fairway unit with Ken. E. Goit, John Quail and Arthur Flack; No. 4—Toro Greens Mower carrier; No. 5—The three Johns—Quail, McNamara and Pressler; No. 6—Worthington fairway unit with Bick Hurlock and Ed. Worthington; No. 7—Ken Goit and Ed. Worthington in conference; No. 8—Fred Jacobs of Stanton Heights operating Worthington "Overgreen"; No. 9—Bob Smith of Westmoreland, Chas. Nuttall of Fox Chapel, and Bick Hurlock

Brands Fungi As Golfers' Foe

BY WALLACE S. MORELAND
New Jersey Experimental Station, New Brunswick, N. J.

THREE species of fungi or minute plant parasites stand convicted of boosting the scores of many a New Jersey golfer.

Guilt of the fungi, which are so small a golfer would need a microscope to see them, was established by agronomists of the New Jersey Agricultural Experiment Station, who for more than a year have been attempting to find the cause of and a cure for a new type of injury to putting greens. This disorder was first noticed during a period of unusually hot humid weather in July 1928, which extended from June through August.

During that period the scores of many New Jersey golfers showed a marked upward trend because of the poor condition of the putting greens, the annual bluegrasses of which were killed overnight in many instances. The disorder became so widespread that help was asked of the state agricultural experiment station

by the New Jersey Greenkeepers' Association and the New Jersey State Golf Association. The golf association provided financial support for the studies, which were started in September, 1928, at the experiment station.

Dr. H. B. Sprague and E. E. Evaul, agronomists, found that three species of fungi—known to scientists as *Colletotrichum cereale*, *Helminthosporium vagans*, and *Fusarium* sp.—killed bluegrass on the greens but had no harmful effect on bent grass.

The investigations of the two agronomists further revealed that serious injury from these fungi would occur only during periods of "abnormally warm, humid weather."

It was found that the degree of injury to the putting greens was correlated with the abundance of annual bluegrass growing on the green. The predominance of bluegrass on the many injured greens, according to the report

A FEW PETERSON SPECIALTIES

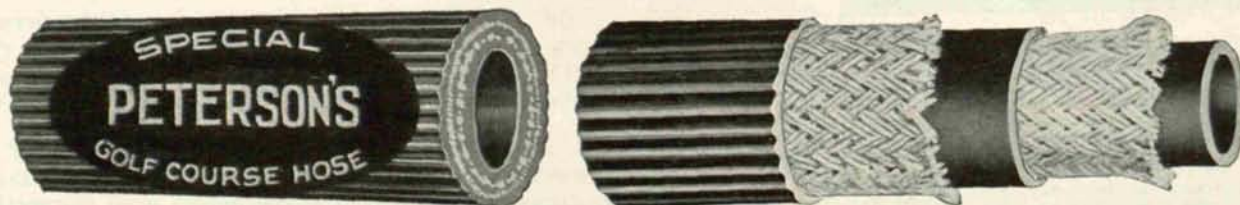
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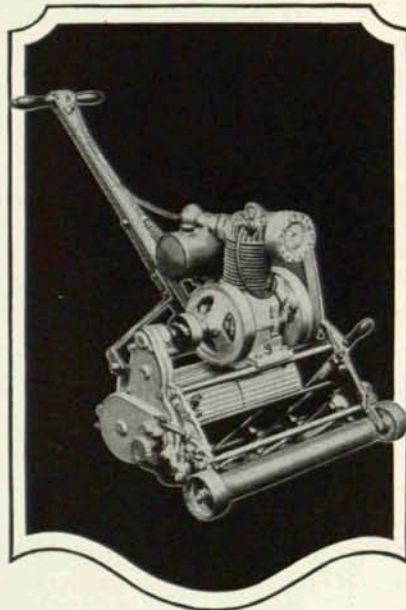
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Keepers of America's most famous golf courses use the Jacobsen Power Mower because of its emphatically superior features, including the auto-type differential which equalizes the traction on two sections of the large rear roller. Result: unequaled ease of turning, a velvety turf without a dent or a scar—a perfect putting turf. Seven-blade high speed reel cuts 19 or 24 inch swath; reel sharpened without removal by mower's own power; special patented brush attachment for close cutting, aerating creeping bent greens preventing "brown patch," and for perfect spreading of top dressing.

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Descriptive literature sent free upon request, explains the mechanical details which have in many years time given world-wide dominance to Jacobsen power mowers. Read it and get the experience of prominent greenkeepers of nationally famous golf courses who use the Jacobsen exclusively; how they maintain 100% perfect greens; also convincing reasons why Jacobsen power mowers help reduce club assessments. Write us today and receive this valuable literature.

A Few of the Many Jacobsen Users:

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Lincolnshire Country Club, Crete, Ill.
Biltmore Forest Country Club, Biltmore, N. C.
Oakwood Country Club, Cleveland Heights, Ohio.
Kahkwa Country Club, Erie, Pa.
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and hundreds of others.

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announced today, was due to heavy subsoil and poor subsurface drainage, which favored the growth of bluegrass at the expense of bent grasses originally present.

"Future outbreaks of the disorder may be expected whenever abnormally warm humid weather is experienced," the report states.

"Control measures have not yet been perfected, so preventive measures must be followed until adequate methods of control are found. To prevent outbreaks of this disorder, do not allow bluegrass to predominate on the greens. Remove all clippings during warm, humid weather, and adopt cultural methods that will make for a rather slow but tough hard growth of grass."

West Penn. News

The Pittsburgh Field Club is in wonderful shape for the U. S. G. A. Qualifying rounds. The greens, tees and fairways are like carpets and the rest of the course has that well groomed appearance common to only the best courses of the country. Jack McNamara is sure following in the footsteps of his father in keeping the Field Club course in faultless condition.

Needless to say, but Oakmont is still in the pink of condition. Emil Loeffler is busy as the proverbial bee since he has taken over the Pro job along with his regular duties as greenkeeper. The Inter-collegiate Championship will be played at Oakmont this year.

Bob Smith of Westmoreland and Dave Bell of St. Clair are still trying to see who can raise the best bent greens. So far it has been a draw and both have shown what can be done with bent when you know how.

John Pressler, the veteran greenkeeper of Western Pennsylvania who keeps the golfer of Allegheny Country Club satisfied, has just completed a few big changes in his course. John had a couple of steam shovels working all spring and has had his hands full. He sodded two fairways and did a wonderful job.

Bill Key from Long Vue is taking a few days off from trying power mowers to build a horse show ring. Bill has some nice horses at his club and anxious to get a good place to show them.

Ralph Martin of Shannopin has his course in fine condition. He is getting ready for an invitation tournament and if he gets the breaks with the weather he will hear nothing but praise.

The West Penn Equipment Demonstration was a huge success. About sixty greenkeepers and others who were interested attended. The Highland hills made the tractors show what they had and they showed it. The progress made in equipment the last ten years has been wonderful. Power putting green mowers also drew a lot of attention as well as the tractors and fairway outfits. The deep tillage tools demonstrated with a caterpillar tractor were very interesting. It showed what can be done to break up a hard subsoil and help drainage.