back some prominent growth, but the art of pruning calls for more than this.

Much depends upon what a shrubbery is intended for apart from its beauty, if for a wind break or screen, or if a formal appearance is desired. In the former case less pruning would be required as the shrubs may be allowed their freedom of growth. To maintain a formal appearance a certain amount of pruning must be performed regularly.

In explaining the method and reason for pruning and to make myself more explicit it may be of interest to some of my readers if I take some of the better known shrubs in detail rather than collectively.

Forsythia

These are about the earliest of spring shrubs to flower, producing an abundance of soft, yellow flowers on the previous year's growth. Elegane, Fortunei, Suspensa are about the best and though different in form require the same treatment. As these shrubs flower in a nude state, that is before the leaves appear they are seen to better advantage if they have a background of some evergreen. Prune directly after flowering is over by cutting out all weak, thin wood and reduce flowering wood to two, three or more wood buds or shoots as desired. The pruning may be done with shears or knife. The latter is to be preferred, as with the former there is generally a bruise, especially in the hands of a novice.



Japanese Barberry



Hydrangea, Paniculata Grandiflora

The cut made should in all cases be slanting and close to the bud or shoot. As growth takes place, this will enable the cut to heal over. This is a very important point especially in fruit trees.

Hydrangea (Paniculata Grandiflora)

This is probably one of the best known shrubs, therefore needs no description. Worthy of a place in any garden and one of the best positions. Prune in early spring after danger from severe frost is past. The weaker growths may be cut hard back to two buds, the strong growths about three or four. This method will prevent the plant from getting "leggy" and produce better results.

Spiraea

If anyone had to limit themselves to one class of shrubs, I doubt if another could be found that would provide such variety of form, flowers and period of flowering as Spiraea. They are not particular with respect to conditions of soil, situation, etc. and are therefore easy to grow. Some varieties are splendid for hedges.

For the latter purpose Spiraea Van Houttei, commonly known as bridal wreath, is extensively used. Undoubtedly the best variety for either a wind break or hedge is Spiraea Opulifolia, a tall vigorous grower, oftentimes making five feet of growth in one season. This variety should be cut back in early spring, reducing the growths about half their length. If full length is allowed to remain it will be seen that growth will commence at the top (as in most cases) causing the buds at the lower part to remain dormant and giving the plant a barren or leggy appearance. This variety will often throw up vigorous growths from the base and in this case it is policy when pruning to cut one or possibly two of such growths hard back. This will insure a certain amount of strong young growths and keep the shrub in a healthy flowering condition, later on, to allow a lot of exhausted wood to be removed thereby letting in more air and light. This method may be adopted in a great many cases.

Spiraea (Froebeli)

This variety is quite distinct from many of the same family bearing flowers in panicles of dark violet red in color, besides having highly colored foliage in spring and autumn making this a very desirable variety.

Spiraea (Anthony Waterer)

A popular, dwarf growing variety suitable for planting in the front of borders, producing large heads of cerise colored flowers, lasting well into late summer. Both these varieties require pruning in early spring and the same treatment accorded them. Prune out all puny wood and as these subjects grow in a natural form, the center growths may be left slightly longer than the outside ones.

Syringa (Lilac)

The common, tall growing form of this shrub is seen practically everywhere, and judging from their numbers, both single and double flowered being cultivated, they have proved themselves to be a general favorite. As their large bold trusses of bloom freely produced are extensively used for cutting, these subjects receive a certain amount of pruning that many shrubs do not get at the time of flowering, and on that account will probably give less trouble.

Shrubs that are better suited for specimens are-Aralia Spinosa, Cratoegul (Hawthorne), Rhus Cotinul, Prunus Triloba, and Magnolias. The latter blooms in a nude state and makes a magnificent specimen with its large tulip like flowers.

Other shrubs suitable for massing in borders, etc., are as follows: Berberis Ilicifloia, Thunbergii (vulgaris stropurpurca); Buddleia, variabilis; Cydonia (Japonica); Ceanothus, Americanue; Deuteziae, (Eleagnus); Prunus, Pissardii; Sambucus, Auresis (Golden Elder); Tamarix, Africana; Weigelias.

If there is one shrub that I might draw my readers' attention to more than others it is Berberis Thunbergii. Of dwarf, dense habit, very hardy, easy to grow and very low priced. This variety should secure a place in any garden. One hardly knows which to admire most, the gorgeous colored foliage or the profusion of crimson scarlet berries, the latter oftentimes persisting right through the winter. I have counted on one of the branches (which are slightly pendulous), eighty-four oblong berries. I may say this shrub requires little or no pruning, also it is fortified with numerous and very sharp spines and on that account it may not be a first favorite. I have on several occasions used this shrub as a "keep off" sign.

Climbing Vines

These vines lend themselves for many purposes other than the covering of walls, dwelling houses, etc. for use on trellis work to shut out some objectionable view, dead trees, garden fences and walls, archways, steep banks or to cover over some necessary outhouse. They are more suitable and effective than trees or shrubs, at least in many cases.

It has been my experience and doubtless that of many others to see where there has been difficulty in getting vines to thrive and cover walls of buildings. In this respect and in frequent cases it is the nurseryman who gets the blame. A great many people have the idea that because a vine will creep or climb they will do so under any condition. This is far from being true. For the benefit of some allow me to relate the following incident.

Investigate Your Sub-soil

Some time ago a friend consulted me with regard to a well known vine, Aristolochia Sipho (The Dutchman's Pipe), which had failed to grow on three occasions, that is, it had been replaced three times. On making inquiries as to soil, etc., conditions were supposed to be good. On excavating we found that appearances were deceiving. After the first foot of soil had been removed we found the source of all the trouble, and this I may say is responsible for many failures. The conditions were a conglomeration of debris left over from the builders mixed with subsoil and almost powder dry.

By this I do not wish to intimate that this is always the case. Just to show that it pays to excavate and examine conditions and replenish with good soil before planting.

Much might be said about choosing different aspects for different vines to cover walls on buildings, also about different trellises, wood versus iron and wire, training and tying, but as a treatise on all things pertaining to a garden is practically inexhaustible, one cannot hope to condense it into a few lines. As in the case of shrubs in our locality, so we have to be guided in our choice of climbers to suit the climate.

Give Each Variety Its Proper Support

To save knocking any wall about by driving in nails for support, it is advisable to make a light though strong trellis work to support the vines used, wood for preference.

About the only vines we have that will cling to a wall (Continued on page 29)

When Nine Holes Are Better Than Eighteen

By JOHN MACGREGOR, Second Vice-President National Association of Greenkeepers of America

I NVARIABLY, land available for golf courses is farm land, and usually it is in an impoverished state. The new club is usually in a hurry to have the course in playable condition, and no thought seems to be given to the future. In a few years, however, the members are dissatisfied with their course. The reason is what I have previously stated, lack of preparation, and lack of fertilization.

It is a certainty, if a course is to be kept in condition, it will cost a great deal more money than the average golf club spends. If a new club is not financially able to build and maintain an eighteen-hole course, it would be well for it to start with nine holes, which would give the members ample golf. In fact the yardage can be changed by having two tees for each hole, thus giving them eighteen holes of golf, until the membership is large enough to complete the eighteen layout. In this way the necessary funds to build the course could be used more practically.

Eighteen Holes on a Nine-Hole Appropriation

The greenkeeper is usually the goat if he fails to produce a golf course on a maintenance budget of \$9,000 to \$12,000 per year, when the budget is anywhere from \$18,000 to \$25,000 per year on the course these clubs are trying to imitate. It would be better to spend the \$9,000 on a good nine-hole course, and have something worth while, than to try and maintain an eighteen-hole course for the same amount of money, and only have a cow pasture.

Then again, there are clubs that have spent considerable money for construction and maintenance for a few years, and then a new chairman takes hold, whose keynote is economy. He feels too much money has been



John MacGregor Chicago Golf Club

spent, therefore he starts his flurry of economy by cutting down the number of men, the amount of fertilizer, etc. The result is weedy greens, impoverished fairways—the first long step in the deterioration of the course. But the greenkeeper is the man who comes under the lash of the whip.

The Membership and the Greenkeeper

I wonder when golf clubs will recognize the greenkeeper as the man who holds the key to their membership? He is working hard for his club, sometimes under adverse conditions. Give the greenkeeper a fair show, and he will produce. Anything pertaining to improvements which run into money, it is wise to talk over with him, as his judgment is generally more sound and less expensive than that of the "expert" who is so often called in by club officials.

Building Up Run-Down Fairways By HENRY A. MILLER, Greenkeeper

Barrington Hills Country Club, Barrington, Illinois

A FTER playing our course a few years, and trying to develop good fairways, we found that our fairways needed something else beside re-seeding. We had grass but it needed nourishment. It looked weak. So a year ago this fall we covered all our fairways with barnyard manure and it certainly made a difference. I started putting it on in November and worked through the winter off and on, as weather permitted. I applied it with an ordinary farm spreader. We are going to put some on the tees, and also go over the hills again this winter.

The rains wash the nourishment off the hills into the low places and the consequences are that the low valleys always look better than the hills. We find this is the cheapest way to establish turf and by this method there should be turf for years to come. I might add that after this manure has been frozen during the winter and the spring rains have brought out the frost it can be raked with wood rakes till it is all evenly spread, and all lumps are fallen apart as fine as top dressing. Of course it must be left to dry before rolling in spring.

After the ground is dry enough to roll and the manure is also dry, a spring tooth harrow will loosen it up again. It will pack if there are any hard rains after it has been raked, but by harrowing it first and then rolling it won't pack as much as it would if rolled without harrowing. I might say from my experience that going over it after it is rolled with a spring tooth harrow which is pulled by a Roseman tractor, (being not too heavy and having wide enough wheels) helps the grass to get a start instead of being smothered which might be the case in some spots where it is still soft.

From the Local Viewpoint

E DUCATIONAL programs are getting well under way in several local districts where greenkeepers' associations are active. Far more important work is being done by local organizations than has ever been attempted before, which is an indication that greenkeepers recognize the value of improving themselves through study and open discussions with their fellow members.

* * * * * Course of Study in New England

THE Massachusetts Agricultural College, in co-operation with the New England Greenkeepers' Club, has opened a ten-week course of study at the college, embracing both scientific and practical subjects relating to greenkeeping.

Members of Green committees and greenkeepers, as well as men who have had at least one year's experience on a golf course, are eligible to enter. No entrance examinations are required, but students are expected to have had a reasonable education in the English language.

The number of students is limited to ten, and the college reserves the right to reject any applicant obviously unqualified for the work.

Massachusetts citizens will have first choice for entry, but if any vacancies occur, greenkeepers from outside states will be allowed to enter in the order of the filing of their applications.

* * * * *

Discuss Arsenate of Lead at Philadelphia

THE regular monthly meeting of the Philadelphia Association of Golf Course Superintendents was held at the Old York Road Country Club, Jenkintown, Pennsylvania, on Monday, November 14.

A number of the members played a round of golf, and then witnessed a demonstration of the Roseman fairway mower.

At the evening meeting it was decided to hold meetings on the first Monday of each month.

An interesting general discussion took place regarding the merits of arsenate of lead, which will be taken up in The NATIONAL GREENKEEPER at a later date.

Dr. Parry, chairman of the Green committee of the Old York Road Country Club was introduced, and in a short address he emphasized the beneficial effects of the Philadelphia Association of Golf Course Superintendents, which he has followed since its organization.

* * * * *

Chicago Starts Extensive Program

A REGULAR meeting of the Mid-West Greenkeepers Association was held on November 26th at 7 P. M. at the Great Northern Hotel, Chicago. Mr. John MacGregor, the president, called the meeting to order, after which the minutes of the last meeting were read and approved as read by the secretary.

A report was then called from the committee in charge of the program arrangements and they advised that sufficient responses had been received in answer to letters sent out that would adequately take care of all meetings during the winter.

Following is a schedule of the winter program of the association:

November-Mr. Wendell P. Miller, Consulting Engineer on drainage and irrigation.

December-Mr. John Monteith, Jr., Associate Pathologist, U. S. Dept. of Agriculture.

January-Mr. O. J. Noer, Prof. of Soil Science, University of Wis.

February—Dr. Lyman Carrier, Former U. S. Dept. of Agriculture, Chairman of U. S. Green Section.

March and April—Subjects of a scientific nature including Botany and Hydraulics will be discussed by authorities from local colleges.

The question of hydraulics in the use of fairway irrigation is one of considerable interest at the present time and the information as to how much water really is required to water an entire golf course will be one of value to the greenkeepers.

Following this report, it was decided that the gold engraved card of life membership to be presented to Mr. A. E. Lundstrom, now in the New York district be forwarded to him with letter of appreciation from the Mid-West Greenkeepers Association.

The next order of business brought before the meeting was the matter of securing a student from one of our universities who would like to secure his master's degree in some specific research work such as defining strains of grasses, weeds and soil reaction to fertilizer and watering and defining a thorough balance in soils in favor of grasses. It was decided to bring this matter before the U. S. Green Section of the Chicago district at their next meeting, in order to arrange if possible the establishment of an Experimental Station.

The greenkeepers at large are strongly interested in this proposed Experimental Station and are anxious to secure the assistance of the district Green Section to cooperate with them in obtaining the help of all the Chicago district clubs to finance this project. The Mid-West Greenkeepers Association has land available for such a station and will gladly co-operate in every way possible to secure the station, which will be of benefit to all clubs.

A motion was made and carried that the Edgewater Beach Hotel be accepted for the first annual Ball to be held in January by the Association.

Mr. Wendell P. Miller then addressed the meeting on the subject of Drainage and Irrigation. Mr. Miller asserted that drainage is necessary on all types of soils. A golf course located on a higher level needed drainage just as well for its excess water. He also stressed the fact that eventually all golf courses would make use of a soil chart as a means of referring to soil textures existing in a given area. This map and data will give the club the information required to explain its drainage problems more intelligently and more accurately. Golf courses in the future should also arrange a definite program of continuity from year to year with regard to fairway treatments of fertilization and soil conditioning.

A number of questions were asked Mr Miller upon the conclusion of his address in regard to drainage, and general discussion followed until the meeting adjourned.

* * * * *

Cleveland Meeting Well Attended

TWENTY-SEVEN of the members of the Cleveland District Association of Greenkeepers met at the Hotel Winton on Monday, December 5, at 2 P M.

The meeting was called to order by President Burkhardt, and after the reading and approval of the minutes of the November 14 meeting, suggestions were requested regarding the special dinner meeting scheduled to be held by the association at the Hotel Winton on January 23.

It was moved and seconded that all members invite their chairmen of Green committees to attend this dinner, and that Mr. O. J. Noer be invited to talk to the assembled group on the problems of golf course fertilization. The secretary was instructed to write Mr. Noer and make a report at the coming December 19 meeting.

Mr. Burkhardt then read the names of members he had appointed on the Advisory committee, which is to serve any district club in need of advice or assistance. The appointments were approved as follows:

> John Morley, Chairman Burdette G. Sheldin Christopher Bain Fred Burkhardt.

The first speaker on the program was L. M. Latta, owner and greenkeeper of the Braeburn Country Club, Copley, Ohio, who read an amusing report of the mistakes he made in laying out and constructing the Braeburn course, which he operates as a daily fee enterprise. Mr. Latta's paper appears in this issue of the National Greenkeeper, under the title, "Have a Laugh With Me."

Mr. Burkhardt then gave the members the schedule of fertilization he proposes to start at Westwood Country Club early next spring, which will appear in the February issue of this magazine.

The next speaker introduced was Mr. Bernard J. Duffey, Jr., president of the Cleveland District Golf Association. In his remarks Mr. Duffey said, "The greenkeeper's job is getting more and more important, having developed from ordinary out-door work into something requiring exact practical knowledge and more than a smattering of the scientific. If the Cleveland greenkeepers keep their association alive, and if every member puts into it his share of effort, all district clubs cannot fail to benefit." Mr. Duffey further remarked that co-operation has paid in almost every other recognized calling, and in greenkeeping this should be particularly true, because of the special knowledge and integrity required to keep a golf course that members enjoy playing over. He assured the association of the full cooperation of the local golf association, in any matter that may require such co-operation.

Arthur Boggs, of the Kirtland Country Club, was asked to report the results he has secured with Cocoos bent during the last two years. Mr. Boggs was enthusiastic about the experiments he has conducted with this grass, and emphasized its value on putting greens that have a decided slope. He stated that the Cocoos bent is now pushing out the Washington, with which the greens were originally planted. Cocoos seed was sown with top dressing on the Washington bent, at the rate of thirty pounds per green, raked in and kept moist. It came up very uniformly all over, and altho in its seedling stage looked very delicate, it has taken on a fine color and texture and seems to be taking possession of the greens. One of the newly seeded Cocoos greens looked somewhat backward, but after an application of Lecco, a special putting green fertilizer, which is also a "Lyman Carrier" product, this green went into the winter in as good shape as the others. Mr. Boggs also reported very favorably on the results obtained with applications of Lecco on some of his fairways.

Following Mr. Boggs' talk, Mr. Christopher Bain, greenkeeper at Oakwood Country Club, expressed his opinion that he has found Cocoos one of the best strains of bent we have, and suggested that every member experiment with a plot of this bent in his nursery. Mr. Bain particularly emphasized one valuable characteristic of Cocoos, its habit of upright growth.

Open discussion followed until the meeting was adjourned, and the next meeting was called for December 19.

(Continued on page 32)

Our Bent Thrives in Hot Weather

By GUSTAVE HANSEN, Greenkeeper Greenville Country Club, Greenville, Michigan

THE bent we have planted is a hot weather grass and stands up wonderfully through the hot weather of July and August, but is slow in developing into a putting green through the cool weather of April and May.

When the temperature reaches eighty degrees it makes a dense turf very rapidly. During this time it calls for several topdressings at very short intervals, also an abundance of water and close cutting every day. After the turf is fairly uniform over the entire green topdress with fine dry sand and brush well into the turf with a flexible steel mat.

Our Grass is Fine and Does Not Nap

I agree to disagree with some greenkeepers who claim that bent should not be cut as close as other grasses. If this is true their bent is surely very different from the strain we have or they have not learned to maintain the upright growth of bent which makes for a fine, true and uniform putting surface.

Our greens are very fine in texture. The grass does not develop a grainy turf as the Washington may. It has a very bright green color when properly fertilized and I believe it to be more resistant to brown-patch than the Washington.

I base my opinion on the fact that the conditions favorable for the growth of the fungus are also very favorable for the growth of this strain of creeping bent. Therefore, this one characteristic makes it more resistant to the attacks than is the Washington, which is a lover of cool weather.

However, it is very susceptible to the effects of cold winds, and it would perhaps not maintain a satisfactory color much farther north than here. I have received a great many compliments from visiting golfers as well as my club members. Among the visitors were the Shriners of Grand Rapids, Michigan. They all claim these greens to be the finest first-season bent greens they have ever played on.

We secured our stolons from the Flossmoor Nurseries, Chicago, and I would suggest that our members give a plot of this bent a trial, especially those who have been having trouble with brown-patch.

Killing Out Wild Morning Glory

E XPERIMENTAL work which has been in progress for some time at the Kansas Experiment Station has determined that sodium chlorate applied at blossoming time on wild morning glory and bind weed will do much to eliminate these pests. This chemical is cheaper than many others, and not injurious to the soil.

New Method for Mixing Concrete

 $T^{\rm HE}$ amount of water which is added to a mixture of cement and aggregate is what determines the strength and durability of the hardened and cured concrete.

For instance, recent tests have proved that one sack of cement, mixed with ten gallons of water and an amount of clean sharp sand sufficient to make a workable mixture, will stand a pressure of about seven hundred pounds to the square inch. In comparison, a sack of cement mixed with three gallons of water and thickened to workable consistency with aggregate, was found to withstand a pressure of six thousand pounds.

The old method of mixing three parts of sharp sand and gravel with one part of cement, thinning the mixture according to the judgment of the operator, is now obsolete. For ordinary purposes, the addition of six to seven gallons of water to one sack of cement, floating in this mixture enough clean sand and gravel to bring it to a jelly-like consistency, will prove satisfactory. Such a mixture will stand a pressure of from nineteen hundred to twenty-four hundred pounds per square inch, which is sufficient for all construction such as steps, sidewalks and roadways.

It is best to mix concrete for at least three minutes before spreading, and the finished work should be kept dampened for from seven to ten days to cure. Too quick drying of concrete interferes with the curing process.

Arsenate and Sulphate

S^{EVEN} years ago Fred Burkhardt started using powdered arsenate of lead on his greens at Westwood Country Club, Cleveland, Ohio.

"I apply it with a fifty-gallon spray barrel," says Mr. Burkhardt, "mixing one and a half pounds to each barrel, and using about three barrels of this mixture to the average six thousand square foot green.

"I always apply it after mowing the greens, and it is now three years since I used any worm eradicator. There are almost no grubs on the Westwood course, and while I have always given the credit for control of weeds to my consistent use of sulphate of ammonia, recent developments in Professor Leach's experiments seem to prove that arsenate has a direct effect in weed control."

One of the most effective uses to which Mr. Burkhardt put sulphate of ammonia during this past fall was in the control of chickweed which crept into two of his greens because of the excessive wet weather. He applied sulphate of ammonia dry from an ordinary large size salt shaker to the patches of chickweed, and within a few days the chickweed had entirely disappeared and the bent filled in so rapidly that no bare patches resulted. S TANDING on the first tee at The Sleepy Hollow Country Club one looks out over a scenic panorama that few clubs in the country can equal. Although only fourteen miles from the center of Cleveland, Ohio, you are over five hundred feet above it and might easily imagine yourself hundreds of miles away. As you look out over the course you see rough and rugged forest covered land rolling away for miles in every direction. This country has often been called the Berkshires of Ohio, and could readily be mistaken for the real thing.

Six years ago a handful of enthusiastic business men purchased one hundred and ninety acres here with the scenery thrown in for good measure. The men and scenery were fine but the land was—well, it was not a greenkeeper's Paradise. In fact to use a borrowed simile, it was so poor you couldn't raise an umbrella on it. This property lies on the southerly bank of the Cuyahoga River valley and I guess ages ago all the top soil was washed down into the river. It had also been



By HARRY LEWIS, Professional and Greenkeeper Sleepy Hollow Country Club, Brecksville, Ohio



Harry A. Lewis

This left us with some grass and plenty of washouts. Mowing this was a very difficult job. We were using thirty-inch mowers with fifteen-inch drive wheels and about every time one went into a washout it came out with a broken wheel. We couldn't stand this, so we looked for some mower with small rugged drive wheels



Ideal Bull Dog mowers in operation at Sleepy Hollow Country Club, Brecksville, Ohio

rented out for several years and was naturally in a badly run-down condition. In fact all it seemed to be was a patch of hard old yellow clay. The necessity of water seemed to have been overlooked as there was no available supply except a small spring.

A lake large enough to hold a season's supply of water was built and also nine holes. This became so popular that in a short time another nine holes was built and then came the job of getting it all in shape to compare favorably with any other eighteen hole course.

Mowing Rough Fairways

We seeded the fairways with red top, blue grass, and Chewings Fescue, but before it caught good the rains took about half of it down where the top soil had gone. which we found in the Ideal Bull Dog mowers. Our troubles in that direction ended then as I don't think we ever broke another wheel. Of course as time went on we put in drain tile and filled up the washouts.

Fertilizer From Nearby Plant

We have a very cheap and handy source of getting tankage which we use extensively on our fairways with the most gratifying results. Each winter we put it on the poorer fairways with a manure spreader. The following season finds these fairways very much improved. We manage to cover about four or five fairways each winter. Last season our fairways stayed fairly green through all the drought we had and are forming a fine

(Continued on page 26)

Interest Spreads In National Gr

The Spanish Room of the Fort Shelby Hotel where the National Greenkeeper's Show will be held.



O UR almanac says that February 21 is the day of the new moon. This augurs well for the National Greenkeepers' Show at the Fort Shelby Hotel in Detroit on that day.

As we go to press fully half the allotted space is contracted for, and every mail brings new requests. Among the well known manufacturers already in are Pennsylvania Lawn Mower Works, Stumpp & Walter, DuPont, Jacobsen Power Mower, Ideal Power Lawn Mower Company, O. M. Scott & Sons Company, Bean Spray Pump, L. R. Nelson, Prosperity Laboratories, Milorganite, Armour Fertilizer Wks., Lyman Carrier and International Seed Testing Laboratories.

The beautiful Spanish room in the Fort Shelby offers an ideal place for the exhibition. Its unusual lighting effects and rich colorful decorations make it probably the finest show room in the country.

That Green committee chairmen and golfers generally are taking a keen interest in the National Greenkeepers' Convention and Show is evidenced by a recent letter from Mr. R. H. Montgomery, chairman of the Detroit District Green Section, who says:

"Many of the chairmen of Green committees of this district will be more than pleased to attend the convention of greenkeepers when held in Detroit, and I am quite sure will be glad to lend any small assistance possible to make this meeting a success. "The District Association will be glad to co-operate with you in any way you see fit and should you wish this and will let me know just what you have in mind we will set the wheels in motion toward that end."

The program of papers to be read and discussed is attracting nation-wide attention, and golf clubs in all parts of the country advise that they will send their greenkeepers to De-

Committee on Golf Show

Fred Burkhardt, Cleveland, Ohio, chairman Edward B. Dearie, Chicago, Illinois Herbert E. Shave, Detroit, Michigan George Sargent, Columbus, Ohio John Gray, Sandwich, Ontario, Canada Charles Erickson, Minneapolis, Minn. Captain David L. Rees, New York

reenkeepers' Convention and Show

Papers to be Read and Discussed at Detroit

Some of the Turf Diseases THE PROPAGATION OF BULB-GROWN PLANTS By Joseph T. Varn Hagen, Sr., Greenkeeper By Dr. John Monteith, Jr., Associate Pathol-Plum Hollow Golf Club, Redford, Michigan. ogist, U. S. Department of Agriculture. THE CONSTRUCTION OF PUTTING GREENS THE FERTILIZATION OF SOILS By Captain David L. Rees, President West-By O. J. Noer, Soils Department, University chester County Greenkeepers Association. of Wisconsin. BRINGING A NEW COURSE ALONG GRUB CONTROL By Edward B. Dearie, Secretary Mid-West By Professor B. R. Leach, Associate Entomol-Greenkeepers Association. ogist, U. S. Department of Agriculture. MAKING USE OF A BENT NURSERY THE PROTECTION OF GOLF COURSE TREES By Hiram F. Godwin, Greenkeeper, Redford By C. M. Scherer, Principal Davey Institute of Golf Club, Redford, Michigan. Tree Surgery. CLUBHOUSE GARDENS GOLF COURSE DRAINAGE By W. D. Chinery, Greenkeeper, York Downs By Wendell P. Miller, Golf Course Drainage Golf Club, Eglinton, Ontario, Canada. Engineer. THE BOOKKEEPER AND THE GREENKEEPER CANADIAN MAINTENANCE PROBLEMS By E. W. Doty, Treasurer By C. A. Tregillus, Consulting Expert, Canadian Cleveland District Golf Association. Golf Association.

program starts Thursday morning, February 24, and comprises two days of intensive study and discussion of golf course problems, under the

troit at the club's expense. The convention country's leading experts. A carefully arranged schedule has been worked out so that every paper will have its allotted time, thus insuring speed and concentration in the discussions.



Golf Course Drainage

First of a series of articles written exclusively for The National Greenkeeper by America's foremost golf course drainage engineer

T HE need for under-drainage and aeration of golf course soils is universal. If the natural character of the soil does not permit of rapid percolation of rain or irrigation water and the retention of sufficient moisture for luxuriant growth, artificial means must be used to change the soil conditions.

Nearly all the processes of plant food liberation within the soil and the absorption of these foods by grass plants are dependent upon the proper balance between moisture and air in the soil.

In approaching a study of land drainage one must have a clearly defined idea of the functions of water in the soil. This first article is therefore confined to this subject, soil, moisture, for the reason that it explains the reason for tile drainage.

In later articles dealing with the mechanics of tile drainage numerous points will be raised which are open to individual opinion, but the statements made here in regard to soil moisture admit of very little dispute. However, you may have at this time a very different idea of the subject and its value in golf course management.

Source of Soil Moisture:—Of the water which falls to the earth's surface as rainfall, or is applied in irrigating, one portion runs away over the surface to the natural surface drainage channels, another portion seeps into the ground, and the third portion evaporates from the place where it falls. It is this second portion, that which is taken up by the soil, which is of particular interest in this discussion.

Moisture Content of Soils:—The capacities of soils to take up and hold moisture vary greatly with the different soil types and formations. The soils with the larger percentages of porosity hold the larger amounts of moisture. The moisture content is usually expressed as a percentage of either the dry weight or of the volume expressing it as a percentage of the volume. Table I shows how widely the moisture capacity of soils vary with the fineness of the soil grains. The maximum and minimum moisture content each increases as the size of the soil grains decreases. Any treatment, such as under-drainage, that will tend to increase the moisture capacity of a soil without too great injury in some other respect is desirable.



Editor's note: Mr. Miller was formerly Extension specialist in Agricultural Engineering at Obio State University, and his background of training includes several years of study in soil physics and chemistry. Since 1920 his unusual abilities have been devoted to solving the drainage and soil improvement problems on golf courses.

Moisture Content and Turf Production :---The amount of moisture necessary for good turf production varies greatly with the soil texture and structure, the turf and the climate. Lyon and Fippin state in their text, "The Principles of Soil Management," that "--other things being equal, more water will be required in an arid region than in one of humid climate; more in a warm region than in a cold region; more in a clay soil than in a sandy soil; more in a windy section than in a region of still atmosphere; more with a high soilmoisture content; more on a poor soil; and lastly, more water is used per pound of dry matter produced in a small growth of turf than in a large growth. Not only is the total seasonal requirement to be considered, but the maximum demand of the turf at any period of its growth must be met."

Forms of Soil Moisture:—Soil moisture is of three different classes: (1) Gravitational water, or that water which is free to move in the soil under the influence of gravity; (2) Capillary or film moisture, which is

held, by surface tension against the influence of gravity; and (3) Hygroscopic moisture or that which condenses from the atmosphere upon the surface of the soil particles.

Gravitational Moisture:—Land drainage has been aptly defined as the removal of the surplus moisture from the soil. (Usually this is only the means to an end, as the benefits of drainage are due to those actions made possible by the removal of the surplus moisture.) Underdrainage is the removal of this water by artificial or natural means under the surface. As it is only the gravitational soil water which is free to move under the in-

TABLE I MOISTURE CAPACITY OF SOILS

			Amount of Available Water		
	Water (Min.	Capacity Max,	67	Cu, In.	Inches in top 4 ft.
Light Sandy Loam-Early	10	70	70	Cu. Ft.	01 5011
Truck Soil	3	8	5	122	34
Silt Loam-Bluegrass Soil Clay-Black Cretaceous	15	25	10	218	6.0
Prairie Soil	23	40*	17	274	7.6
(From "The Princip	oles of	Soil	Mana	gement",	Lyon &

Fippin), *Assumed.