

Ready for Spring  
with a Complete Line of  
Seeds, Equipment, Ferti-  
lizers for Golf Courses and  
Sport Grounds up-keep.  
Ask for Catalog

SOUTHERN HEADQUARTERS  
OF  
GOLF COURSE  
EQUIPMENT

**T. W. WOOD & SONS**  
RICHMOND, VA.

In judging seeds all firm names should be out of sight and not permitted to influence the decision. If equal volumes are taken, and all samples observed under similar conditions the true characteristics of the samples are easily noticed and a correct selection can be made.

#### Bent Seed Loses Purity In Handling

**P**URITY tests as well as germination tests will vary with the age of the seed, and purity will decrease with handling, especially with bents, as they shed their paleae and glumes.

Bent seed showing an 80% purity test on leaving the cleaners, might show slightly less than 70% pure by the time it reached the greenkeeper, and the increase in impurity would be due solely to the increased amount of chaff caused by handling.

From these remarks do not think that seed houses are all dishonest, crooked or even bent (though they do sell bent). They are not. Neither should a reputed reliable seed house be forever condemned if in some reason their seed failed to be "as good as usual."

Weather conditions at the time of harvesting that particular lot of seed might quite properly be blamed for the poorer quality, or perhaps some competitor "beat" the market and the reliable house was forced to take the inferior seed.



# ARMCO

*drained courses are*

# DRY

*in the Spring!*



*Bert Sheldon, greenkeeper at the Cleveland Country Club, superintending installation of Armco Perforated Pipe on his course*

**M**ANY of the best courses are dry and ready for play ahead of the season—because they are drained by Armco Perforated Pipe.

Courses like that at the Cleveland Country Club no longer embarrass a good score with casual water. Fairways and greens are firm and dry. Armco Perforated Pipe, just under the surface, offering no interference to growth of the turf, takes off water as it falls!

Architects and greenkeepers agree that Armco Perforated Pipe, Nature-tested and proved by its unequalled record of 24 years' service in the soil, is the logical pipe for efficient golf course drainage. Armco engineers specializing in drainage offer cooperation in working out any problem of water disposal. No obligation. Write.

*Armco culverts and drains are manufactured from the Armco Ingot Iron of The American Rolling Mill Company and always bear its brand.*

**Armco Culvert  
Manufacturers Association**  
Middletown, Ohio



## Penn State Greenkeeper's Course

By JOHN QUAILL

THE Penn State Short course was attended by twenty-one greenkeepers and lasted four weeks.

The subjects taught were of vital interest to the greenkeeper and were well given. The professors who taught the greenkeepers are members of the staff of one of the largest and leading agriculture colleges in the United States. Each subject was covered well and thoroughly and the laboratories and experimental plots were at the greenkeepers' disposal.

The conference was of one week's duration and was attended by sixty-five men. This program was also well planned and all who attended were very well satisfied. The men in charge of the experimental plots at State are carrying out experiments that no other station in the United States is trying.

Following is a program of the course and conference.

### Greenkeepers' Short Course

Feb. 2-28, 1930

The aim of this course is to give instruction in the broad underlying problems that have to deal with practical turf management. Anyone who is interested and who can read and write will be eligible. The course is especially designed, however, for those who have had some experience with fine turf management. During the first three weeks the subjects listed below will be studied. The fourth week those attending the short course will be expected to attend the Greenkeepers' Conference.

The courses will be taught in the college classrooms and laboratories.

### Expenses

Living expenses and college fees for the four weeks need

## A Real Golf Course Sprinkler



## THE SLOW ROTARY

Mounted on a Sled or Roller Base as desired

A Putting Green can only be maintained properly with a perfect sprinkler—one that distributes the water evenly, gently and slowly.

The SLOW ROTARY, on account of its very wide covering (125 ft. on 50 lbs. pressure), is particularly well adapted for FAIRWAY watering.

Send for Catalog.

## Campbell Irrigation Co.

MALCOLM C. LUDLAM, Proprietor

Woodbury - - - New Jersey

not exceed \$60.00. The largest single item of expense is room and board, which will be from about \$9.50 to \$10.50 a week. An incidental fee of \$10.00 is payable by all winter course students. Other expenses will consist of laundry, stationery, and miscellaneous items. In some of the courses books may be required.

### Description of Work

1. *Soils and Fertilizers*—Discussion and laboratory studies covering the origin, formation and physical properties of soils, and soil acidity, as well as the purchase, mixing and use of fertilizers and lime.

2. *Fine Turf Grasses*—Class room and laboratory work on classification, identification, and propagation of the important fine turf grasses, including seed identification and analysis.

3. *Weeds*—The characteristics, life habits, and control means of the various weeds common to golf courses will be studied. Some time will also be given to weed seed identification.

4. *Insects*—A brief study of the insects affecting fine turf grasses with particular reference to their control.

5. *Diseases*—A consideration of the nature of diseases and their effect on plants, together with the principles of prevention and control. Application to turf problems will be emphasized.

6. *Landscape Problems*—Factors determining the location and layout of golf courses, a study of golf course plans; grading problems; discussion of trees and shrubs for golf courses and club house grounds; their identification, special uses, planting, and maintenance.

7. *Machinery, Drainage, and Irrigation*—Detailed study of gasoline engines, their operation, repair, care, and adjustment. The location, design, and construction of tile drainage systems. Power requirements, design, and operation of spray irrigation systems; pipe friction, pipe sizes, and pumps.

### Greenkeepers' Conference Program

From 9:00 A. M., February 24, to  
Noon, February 28, 1930

Monday a. m.

Chairman, A. L. Patrick

9:00—Registration

10:00—Welcome ..... Dean R. L. Watts

10:10—Greenkeepers' Research Committee Report

..... Joseph Valentine

10:30—Outline of the Research Program at State  
College

..... J. W. White, C. O. Cromer, H. B. Musser

Monday p. m.

Chairman, John R. Bracken

2:00—Golf Course Architecture Discussion

Tuesday a. m.—Golf Course Construction

Chairman, Nickolas Schmitz

9:00—Drainage and Irrigation Systems

..... J. R. Haswell, R. U. Blasingame

10:00—Soil Types ..... A. L. Patrick

11:00—Grading and Tillage Implements

..... R. U. Blasingame, H. B. Josephson

Tuesday p. m.

2:00—Commercial Fertilizers

..... A. L. Patrick, Nicholas Schmitz

3:00—Nature of Soil Acidity and Methods of

Determination ..... F. G. Merkle

3:30—Lime ..... J. W. White

4:00—Final Preparation of Seedbed ..... Joseph Valentine

Wednesday a. m.—Seeding Greens and Fairways

Chairman, H. B. Musser

9:00—Choosing Varieties

Classification and Identification of Fine Turf

Grasses ..... H. B. Musser

11:00—Seed Identification and Analysis ..... J. S. Cobb

Wednesday p. m.

2:00—Seed Sources ..... Nicholas Schmitz

3:30—Seeding Implements ..... H. B. Josephson

4:00—Time and Rate of Seeding ..... James Bolton

Thursday a. m.—Maintenance Problems

Chairman, F. D. Gardner

9:00—Landscape Problems ..... John R. Bracken

10:30—Diseases ..... John Monteith, Jr.

Discussion, Leader ..... H. W. Thurston, Jr.

Thursday p. m.

2:00—Insect Problems ..... H. N. Worthley

Discussion

3:30—Records and Accounts ..... E. L. Moffitt

4:00—Machinery ..... G. M. Foulkrod

7:00—Dinner—Centre Hills Country Club

Friday a. m.—Weeds ..... Chairman, A. L. Patrick

9:00—Nature, Habits, and Chemical Control .. C. O. Cromer

10:00—Effect of Fertilizers and Lime on the Relative

Growth of Grasses and Weeds

..... C. F. Noll, J. W. White

11:00—Use of Fertilizers and Composts .. Nicholas Schmitz



# Drainage and Soils

BY WENDELL P. MILLER, President

*Wendell P. Miller & Associates, Chicago*

*Read at the Fourth Annual Convention of the National Association of Greenkeepers of America at Jefferson County Armory, Louisville, February 4-7, 1930*

**M**R. CHAIRMAN, Ladies and Golf Course Managers of America: Why did

I address you as the "Golf Course Managers of America?" Because gathered here today are the men behind the guns of one of America's greatest and most rapidly-growing industries. There are twenty men here today who are running million dollar factories to manufacture just one single identical product—PLEASURE. The dividends you earn for your member stockholders are totaled up at the end of the year not as so many dollars and cents, but as so many good days of perfect golf.

Let's analyze this idea of the pleasure factory and see just who is the really important man in your company on whom depends the dividends your club will pay at the end of the year.

Every manufacturing concern when it gets into the big business class with \$100,000 to a million or more dollars invested capital, has a President, a Secretary, a Treasurer, a Board of Directors, but they do not really produce the manufactured product. They only direct the business. Out in the factory you will find the men behind the guns and the big boss here is the factory or works manager. You greenkeepers are in identically the same relative position to your Board of Directors as is the works manager.

## Greenkeeper is Biggest Factor

**I**F I can only help to get you men to feeling that you are the biggest single factor in the manufacturing of this thing called golfing pleasure, I will have done enough.

When the works manager finds that the machinery which his Board of Directors has provided for him is getting obsolete, he does

not wait for the Board to ask him what is the trouble with his production. If he is a smart works manager, he is the one who is constantly plugging at the Board to let him make improvements which will speed production, lower costs, or improve the product.

The point I want to make here is that unless the greenkeeper himself demands of his club that he be provided with adequate drainage, irrigation, or maintenance equipment he is not likely to secure these benefits in time to save his job.

Practical expert help is available but engineers are slow to force their attentions upon golf club boards of directors. Every greenkeeper should bring the importance and necessity for drainage improvements to the attention of his Board of Directors.

Economical maintenance, I hear you say, is entirely relative. What one club finds economical would, for another club, be a waste of resources. The perfect golf course from the standpoint of economical maintenance has never yet been built. There are always factors

affecting the final cost of upkeep and consequent amount of income which can be improved. How many of these factors which affect profit and loss in the operation of your course and clubhouse, can be traced back to the drainage of the grounds?

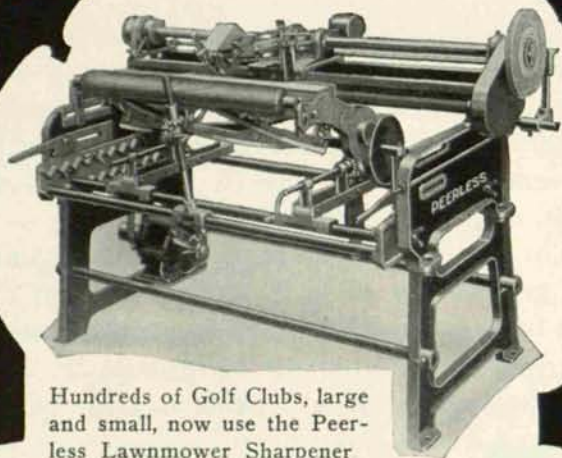
Did it ever occur to you that the clubhouse manager may show red ink figures all through the months of April, May, October, and November because he has filled his ice box with perishable foods and a rainy Friday has kept his Saturday and Sunday patrons at home? If your course had the reputation for always being dry, regardless of the frequency and



WENDELL P. MILLER



# The Peerless Mower Sharpener



Hundreds of Golf Clubs, large and small, now use the Peerless Lawnmower Sharpener

## It Perfects The Cutting Edges of any make of Mower

### And That Means Perfect Turf

The Peerless Mower Sharpener is the only machine that sharpens all makes of Power, Horse and Hand Mowers *scientifically — quickly — perfectly* — does the work as nothing else can. Operated by  $\frac{1}{3}$  H. P. Motor—attach it to your lamp socket. Special Grinding Wheel for sickles, scythes, etc. Skate sharpening attachment included. Will save its cost the first season. Write for catalog and list of users.

**THE FATE-ROOT-HEATH CO.**  
925 Bell St., Plymouth, Ohio

# The Peerless Mower Sharpener

amount of rainfall, this loss would be largely eliminated, due to tile drainage.

### Tile Drainage Pays Dividends

BRIEFLY stated, the following facts regarding tile underdrainage will all stand the searchlight of scientific investigation. Whether your course is flat, rolling, or hilly; of clay, loamy or sandy soil; uniform tile drainage from the tee through the green will pay dividends on the investment, both in cash and pleasure because:

1.—Drainage reduces the cost of putting the course into condition in the spring by preventing winter kill, heaving of the grass and erosion of bunker slopes.

2.—By increasing the efficiency of labor due to good working conditions.

3.—By permitting the use of larger units of machinery without damage to the turf or soil.

Uniform drainage has lengthened the playing season an average of two months in the Chicago, Detroit, and Cleveland districts by permitting safe conditioning of courses for April first opening and December fifteenth closing.

The total number of rounds of golf played for the year will be greatly increased but the peaks on a curve showing daily number of players will be smoothed by increased numbers of players using the course early and late in the season and also by preventing the heavy drop in week-end attendance during mid-season caused by a wet course and the consequent jam on the following week-end. It costs little more to keep a course in condition for 200 than for 50 players.

### Good Drainage Cuts Sprinkling Costs

THOROUGH tile drainage reduces materially the amount of sprinkling water required to keep the turf in best playing condition, both as to amount of water and frequency of application. This statement is the one most likely to be doubted.

Drainage, by causing a chain of physical changes to occur in the natural undrained soil, actually increases the absorption and moisture holding capacity of all types of soils. Thorough tile drainage increases the content of capillary moisture in the soil to such an extent that this factor alone is of enough value to make it a





## Plan Now

*to fertilize your fairways with*

## MILORGANITE

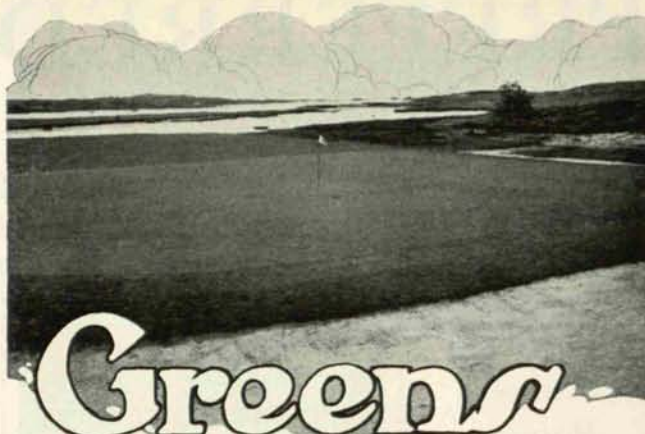
*used on more than 1500 golf courses during  
1929*

Exceptional Mechanical Condition facilitates uniform distribution and makes it an excellent carrier for lead arsenate, sulphate of ammonia, etc.

Milorganite supplies valuable Organic Nitrogen, the vital plant food element for turf grasses. Its nitrogen is Highly Available and Water Insoluble. Upon application its plant food is gradually released, thus furnishing long, continuous feeding.

While ample reserves have been accumulated, it is suggested that clubs anticipate requirements early to insure prompt shipment during rush season.

**Milwaukee Sewerage  
Commission**  
Milwaukee, Wisconsin



## TO BE PROUD OF

Your first experience with the Cooper Putting Green Mower will be a revelation. The mower is light in weight, short coupled, perfectly balanced and extremely easy to operate. Differential action in the three section cast aluminum roller permits the mower to be turned about within its own length without danger to turf. Independent clutch for traction permits easy transportation from green to green under its own power and without the aid of a transport cart.

Mower has full 20 inch seven-blade reel, reversible and operated by individual clutch. Blade reel and bed plate are one compact and easily removable unit.

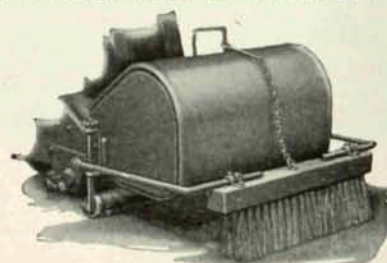


*The Cooper* **PUTTING  
GREEN  
MOWER**

is powered by the famous Briggs & Stratton 4 cycle gasoline motor, has grease packed gears and is equipped with ball bearings and roller bearings throughout.

### Grass Catcher and Brush Attachment

The frame and body of the Cooper Putting Green Mower is of special steel and aluminum alloy construction which insures maximum strength and minimum weight. Mower is equipped with grass catcher. Brush attachment for aerating soil, keeping the grass from matting and brushing in top dressing, optional equipment.



Scores of progressive greenkeepers are now using the Cooper Putting Green Mower to advantage, saving time and labor costs and maintaining super-greens as present day golfers demand them. Let us send you more detailed information, specifications and prices covering this wonderful putting green mower.

**COOPER MANUFACTURING COMPANY**  
526 S. First Avenue Marshalltown, Iowa

Gentlemen: Please send complete putting green mower information, specifications and prices.

Name \_\_\_\_\_  
Club \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_



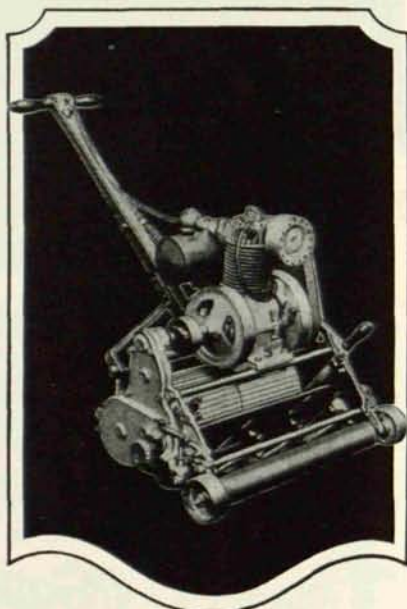
# PREFERRED

on the

## World's Finest Golf Courses

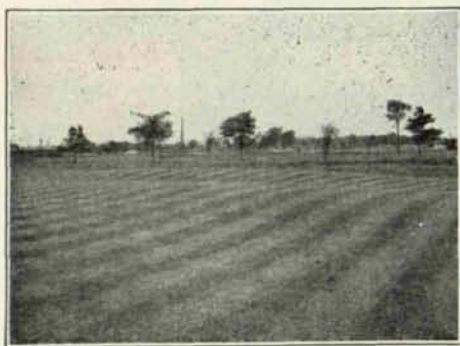
If You Don't  
Use the  
Jacobsen  
Power  
Putting  
GREEN  
Mower

It's Because  
You Never  
Tried One



A TIME-TESTED PRODUCT

WOULD you have Putting Greens perfect beyond expert criticism? Would you cut labor costs 50 to 75 per cent in making them so? One man can cut 18 greens a day with the Jacobsen with an ease of operation and an excellence of work duplicated by no other mower.



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 velvet 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.

### Send for Interesting Information

Descriptive literature sent free upon request, explains the mechanical details which have in many years time given worldwide 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:

Jackson Masonic Country Club, Jackson, Mich.  
Brookmoor Golf Club, Shreveport, La.  
Binghamton Country Club, Binghamton, N. Y.  
Oakland Municipal Golf Course, Oakland, Calif.  
Lincolnshire Country Club, Crete, Ill.  
Biltmore Forest Country Club, Biltmore, N. C.  
Oakwood Country Club, Cleveland Heights, Ohio  
Kahkwa Country Club, Erie, Pa.  
Interlachen Country Club, Minneapolis, Minn.  
Lakeside Golf & Country Club, Oklahoma City, Okla.  
and hundreds of others.

**Jacobsen Mfg. Co.**  
Dept. 11 RACINE, WIS.  
New York Office, 507 W. 56th Street



sound investment in reducing the cost of maintenance.

Capillary moisture, the only form of soil moisture of value to plants, moves in all directions in the soil regardless of the force of gravity, but the rate of movement toward the surface is largely dependent upon the tilth of the surface layers of soil.

Drainage keeps the soil mellow and open. In puddled soils, that is, soils that have been compacted by rolling or trampling when full of free soil water, the capillary moisture supply and replacement is reduced to a minimum, hence more artificial sprinkling is required. Free soil water is absolutely detrimental. If saturation is maintained for more than a few days, air starvation will result in killing the turf. Properly installed tile drainage produces and maintains the proper aeration of the soil.

### Soil Aeration

SOIL aeration—I wish I could tell the story of air in the soil. Let me tell just enough here to show its importance in economical maintenance. It is the benefit resulting from increased soil aeration which makes profitable tile drainage of sloping fairways where surface water never stands. Air and water cannot occupy the same space in the soil at the same time, hence, when the soil is full of free water, air is entirely excluded. When the free soil water is removed by run-off through tile drains fresh air is pulled into the pores of the soil. The rapidity and frequency of this ventilation of the soil is a most important factor in determining the cost of growing good turf.

There is a universal law in organic life, be it plant or animal. Life, to be maintained, must have the right kind and amount of food, air, moisture and warmth. If any of these are taken away there is sickness. Soil air, the element generally lacking in the combination that constitutes the vital force in plant life, can be permanently and cheaply supplied by tile drainage.

Nitrogen, purchased as ammonia in the fertilizer bag, and oxygen, so essential to soil fertility and plant life, are the two principal constituents of air, totaling nearly 98 per cent of the entire volume. Plants must get their oxygen through their roots as well as through their leaves.



# only ROSEMAN mowers

offer these essentials  
of modern fairway  
turf maintenance:

- ✓ denser turf growth
- ✓ healthier root development
- ✓ prevention of scalping
- ✓ elimination of cuppy lies
- ✓ sealing of heat crevices
- ✓ retention of moisture in soil
- ✓ eliminate separate rolling
- ✓ maximum economy, durability and dependability
- ✓ clean, uniform cutting of both fairways and rough.

A deferred payment plan on Roseman Mowers and Tractors makes it possible for smaller clubs to share with ALL CHAMPIONSHIP courses, the advantages of Roseman equipment.

Before you buy a fairway mower, get the complete story on ROSEMAN—Hollow Roller Type—MOWERS. Their design, material and workmanship make possible the most liberal of all mower guarantees—ask for a copy.

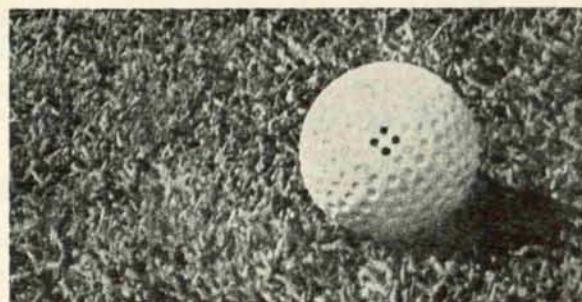
## ROSEMAN Tractor Mower Co.

Hollow Roller Mowers for  
Fairway and Rough

810 Church Street  
EVANSTON, ILLINOIS

or

11 W. 42nd Street  
NEW YORK, N. Y.



A Piece of Cocoos Bent Turf

### For the Finest Turf Sow Bent Grasses

Because of the extreme fineness and beauty of turf produced from *Bent Seed* we recommend the use of a certain percentage of Bent in all mixture for *Fairways* and *Lawns*. Its superiority for use on golf courses, especially the putting greens, has long been recognized.

## Grass Seed of Known Quality

TESTED for PURITY and GERMINATION

South German Bent

Colonial Bent

Rhode Island Bent

Washington Grown Bent Stolons

Wholesale prices on the above, or any other turf grasses, such as *Fancy Red Top*, *Ky. Blue*, *Chewing's N. Z. Fescue*, etc., on request.

**COCOOS BENT** Because of the fine turf producing qualities of this *Creeping Bent*, it is meeting with favor in sections other than the Pacific Coast, where it is already recognized as the outstanding *Putting Green Grass*.

Cocoos Bent is botanically known as *Agrostis maritima*, but all strains of *Agrostis maritima* are *not* Cocoos Bent. We offer the *true Cocoos Bent*, the finest of the *Agrostis maritima* grasses.

Per lb. \$2.50, per 10 lbs. \$22.50, per 100 lbs. \$200.00

#### Special Putting Green Bent Formula

consists of imported and domestic grass seeds of the highest quality, that will produce a fine, uniform and enduring turf. Further information and prices on request.

#### Superfine Fairway Formula (with Bent)

contains Bent seed, as well as Kentucky Blue Grass, Superfine Red Top and Chewing's N. Z. Fescue. We adapt it to your condition, so a uniform and enduring turf is secured. Further information and prices on request.

Special formulas for *Tees*, *Rough*, *Bunkers*, *Lawns*, etc., on request.

**Remember:—** We are one of the largest direct contractors for foreign-grown Grass Seeds in the United States. Over thirty years of Seed Service have enabled us to segregate those collectors of Bent Seeds who are reliable from those who are not; to single out those growers of Chewing's Fescue whose strains are pure; also to contract for true American-grown seeds of high vitality. All our seeds are botanically true to name and are cleaned and re-cleaned until brought up to the highest possible state of purity and germination, special care being given to the elimination of weed seeds.

Without obligation we shall be pleased to send a representative who, from long experience, is qualified to advise regarding grasses and furnish such other information as is necessary for the best results.

*Stumpp & Walter Co.*

Specialists in Golf Grass Seeds and Equipment

30-32 Barclay Street

New York City



Drainage is designed for two purposes. First, for the removal of all surface water and run-off from roofs, roads, and other areas. Secondly, the removal and control of soil water, whether resulting from rainfall, springs, or seepage from adjacent land.

The engineering data and experience is already at hand for the accurate and economical design of the drainage faculties required for the removal of surface run-off. The second purpose of drainage, that of soil water removal and control, is the subject on which very little information is available except from the few engineers who have spent a lifetime on the subject. The mechanics of drainage construction and the hydraulic formulae for calculating the movement of water through pipes are an open book, but data on how fast water will seep into the ground and how fast it will run out is a major question that must be investigated on each individual golf course.

The determination of the drainage characteristics of each soil type on each golf course and the source of the ground water are, therefore, the major problems confronting the drainage engineer in planning a system.

## The Soil Profile

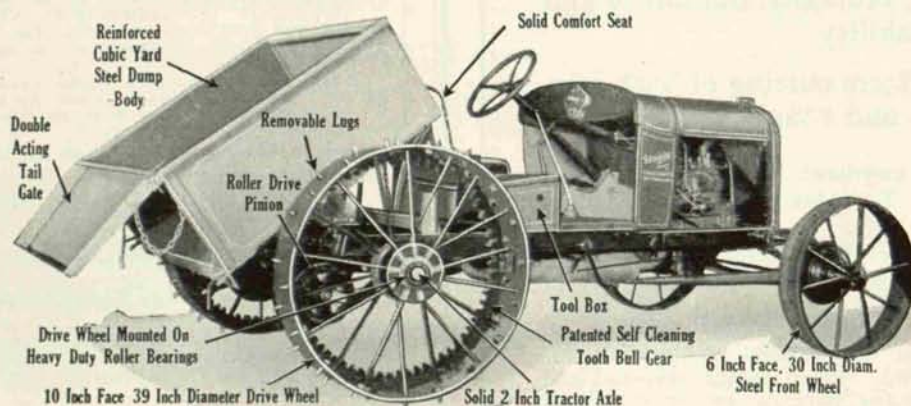
IF one examines a freshly exposed vertical column of soil there are found various layers or horizons differing in their depth, thickness, color, texture, reaction and in other characteristics. This entire series of horizons is collectively known as the "Soil Profile".

Soils show marked differences in the character of the horizons which make up their profiles. These differences are the result of different conditions of climate, of topography and of drainage during the formation of the soil from its parent material.

Consider the case of a soil adjacent to a stream subject to annual overflow; it receives yearly deposit of soil material dropped from the flood water. Before this deposited material has opportunity to undergo much change a fresh deposition is made. This continues from year to year. A soil formed under such conditions will show little variation from the surface downward. It may be almost entirely uniform to a depth of three feet or more.

In marked contrast is the soil on the upland far removed from any possible deposition by flood water. It has been in place for possibly

**More  
than  
1000  
Golf  
Clubs  
Use  
the  
Staude**



**Built  
to  
Meet  
Your  
Needs  
in  
Every  
Way**

# STAUDE GOLF COURSE TRACTOR

If you want a golf course tractor that has power to spare, speed to satisfy the utmost in expectations and the strength to stand the strain, invest in a Staude. Your investment will be amply protected by the money-back guarantee under which the Staude is sold.

MODEL A

**\$655**

F. O. B.  
ST. PAUL

**POWER-SPEED-ECONOMY**

That the Staude always delivers the goods is proved by a great number of letters we have received from satisfied users from practically every state in the Union. This list of names is yours for the asking.

Write for Information and Easy Terms

**E. G. STAUDE MAK-A-TRACTOR CO.**

2630 University Ave.  
ST. PAUL, MINN.

MODEL T

**\$475**

F. O. B.  
ST. PAUL



thousands of years. Through all this long period of time it has been undergoing slow changes. The soil-forming processes have been continually remodeling it. Finally there results a soil in which there is a marked gradation in physical and chemical characteristics from the surface downward. A definite soil profile is developed in which there are several distinct layers of horizons differing in many ways, especially in thickness, textures, and color, and often in reaction.

Upland soils of the humid regions generally tend to be somewhat stratified as to texture or size of particles. Their upper or surface horizons usually contain a greater proportion of large particles than do the lower or sub-surface horizons. The process of leaching, especially in old soils, has tended to move the finer particles downward with the consequent formation of layers made up for the most part of very fine soil particles. Such layers offer considerable resistance to the flow of water through them. The opposite condition is sometimes found in sandy or gravelly layers in the sub-soil, with consequent ease of water movement.

**No Other Pipe Saves You This!**

Just ONE of McWANE Pipe's economies is the large number of costly fittings it eliminates. McWane Pipe is cast by superior methods that permit at low cost special lengths of pipe that take the place of such fittings. The savings are startling.

No small advertisement can even list all the advantages and economies of McWANE pipe—write for folder, and see why so many sporty courses are piped with McWANE pipe.

McWANE is the only maker of a COMPLETE range of sizes for a golf course irrigating system in enduring cast iron. We make the smallest cast iron pipe in America.

**McWane Cast Iron Pipe Co.**

Birmingham, Philadelphia, Chicago. Los Angeles, Dallas, San Francisco, Portland, Salt Lake

## You Can Improve Your Turf with Lyman Carrier's Products

### LECCO

*"the complete grass food"*

Lecco contains all the elements grass needs to thrive. Lecco is a scientifically prepared "grass diet" discovered by Lyman Carrier after years of research and experimenting on plats and golf courses. Lecco produces consistently healthier turf, tends to eradicate weeds and brown patch, and develops vivid green turf. Use Lecco and you'll never use composted soil again. Send for trial order and explanatory booklet.

### COCOOS

*"the last word in fine turf"*

Cocoos is a seaside variety of creeping bent discovered by Lyman Carrier and first used by famous California Clubs to develop their beautiful greens. Inland clubs now use Cocoos with similar results. Cocoos is silk-like, stands erect, maintains a vivid green color, and resists disease, hard usage, or adverse weather. Spreads rapidly, crowds out weeds and forms a carpet-like turf. Seed supply limited. Order now to insure spring delivery.



**Lyman Carrier**

Office  
Willoughby  
Ohio

Plant  
Granger  
Ind.

*—as hundreds of other greenkeepers are doing*

Lyman Carrier, former government agronomist, is nationally recognized as one of the greatest contributors to the Better Turf Movement. His products, Lecco, the complete grass food; and Cocoos Seed, the last word in fine turf, are helping greenkeepers in all parts of the country to maintain healthier and more beautiful golf courses. These products will improve your turf.



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### Sub-surface Soil is What Counts

IT is seldom the case that the character of the surface soil furnishes a reliable clew to the kind of sub-soil underneath. The drainage engineer is not so much concerned with the properties of the surface horizons as he is with those of the sub-surface. It is particularly important to him to know whether or not any of the horizons of the sub-soil are only slowly permeable to water. If they are, he must know the exact location of these impervious horizons with respect to their distance below the surface.

He also needs a clear picture of the nature and texture of the soil material in these impervious horizons in order to know how to proceed to provide good drainage. A lack of knowledge of these two points might result in so placing lines of tile in the subsoil as to render them ineffective.

A determination of the percentages of the various sized particles which constitute a soil defines its texture. Soil particles vary in size from mere specks, invisible with the most powerful microscope, to those which are large enough to be seen with the unaided eye. The physical properties of any soil horizon are determined largely by the size, arrangement, and relative proportion of these different sized particles in it. Of particular interest to the drainage engineer is the amount of extremely fine or "colloidal" material present. He is especially interested in this because of its marked effect on the total surface area of the soil particles which in turn effects the movement of water through the soil.

### Analyzing the Soil Texture

AS THE number of fine particles in a given weight of soil is increased the combined surface area of the soil particles increases also, but not in the same proportion. If the sizes of particles is decreased to one tenth the previous size, the total number present in a given weight of soil is increased one thousand times. At the same time their total surface is ten times as great. It is this latter which is of most significance from the drainage standpoint.

If all the particles contained in an acre of soil to a six-inch depth had diameters of one twenty-fifth of an inch the total surface area of the soil particles in the acre would be less than five hundred acres. On the other hand if the particles all had diameters of one ten-thousandth of this amount the total internal surface area in the acre would be five million acres. In this latter case the particles would tend to stick together with a consequent slowing up of the rate of movement of water through the soil. Many soils contain a considerable proportion of particles smaller than those last mentioned, especially in their sub-soil horizons.

These fine colloidal particles tend to decrease the size of the drainage channels through the soil and cause them to offer great resistance to water percolation. Imperviousness is usually most highly developed in textured soils which necessarily have minute interspaces and hence high friction. This condition is usually intensified in the subsoil horizons.

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