

Foreign Grubs, a Menace of the Future

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PART 3

WITH a forecast of a serious grub invasion throughout the Middle West next year, it will repay green-chairmen and greenkeepers of the Mississippi Valley to follow this series carefully, even though the articles consider specifically the Japanese beetle, whose range is limited to the eastern states. For grubs that injure golf courses have similar habits, and the methods of control are the same, whatever the species.

This month's installment, the third *Golfdom* has run, points out the essential features of the beetle's feeding habits and life-history, details that form the basis for the control measures that have proved so successful.

IN last month's article I discussed the history of the Japanese beetle since its importation into the United States with special reference to its effect on golf courses. Before beginning a discussion of control measures for the grub of this and allied species it would seem advisable to consider the life-history of the insect in its relation to golf courses and the habits of the grub in turf.

The Japanese beetle has what is technically termed a one-year life-cycle. In other words, the four phases of its existence—egg, grub, pupa and beetle—are all passed through in one year. That is in the latitude of Philadelphia. In the North the life cycle may require two years. The insect overwinters in the grub stage underground. In late May and early June, when the ground is beginning to warm up considerably, the grub undergoes a change

and becomes a so-called *pupa*, which is really a half-way stage between the grub and the adult beetle. The pupa, in turn, continues to develop and in the last stage of its growth the tough yellow skin-covering splits lengthwise, disclosing the mature beetle.

All this transition from grub to beetle occurs in a few weeks' time, the actual time required depending upon the soil temperature. During a cold spring the change is slower than is the case in a normal spring season.

The control which temperature exercises on this transition stage from grub to beetle is a provision of nature intended to prevent the appearance of the beetle above ground before the day and night temperature of the atmosphere is propitious.

The Japanese beetle, in the adult stage, has no liking for cool



The grub of the Japanese beetle. It is in this stage that the greatest damage is done to turf. Photo greatly enlarged.

temperature. The beetles, even though they are fully formed, will remain under the surface until the soil has thoroughly warmed up. When the June weather settles down to a series of hot days and warm nights (good corn weather), the beetles emerge from the soil in swarms, each beetle leaving a characteristic round exit hole in the soil, and fly to neighboring trees and weeds for the purpose of feeding.

Spraying Deters Adult Beetles

Golf clubs located in the Japanese beetle area have been compelled to do considerable spraying of trees and shrubs during late years in order to prevent injury by the feeding of the beetles. "Coated" arsenate of lead is best for this purpose as it sticks to the foliage throughout the entire period of the annual beetle flight. Only one spray application is necessary, whereas with the ordinary arsenate of lead, easily washed off by rains, two or more sprayings may be necessary. The beetles avoid foliage which has been sprayed with arsenate of lead.

While the beetles do a great deal of damage by feeding on the foliage of shade trees, fruit trees, shrubs, etc., nevertheless from the life-cycle standpoint, the main business of the adult beetles is to lay eggs, thereby providing for the next generation and the perpetuation of the species.

Shortly after the beetles have emerged from the ground and have spent a short time in feeding, the two sexes mate, and while the males continue to live the life of Riley in the tree tops, the female beetles, who are no doubt firmly convinced that justice is an abstract issue in this life, turn away from the joys of sunshine and tasty leaf and return to the soil for the prosaic task of laying a batch of eggs.

Eggs Require Moist Soil

The female may deposit her eggs almost anywhere in the ground—they have been found in cinder sidewalks—but the great bulk of the egg deposition occurs in turf. Here again the female has a natural instinct which governs her selection of a site for egg-laying. Those portions of a given locality are chosen in which the grubs emanating from the eggs thus deposited will have the best environment for a favorable existence. Such an environment calls for a rich, moist, loamy soil with a good stand of fine turf growing upon it. What extensive turf area, embodying all these requirements, can be found anywhere equal to a golf course?

Hence, in the area infested by the Jap-

anese beetle, golf courses are the favorite egg-laying terrain for this insect. In fact, it is safe to say that decidedly more eggs are deposited in the turf of golf courses than in any other turfed area of equal acreage.

The beetles are apparently guided in their choice of a spot in which to lay eggs by the color and vigor of the turf. This is evidenced by the fact that in a season of normal or excess rainfall, when fairways and even the rough are a nice green color, the beetles lay eggs indiscriminately over the course—in the rough, fairways, approaches, tees and greens. In dry seasons, when the greens are emerald oases in a desert of sun-parched turf, the beetles concentrate their egg-laying in the greens and the other relatively limited portions of the course which receive sufficient water to maintain them in a growing condition.

The front feet of the female Japanese beetle—this is not true of the male beetle—are enlarged and spatula-shaped like the front feet of the common ground mole and enable her to dig into the ground with ease and dispatch. The eggs are deposited at a depth of from one to three inches, depending upon the moisture content of the surface soil layer, deep enough so that the eggs will always be surrounded by moist soil during the week to ten days necessary for them to hatch into grubs. Eggs surrounded by dry soil often shrivel and fail to hatch.

Sixty Eggs per Pair

The female usually spends from 24 to 48 hours in the soil, during which time she may lay ten or more eggs. At the end of this period she comes to the surface, mates again with a male, feeds for a day or two, and again returns to the soil for more egg-laying. This process continues until she has laid on an average of 60 eggs, whereupon she succumbs to her strenuous life.

During this period the beetles are a decided nuisance to the players on the greens. They hang around the greens during the heat of the day and are trod on by the players until the greens become slimy and unpleasant in spots.

About the middle of August, when the nights become cool, the beetles die off rapidly, for they cannot withstand cool night temperatures. The hordes of beetles disappear and are forgotten until new hordes appear the following year.

Turf Habits of Grub

The eggs hatch in a week to ten days, the newly hatched grub being not much

larger than the head of a pin and not readily discernible by the novice. The young grub grows in size very rapidly and is one-third matured in from two to four weeks.

It seems to be the general opinion of entomologists that the food of the grub, during this period, consists almost entirely of partially decayed organic matter, since the grub in the first third of its life causes no apparent injury to turf. It is very probable, however, that the grub, from the day it is hatched, prefers living roots of grasses or other plants; the lack of apparent plant injury is in all probability due to the relatively small feeding capacity of the grub at this stage of growth compared to its voracious appetite and large root-consuming capacity when nearly full grown.

The grub's life period is divided into three parts known as *instars*. When one-third grown, it casts its skin, including the hard, chitinous covering of the head, and passes thereby from the first into the second instar. The new head covering and body skin is much larger than before, and the grub proceeds to grow up until it fills its new suit, whereupon it again casts its skin and passes into the third and last instar.

Grubs Fatten Up for Winter

By the latter part of August, the grubs enter the last stage of their growth, namely the third instar. From then until cold weather the grub does the heaviest feeding of its career and consequently the heaviest damage to turf. During this period (August 15th to freezing weather) the grub gorges itself with more food than is needed to maintain life and transforms the surplus into a heavy layer of body fat which is stored along the back and sides of the body. In the late fall, the grub has a pronounced yellowish color due to this layer of fat lodged beneath the skin. This fat is the grub's winter provision against the months when the

ground is frozen and it cannot secure food. Like a hibernating bear, the grub winters on its fat; in the spring it has the thin, neglected appearance of a half-starved alley cat.

As soon as the ground begins to freeze, the grubs go down in the soil and become more or less dormant. They can withstand very cold soil temperatures, but they cannot endure sudden changes in soil temperatures; hence they usually go down sufficiently deep in the soil to avoid the extremes of surface freezing and thawing.

In the spring when the ground thaws, they come up near the surface of the soil in a very thin and hungry condition and again feed voraciously so as to get back into good bodily condition in preparation for the change to pupa and beetle.

Many Grubs Look Alike

Before concluding this month's installment in this series of articles on grubs now appearing in *GOLFDOM* it might be well to state that the grub of the Japanese beetle is comparable in size, shape and color to many of our native species of white grubs, so much so that it is almost impossible with the naked eye to

identify positively a white grub suspected of being a Japanese beetle grub. It is, therefore, necessary to examine the grub in question under a microscope in the hands of an entomologist specializing in this phase of insect work. The various white grubs, in practice, are differentiated and identified as to species by means of the position and arrangement of certain short spines on the underside of the body near the posterior end.

In next month's article I propose to discuss the effect of grub feeding on turf, and to point out the two weak places in the grub's apparently otherwise impervious environmental armor and to show how these two weak spots are the grub's two "heels of Achilles" which render it susceptible to two highly efficient methods of chemical control.



The shiny, iridescent adults do no direct damage to golf turf, but at times they are crushed underfoot in such quantities that putting on a green is a most unpleasant experience. This photo is much enlarged.

To Out-Sell the Local Stores, Loud-Pedal Your Name!

*Some Sound Advice to the Pro Who Is Fighting
Department Store Cut Prices*

A ROSE by any other name may be as sweet to a poet, but Ivory soap, Wrigley gum, Tiffany jewelry, Rolls-Royce automobiles and a multitude of other products would not be as "sweet" to their stockholders, by many millions of dollars, were the names of these products changed. Wonder if the average pro ever thinks of this in considering the value of his own name in making golf merchandise more desirable to the prospective buyer?

There is plenty of evidence supplied by the manufacturers that a professional golfer's name is worth money. Walter Hagen, Gene Sarazen, Bob MacDonal, Jock Hutchison and a host of other star performers can look over their royalties and see how it has paid to have their names capitalized. So much for the star sharpshooter, but how about the average pro who keeps a good shop, attends to the requirements of his members, wins a local or sectional tournament now and then and occasionally qualifies for one of the national events?

He may think there's nothing in his name for him, but if he capitalizes his name either in his bench-made goods or in the superiority of his selection of factory-made stock or, in both cases, in the "fitting" of the proper club to the buyer, he will see quickly one of his greatest defenses against department store competition. In the case of the bench-made goods, the job is not difficult if the man is on the job. Around the Chicago district the Herd and Herd clubs command a premium. In the St. Louis territory the Harrison brothers' name is a sterling mark, and around Duluth, as GOLFDOM recently related, Dick Clarkson's own clubs sell with a speed and at a price that very brightly shows the value of a pro capitalizing his name.

Weighing the Values

Undoubtedly the psychology of golf plays a part in the value any club has to its player. What confidence that the club is right can be had by an average player when the club bears the stamp of "The Leader Store" or some such general mer-

cantile establishment with sales covering almost everything from antiseptic solutions to zithers? Practically none, because the player has the idea that the department store is the jack-of-all-merchandise and master of none.

The average golf player always is looking for an alibi and it takes very little comment to show him that he has a pretty substantial excuse for misplay in the clubs he gets from the sporting-goods section of almost every department store. Some care taken in assuring the customer right off the bat that he has a club satisfactorily and expertly endorsed soon makes itself a feature of pro shop operation that is widely and enthusiastically appreciated by the pro's customers. By his own talk at the time of sale and by reference at every opportunity to this careful selection and fitting of clubs, the pro can make this word-of-mouth advertising active in his behalf.

Since word-of-mouth advertising is about all the advertising the pro ever does he might well guide it so it will carry some weight regarding his leadership as an expert and careful supplier of golf goods.

Study the Sources

The pro can tell of his visits to the various manufacturers' branch offices or factories, and his personal selection of the clubs. He can refer, with good reason, to the leading manufacturers being anxious that the pro get the best of their stocks, for it is the pros who make the golf market and the manufacturers' reputations. It won't hurt to go into plenty of detail when it can be done without boring a buyer who may be in a hurry, for the average player is anxious to get a "peek behind the scenes" in the golf business and will be very active in repeating any "inside" information that the pro can hand out deftly for the good of the pro's business.

It seems to us that many a pro during his off season would do well to visit the plants of some of the leading golf-goods manufacturers and get the "close-up" on the interesting and scientific methods of manufacture that prevail. The selling inspiration and help that the pro will gain

from such visits will be a decided aid to him in merchandising as well as in buying.

During the past summer we heard a successful young pro tell of the methods of one of the well-known Scotch factories making iron heads. The pro had visited this plant during his previous winter's vacation and brought a number of heads home with him. This little talk, made off-hand to a group of three or four members, was passed around in locker-room confabs, embellished and enlarged, for the fellows who recently had been put "in the know" were anxious to show off their wisdom. The next time we visited that club, the pro told us he'd sold the last of the heads he had brought back. The incident was one that vividly showed how a pro could boost sales by telling members that he picks the best and why he picks the best.

Work on every angle of capitalizing your name and you'll not only find sales a lot better, but you'll knock out all department store competition big enough to be noticeable.

Make Pro Partner of Santa Claus

ALTHOUGH we know nothing of the circumstances of the case described in the quoted paragraphs following, we are printing the story as sent to GOLFDOM by a western correspondent, and making some comments of our own relative to the position of the pro in the case.

The article, as sent us, reads:

"A golf club officer who believes in seizing every opportunity between seasons to keep golf interest keen is _____, Secretary, _____ Country Club, _____, Colorado.

"He sent a letter the middle of December to the wives of all _____ Country Club members. He suggested golf equipment and novelties for gifts. This was his letter—

"Dear Madam:

"During December I imagine that wives of men are pretty much like husbands of women. They rack their brains in an attempt to arrive at suitable gifts to present on Christmas eve!

"Men are generally fed up on socks and ties. While the old boy may smile and act happy when presented with a tie of many colors, down deep in himself there is likely to live a feeling different from that which his actions attempt to show.

"So, as Secretary of the _____ Country

Club, it occurs to me that I should be able to assist you. Your husband likes golf. I feel sure that to him an item of golf equipment will mean more on this Christmas morning than anything else you could select for him.

"I offer this merely as a friendly suggestion, hoping to aid you in the selection of a gift that will carry happiness to him.

"The _____ Sports Store and The _____ Hardware Company both carry complete lines of things for the golfer that I know he will like for Christmas.

"With best of wishes for a very Merry Christmas and a Happy New Year, I am,
Sincerely,

"Secretary."

"Using a large display advertisement, headed "Thanks, _____", The _____ Sports Store, mentioned in the Christmas golf letter, reprinted it in a large newspaper advertisement.

"A noticeable influence on purchase of golf supplies for Christmas gifts followed the letter."

So much for the yarn as submitted. Now here's GOLFDOM's reaction:

The golf club whose official wrote the letter obviously is an adept sales correspondent and the results of his letter, so the testimony states, stirred up business for the stores handling golf equipment. It means that the business going to the stores was business taken from the club's own pro shop. Whether the shop was operated by the club or by its pro as part of his contract, the official's excellent sales letter diverted some golf sales from the club shop with consequent handicapping of the club's operations.

But what are you going to do about it when the club is closed around the Christmas shopping time? If the pro lives in town such a letter might direct purchasers to him and if he's on the job he ought to be able to make a goodly little profit around Christmas. In many towns it is possible to operate the club shop's selling quarters for a couple of weeks before Christmas and cash-in on the holiday shopping.

Pros will find their club officials in the holiday mood of helpfulness and if some effort and resourcefulness is exercised there is no reason why such expert sales help as that in evidence in the case cited above, shouldn't be allied with the pros' interests.

T a l k i n g I t O v e r

Mid-West Vol- unteers Valuable Greens Help

Elsewhere in this issue details of the Mid-West Greenkeepers' association's new plan of consulting and advising service appear. Not since the formation of the U. S. G. A. Green Section has such a valuable contribution been made to the cause of better course maintenance, providing the golf clubs to which the service is available will take advantage of it in the same earnest manner in which the service is tendered.

We have difficulty in calling to mind any other business that could, and would, send out some of its foremost authorities to determine and remove operating difficulties, and make a charge that represents only bare expenses and not a cent for the valuable and authoritative knowledge brought into play. The Mid-West association deserves the highest commendation for its new plan. The plan means more work for the volunteer experts to whom "union hours" now run the length of a farmer's laboring day, but the added responsibilities have been willingly accepted. The Mid-West men are going at this new proposition in their usual energetic fashion, with the enthusiasm of crusaders for better and thriftier maintenance of perfect course conditions. We have wondered if green-chairmen give these fellows due credit for their idealism. When the greenkeepers meet there is a lack of that air of eat (if absolutely necessary), drink and make merry that is so evident at many business conventions. The greenkeepers mean and act business. They want every course to be perfect, and after that perfection is achieved they may think of their own monetary reward for the work, but the great national game of "getting theirs" doesn't seem to bother them much.

That may be a handicap to this new plan the Mid-West association announces. There are some who don't realize or appreciate the extent to which good greenkeepers will go "for the good of the game." These unknowing ones will under-estimate the value of the service because it is gratuitously given and thus will deny their clubs the benefits of one of the most important helps that has been offered to golf. The almost complete lack of selling force in the makeup of even the greatest of greenkeepers means that probably there will be just the announcement of the consulting and advisory service, and no persistent follow-up. However, the announcement alone should be enough as revealing the location of ready rescuers when a brother greenkeeper or green-chairman sends out an S. O. S.

Department Meetings Promote Smooth Operating

Meetings of department heads of commercial establishments are more or less customary and successful, but such cases are rare in golf club management.

We ran across a case recently of a club where the president and committee chairmen meet twice a month during the season with the manager, greenkeeper and professional. These sessions, so the club president told

Between Ourselves

us, were directly responsible for a \$4500 profit this year as compared with a \$2900 deficit in 1926.

Get your men together and encourage them to speak out in meeting. You'll get harmony and a very welcome unity in striving for thrifty and satisfactory operation.

Tell Virtues of Many, Not Faults of Few

We read "Elmer Gantry" when it was hot off the press, and despite its several hundred pages to the effect that the minister of the gospel was a hell of a guy, we continued serenely to hold our opinion of the generally lofty character of the clergy. The other day we got a letter that reminded us of the Gantry volume. It blistered the professionals as the Lewis book lit into the ministers.

The letter was written by an evidently very earnest fellow, and what he said was plenty. There was just one thing wrong with the letter and with "Elmer Gantry," restricted vision.

In the year preceding the publication of the first issue of GOLFDOM, while we were laying its foundation, we talked with a number of the country's foremost professionals regarding a proper editorial policy for their phase of the game. The sage veteran, Alec Pirie, at that time said to the writer: Hir-r-b, dinna scold the pr-r-o, it's been over-r-doon. Help 'im."

That came back to us as we read the critical letter.

The pro needs help in correcting just such misinterpretations of his status and profession as that our interested but mistaken correspondent sent to us. That is the sort of aid that club officials can give to assist the representative and worth-while pros establish the publically recognized standards of their fraternity. On such matters as concern his own business operations the pro is doing a pretty good job of helping himself and should be allowed to push his progress in this direction instead of being handicapped by any idea that he is to be condemned for the shortcomings of the few in the fold.

"Catch 'Em Young" Is Tip to Manager Who Looks Ahead

Our records show that seventy per cent of the country's golf clubs have their annual elections between November first and December fifteenth.

The wily club manager, knowing from experience that it is only human nature for these newly elected or appointed officials to assume "new-broom-sweeps-clean" tactics, will make it a point to hold a conference or two with the new president and house chairman before they start their sweeping.

A few weeks' delay and the new administration may have committed itself to some impractical plans of operation and the responsibility for failure, if it occurs, will have to be assumed by the manager without his ever having had a chance to figure in the conferences that established the line of march.

"Look Before You Leap" Is Beaumont's Plan

The Beaumont Country Club, at Beaumont, Texas, planned to install a watering system for its greens. But before signing any contracts for the work, they sent questionnaires to all the interested manufacturers. Armed with this information, Beaumont was able to buy intelligently with the assurance that the watering system would be satisfactory.

TO A LIST of manufacturers of watering equipment for golf courses, Beaumont wrote the following letter:

"We are contemplating the establishment of a watering system for grass greens to cover nine holes at present and eighteen holes in the course of two to five years. We will be in the market for supplies of various kinds and wish to have prices, circulars, descriptive matter and advice in regard to what we will require in the establishment of this water system, and its approximate cost.

"Our golf course is within one hundred yards of the river where water is obtainable in unlimited quantities. We have not at present any other source of water supply which is available in quantity or quality to the extent that the river would furnish. The only thing we are doubtful about in this connection is the effect of the river sediment on any system we may install.

"On a direct line from the river bank; the furthest point of distribution would be about three thousand feet. Two hundred and twenty-volt alternating current single phase electric current is available for power.

"We do not contemplate now or at any time in the future to water our fairways from this plant.

"Please give all details, information and advice you can or may be disposed to give in this connection and oblige.

He enclosed, with this water system letter, a questionnaire to be filled in by those interested in supplying the club's requirements. This questionnaire read.

"What type of pump would be most suitable for our requirements?

"What type tank is most suitable for this kind of water distribution?

"Give reasons for preference as to pressure or gravity tank system.

"How much water is necessary to water properly 18 grass greens in the course of one night's watering?

"What size or capacity of tank would be

necessary under (a) a pressure or (b) a gravity system?

"How much higher than the highest point on course would tank have to be elevated in a gravity system?

"What pressure per square inch is necessary (a) at tank, (b) at sprinkler heads for the proper or satisfactory operation of the larger size sprinklers?

"What size pipe leading from tank to greens on main line will give best results? What size laterals and green connections will give best results?

"Is well water superior to river water for green watering purposes? Or, is river water better? Give reasons."

Watering Data Supplied

Getting help on the watering problem via the questionnaire means that only some excellent general information may be expected. There are too many details that are entirely dependent upon a careful study of the local situation for the conscientious helper to submit data that will answer all the questions.

Some of the factors that control the watering system design are the size of the course, distance to the point farthest from the source of the water, irrigation pipes that will be piped off from the main line, the various elevations, and the sprinklers that will be used. Sprinklers vary in their demands in capacity and pressure, and this makes a big difference. Then there is the matter of labor available. Clubs water varying numbers of greens at a time. These varying requirements figure prominently in the design of the watering system. The soil, too, is a controlling factor, for sandy soil requires two to three times as much water as soil containing considerable clay. There also are varying water requirements of different grasses on greens.

One of the manufacturers supplying data for the Beaumont club suggests that

golf clubs write pump makers for the manufacturers' own questionnaire blanks for these blanks carry leading questions, enabling the manufacturer to submit some definite figures and recommendations.

A point of error common to golf club water installations is emphasized by M. B. MacNeille, manager of Fairbanks, Morse and Company, pump division. He says most golf clubs are paying an unusually high price for pumping water because the pipe lines are too small in size, resulting in abnormal friction losses. He states that he has seen a fairly level nine hole course requiring water being pumped against 100 pounds pressure, where, if the lines had been of adequate size, 45 pounds would have been sufficient pressure.

In a number of respects there are wide variations in the recommendations passed on to Beaumont for its water system. All of those answering have had successful experience with golf club installations, so it goes to show that some latitude is allowable in this matter of watering installations. Wendell P. Miller, who has specialized on golf course watering problems, the Kewanee Private Utilities Company, which also has done considerable golf course watering work, A. D. Cook, and Westco-Chippewa Pump Company are the suppliers of the following data:

Miller Answers

Direct connected electrically driven or double stage centrifugal pump should be used.

No tank should be used unless automatic water pressure control is desired, in which case use 1,000 to 2,000 gallon hydro-pneumatic tank.

Modern efficient sprinklers require line pressures of from 60 lbs. to 80 lbs., which would require too high a gravity for economical storage.

Greens should be given at least one-half inch of rainfall at each watering and counting an average of 8,000 square feet to the green you would require approximately 45,000 gallons of water at each application.

Capacity of tank for pressure system should be 1,000 to 2,000 gallons, for gravity system, 20,000 to 45,000 gallons, depending upon the capacity of the water system supplying the tank.

Tank for gravity system should be elevated above the highest point on the course not less than 140 feet for efficient sprinkler operation and provided friction loss in the mains was held down to a minimum.

Pressure per square inch necessary at tank is 60 lbs. to 80 lbs. and not less than 50 lbs. at sprinkler heads for larger size sprinklers.

Pipe size—all depends upon layout of system; relation of pumping plant to center of distribution and number of greens to be watered at one time. Never less than four inch, usually six inch, seldom over eight inch.

Minimum of 1½-inch pipe should lead to greens where run from main does not exceed 200 feet; over 200 feet from main use 7-inch pipe. Minimum size lead to a tee should be 1¼-inch with 1½-inch used on leads in excess of 150 feet.

There is absolutely no difference in the value of well water or river water for greens watering unless the well water should be so heavy mineralized as to corrode the pipes rapidly, in which case I would prefer the river water. Temperature of the water has nothing to do with its value.

The Beaumont system should be designed so as to keep friction losses in the pipes down to less than 5 per cent. Beaumont should count on a discharge of not less than 25 gallons per minute at each green and ten gallons per minute at each tee. I usually design a system to water either six or nine greens and tees simultaneously, depending upon whether daylight or night-time watering is desired and upon power rates and line sizes.

Kewanee's Advice

The Kewanee Private Utilities Company answers the questions as follows:

No. 1: Under most conditions a displacement type of pump in either a single, double acting or in a triplex plunger type will be most suited for golf club requirements. The efficiency of this type of pump is very high and far surpasses the centrifugal unit. The life of these pumps is also very much greater. Consequently over any period of time a displacement pump is found to be the most economical.

No. 2: A pneumatic tank is best suited for golf club water distribution. This sprinkling requires high pressure. High pressure will give the best spread to the water out of the sprinkler and at the same time will reduce the size of pipes necessary. This means a cheaper installation. When it is considered that a tank 40 feet high will give less than 20 pounds pressure and that the friction loss in each 100 feet of 2-inch pipe at 20 gallons per minute is approximately ½ pound, you can see that this small amount of pressure in this tank is not going to be very much at the farthest end of the course. It is not always found that the farthest end of the course is the lowest and it is not always good practice or is it economical to try to have the tank located at the highest point and perhaps the source of the water will be clear across the course.

No. 3: Pneumatic tanks will give higher pressure and reduce costs, as explained above, and they can be installed under-

ground or in a pump house as preferred. They can be easily reached for attention and do not require a great deal of painting. One coat of paint every second or third year is usually sufficient. A gravity tank system, on the other hand, is costly. The tower must be gone over to see that the tower has not weakened and that everything is painted. Failure to do this has resulted in collapse of the towers or breaks in the tanks. This not only means destruction of the tank and tower, but sometimes of property or life below.

No. 4: Watering of greens is greatly dependent on the kind of soil and the season. As we explained, sandy soil may require as much as 20 gallons of water per minute and other soils of denser nature are down to approximately 8 or 10 gallons per minute. At our local club we have the past several years succeeded in watering eighteen greens at a rate of about 4 gallons per minute and have never had a burnt out green all this time. Then again some clubs prefer to water the entire course every night, some water one-third of the course one night, another third the second night and the last third the last night and then repeat. Some divide the course into two so that every green gets watered every other night. This depends, of course, upon what the club wants to do, and of course, as we have stated, on the kind of soil.

Nos. 5 and 6: The capacity of the tanks varies considerable on the amount of water necessary. With a pneumatic system the capacity of the tank is quite a bit less than an elevated tank. The pneumatic tank is generally figured about one hour's capacity of the pump, and the pump is generally figured to furnish sufficient water or a little more than what is taken out for the greens at one time. In this way the pump puts back as much or a little more than the sprinklers are taking out and at the same time this keeps up the pressure in the tank so that there is no break or variation in the pressure or the volume of water being supplied to the greens.

Nos. 7, 8 and 9: For the majority of courses 75 pounds pressure at the tank is usually the maximum. In some cases on very hilly courses pressure has been raised to 85 and 110 pounds. Seldom is it necessary to go farther than this at the tank. To obtain an elevated tank pressure equal to 75 pounds the tank would have to be approximately 170 feet high. This would be an expensive tower to construct and keep up. The pressure at the sprinkler heads is at an average about 40 pounds. We have data here from a great many sprinkler manufacturers and as we go through these we find that they state that the sprinklers operate best at a pressure of about 40 pounds. Some of them will operate as low as 20 and 25 pounds but

will not give the coverage.

No. 10: This question has been answered in our letter, and we will again state that it is impossible to state offhand what size pipe should be used until we have some idea as to what the course is and can figure properly just what the friction losses and the elevations are. We will state that not less than one-inch pipe should be used from the sublaterals to the greens. This means, of course, that all pipes back through the sub-laterals and then the main to the tank must each be correspondingly larger.

No. 11: This question has been practically answered in No. 10.

No. 12: In some instances well water is not desired for irrigation. This is where a certain mineral may be held in solution that would have a bad effect upon the plants. There should be no objection to any river water that is flowing so that there would not be any stagnant water pumped. It is claimed that river water is to be preferred because of certain life in river water that when distributed upon the ground really provides a sort of plant food. It is also claimed that river water is of a softer nature, while deep wells will provide water that is hard and less desirable for growing grasses. Many clubs are using well water for the reason that they have one system of water supply. They take the water from the well and use it at the club house for all purposes such as showers, drinking, cooking and kitchen and also use the same system for supplying water to the course.

Cook's Answers

A. D. Cook advises Beaumont with the following answers to the questionnaire:

A triplex pump is most suitable for this service with belt or silent-chain drive. Is more positive and more efficient than a centrifugal pump.

We recommend 5,000 to 10,000-gallon hydro-pneumatic pressure tank and a small air compressor unit for surplus air for tank.

A tank with triplex pump gives higher pressure. Pressure tank is less in cost and maintenance. It also can be protected from weather.

Amount of water depends upon soil, kind of grass in greens, etc. To be safe figure 15 gallons per green for about two hours, but only water six greens at one time, then change to six other greens during the evening or night, etc. Eighteen greens can be watered thoroughly.

Use 10,000-gallon pressure tank and triplex pump for 75 G. P. M. and maintain 60 lbs. to 80 lbs. pressure, or 5,000-gallon tank and a 90 G. P. M. pump. Would not consider gravity system.

If you must use a gravity tank get it as high as you can afford—2.3 ft. elevation means 1 lb. pressure.