lines causes loss of suction and the lines do not 'draw'."

Cadmium Fungicides for Turf Diseases was the subject presented by Dr. W. H. Thurston, Jr., Penn State College, State College, Pa.

Dr. Thurston said the use of cadmium fungicides for turf diseases developed while looking for a new material for potato treatment. Chromate materials were tried in the Philadelphia section. These are complex materials containing copper, zinc chromate and calcium. Tests were made on plots on courses of Joe Valentine and Marshall Farnham. Slides were shown of 1946-47 observations.

Excellent control was found on dollar spot. The chromium materials are not as efficient on large brown patch as some other materials.

The cadmium materials have the advantage of not discoloring or setting back turf growth rate, are non-corrosive, and can be used either wet or dry. To the question raised if the copper in the mixture had any ill or cumulative effect due to residue, the reply was no injury was observed over a two year period of the copper complex. This may be due to the copper being tied up with the other elements.

Cadmium fungicides are not the answer to large brown patch control. Using "Tersan" and "Crag" alternately in judicially spaced intervals was suggested. Tests are incomplete on snow mold control.

Differential Responses of Norbec and Arlington Bent Grasses to Kind and Rates of Fertilizer were reported to the convention by Ethan C. Holt of the Midwest Regional Turf Foundation at Purdue University.

Experiments were run under controlled greenhouse conditions with controlled solutions. (Norbeck is C36 and Arlington C1, previous USGA strain test numbers.) Nitrogen, phosphate, potassium and calcium deficiencies were studied on growth rate of tops and root accumulation. Dated photos were taken of tests. Grass growing on top of pots containing white quartz sand were photographed, and negative density measured with a photo or light meter, in foot candles. Slides showing the tests, and printed data were shown at the convention. Grass roots were later weighed dry, to tabulate growth.

Effects of Urea-form Fertilizer

Effects of Urea-form Fertilizer on Turf, the address by W. H. Arminger of the U.S. Dept. of Agriculture, was illustrated by slides. Arminger explained that materials are a combination of urea and formaldahyde, containing 34-to 38% nitrogen.

Arminger summarized the greenhouse tests as follows:

"Bermuda grass and perennial ryegrass grown as indicator plants in pots have shown that the nitrogen content of urea-form materials is available to crops over a much longer period than nitrogen applied as ammonium sulfate or Milorganite. In contrast to standard nitrogen sources which usually are applied in readily available forms, urea-form materials have a low solubility and are not readily available at the time of application. After application they undergo gradual decomposition and release nitrogen slowly for plant growth over an extended period.

"Analysis of variance of the data from both the Bermuda grass and perennial ryegrass experiments show that crop yields were significantly greater in the latter part of the season when one of the urea-form materials of moderately low solubility was the nitrogen source. Crop yields were greater in the early part of the growing season when nitrogen was supplied by a standard nitrogen source, thus indicating the desirability of using a mixture of the two types of nitrogen to promote uniform growth.

"Urea-form materials, in general, stimulated greater root and crown development than did conventional sources of nitrogen. This development is desirable from the standpoint of turf production.

"Urea-form materials have been applied at the rate of 400 pounds nitrogen per acre without any trace of plant injury due to burning. This rate is the equivalent of applying 4,000 pounds of a 10% nitrogen fertilizer per acre."

He summarized the field tests as follows:

"Certain urea-form materials applied to Centipede grass in Georgia and Bermuda grass in Florida did not promote as heavy or as uniform turf production over an extended period as did ammonium sulfate or sodium nitrate. A long period of low rainfall at both locations enabled the highly soluble materials to remain available in the soil longer than normal. The urea-form materials failed to release adequate amounts of nitrogen during this period since the unfavorable moisture conditions decreased the bacterial activity required for their decomposition.

"During the first 41 days after application conventional nitrogen sources were superior to urea-form materials in the production and quality of the turf on an established Kentucky blue grass sod in Ohio. Following this the urea-form treated sod was superior to that treated with ammonium sulfate or Milorganite for the next 89 days. At this time the bluegrass sod was affected physiologically by extremely high temperatures and thereafter only

slight differences were noted between any of the treatments.

"In the first 95 days of a 195-day experiment on established Bermuda grass in Texas, conventional nitrogen fertilizers produced higher clipping yields than any of the urea-form products under test. The most readily available urea-form material gave higher yields in the 96-195 day period than the standard sources of nitrogen. The less readily available urea-form products either failed to show any superiority during the experiment or showed it considerably later in the season. This excessive delay in release of nitrogen by the urea-form materials is attributed to low temperatures at the start of the experiment followed by a period of inadequate rainfall. As a result only one of the urea-form products gave a total yield higher than Milorganite, which in turn was exceeded by both ammonium sulfate and sodium nitrate.

"Three urea-form materials, ammonium sulfate, and Milorganite were compared on Alta fescue sod at Beltsville, Md. The grass was clipped weekly for 10 weeks without removal of the clippings, and then it was allowed to grow for two weeks to obtain yield data. All plots receiving urea-form gave yields considerably greater than those treated with ammonium sulfate or Milorganite."

Charles Hallowell presided as chairman of the Southern Turf section which opened with O. S. Baker, supt., Indian Creek CC, Miami Beach, detailing his procedure in changing to bent greens at the famed Indian Creek course.

Baker seeded with a mixture of Astoria, Colonial and Highland on a 1-1-2 basis. He seeded Oct. 15 and by Feb. 1 had fine dense greens despite unfavorable weather conditions. He sowed rye as a nurse crop but regards that as an error as he discovered that rye was susceptible to disease and exposed the bent to stronger attack than it might normally suffer.

Indian Creek, as well as other Florida courses, have been subject to a fusarium attack, identified by David Stoddard of the Everglades Experiment Station as snow mould. The spore is wind-borne from the north and found Florida condition last November and December favorable to its development. Usual snow mold preventive treatment employed in the north now looks to be something more for southern budgets. Baker said the snow mold finds rye more susceptible than Bermuda although unfertilized Bermuda areas were hard hit. As in the north bad drainage on Florida courses was associated with serious snow mold damage.

Prior to seeding with bent, Baker had a program of chemical elimination of weeds and Bermuda on greens. Although he kept this program on the conservative side to avoid risk of soil sterilization he said that torrential rains following treatments diminished power of the applications.

Work Schedule for Seeding

Greens, prior to seeding were topped with a mixture of coarse beach sand, limestone screenings and muck, then worked over with an aerifier, a Cultihoe, harrowed to further mix and true up, worked over with a box drag, then dragged with a 6 x 10 steel door mat. A jeep operator and helper did this work. Greens then were rolled with a fairway roller. A Delmonte rake furrowed for the bent seed which was put on with a Gandy seeder. Then a greens roller went over the job. A mist spray was applied to keep the seed from being blown.

Heavy rains handicapped the work, making it necessary to process the greens four times before seeding.

Baker said that he believes bent greens will be the answer to saving $2500 to $3500 seeding costs annually on greens of the better Florida courses and will provide greens the year around that will put like northern greens.

During last year's late storms Baker got hole-cutter plugs of grasses from the Florida experiment station when there appeared to be danger of the station's turf

plots being washed away. Baker showed colored slides of these samples as of approximately Feb. 1 and views of his beautiful course.

This summer the Indian Creek bent greens will be mowed on regular schedule and from these greens and observation of the test strains Baker hopes by fall to have some fairly good information on what bents will do best in southern Florida. By then he also expects to have definite data on the procedure that will keep Bermuda from growing into the bent greens.

Air and Moisture Balance

Fred Grau, director, USGA Green Section, in substituting for Dr. Thomas Longnecker, Texas Research Foundation, in talking on "Aeration and Moisture Relationship in Turf" also commented on Baker's address in remarking that the finer Bermuda strains still are a possibility in the southern greens picture.

Grau emphasized that the proper balance of air and moisture is the most important topic in turf maintenance. Cause of most putting green trouble is too much moisture or not enough air, he said. There's no one answer that solves the problems of air and moisture balance but changing soil texture is the answer that many courses will have to apply before they can solve their greens troubles, observed Grau. He said that if greenkeepers had the proper balance of air and moisture to promote the growth of micro-organisms essential to plant health and to provide hair roots of grass with nutrients in solution they wouldn't have to water greens as much as they now think they must.

The Green Section director declared that more research is needed on the problem of placing fertilizer where the plant can make best use of the food. The farmer who can plow has an easier job of getting plant food to roots but the greenkeeper who can't use this method and who has to keep his plant product in use 366 days of a year has a complex job. He reminded his hearers that plant roots constituted one of the best means of breaking up heavy soil and binding light soil but how to get deeply rooted turf is a job that calls for all the business knowledge the greenkeeper can muster.

Dixie Meeting in May

T. M. Baumgardner, Supt., Sea Island (Ga.) GC, presented an excellent practical round-up of fairway management methods for good results in the south. This paper appears in this issue of GOLFDOM. Baumgardner urged that all interested in southern turf attend the Second Annual Southeastern Turf Management Conference which will be held at the Coastal Plain Experiment Station, Tifton,

Ga., in May. He said exceptional progress has been made in the experimental work conducted by Dr. Burton in cooperation with the USGA Green Section. Among the many experimental plots are more than 100 distinct strains of Bermuda, some of which are far superior to ordinary Bermuda in texture, color, aggressiveness and in some cases, disease resistance.

Everitt Shields, supt., Druid Hills CC, Atlanta, gave a remarkably complete but concise paper on "Summer Maintenance of Bermuda Greens." The Shields address was practically a compact handbook on the subject and will appear in its entirety in GOLFDOM.

Chlordane Results Noted

The informative, helpful address of Dr. Roy A. Bair, Everglades Experiment Station, Belle Glade, Fla., on "Minor Elements in Turf Production" also will appear in GOLFDOM. Before his talk on minor elements Dr. Bair spoke on chlordane results as observed in Florida. He said it shows great promise of cricket mole control. Chinch bugs, army worns and ants have been closely controlled by the material. Chlordane is inactivated quickly on sweet soil, Bair said. Results on acid soil are more complete. Mixed with organic material as a bait chlordane gives quick results but it has to be watered in.

Bair also said that the latest dope on 2, 4-D is that it is activated by ultra-violet light and gives best results on a clear day especially after rain has cleared the dust from the air.

"What's New in Control of Turf Insects," the paper of John C. Shread of the Connecticut Agricultural Experiment Station, appears complete in this issue of GOLFDOM.

Fitting the Fungicide

A history of fungicide chemicals was given briefly in the address of Frank L. Howard, Rhode Island Experimental Sta-

tion. There are over 50 fungi species which can effect or kill turf grasses. This makes it a problem to find one chemical to control all diseases, and calls for a "tailoring problem" to fit the fungicide to the fungus control. In a way, fungicides act as a monkey-wrench to wreck the fungicide mechanism. Two methods of disease control are generally considered. 1—a chemical barrier to prevent disease, and 2—to build up plant resistance to disease. Safety margins vary with the material used, soil type, moisture, temperature, pH, soil structure, organic matter present. These factors enter into the effectiveness of fungicides and the extent of plant injury which may occur. Also, the age, variety of turf, and height of cut need consideration. Another problem in turf fungicides is how poisonous the fungicide is to man, animal or bird.

Whose responsibility is it if someone is poisoned by the use of fungicides? It is not the government's and not the manufacturer's. So long as the container is properly labeled as to contents, marked poison, with the usual skull and cross bones, and antidote given, the responsibility is up to the user of the material. Humans may be affected internally, by mouth, by respirants or breathing, or skin injury.

In preparing fungicides, plant pathologists strive to make all materials in dry materials so they can be applied either wet or dry and to make materials concentrated, and non corrosive to equipment. In considering the cost of fungicides bear in mind you are buying control; not tonnage.

The longer-lasting less frequent applications made, the better, and scientists strive to develop materials which need only three or four applications per growing season. Materials must be comparable with other materials and controls such as insecticides. The residue effect from continued use needs to be considered, and tests made on various turf species. Plant feeding for vigorous growth helps resist disease. Applications of 2, 4-D on greens turf lowered the grass resistance to

disease attacks. Summarizing disease control, Howard advised to maintain high plant vigor, use an alternate spray control, and until further developments, for best control, use mercurials (inorganics) cadmium compounds and phenol mercury materials alternately.

New 2, 4-D Developments

Speaking on New Developments in Weed Control with 2, 4-D, Chas. Hamner of Michigan State College emphasized that 2, 4-D is one of the most potent of plant toxicants. Scientists are seeking a plant antidote for 2, 4-D to revive plants which accidently may be sprayed with the material. It has been observed that monocotyledonous (single stalk-leaf) plants such as grasses and onions are most resistant to 2, 4-D. Experiments are being made with plant extracts from "monocots" to check 2, 4-D injury.

Slides were presented by Hamner showing the amount of growth inhibition measurement. Below pH 3 or 4 2, 4-D was greatly stimulated. Buffer solutions are being tested to prevent acid changes. Buffered solutions greatly controlled 2, 4-D toxicity.

Another line of study is the effect of 2, 4-D on weed versus grass seeds. Some seeds can be killed with concentrations weak as 1 part per million. Ten parts per million will kill most weed and grass seeds in soil. The toxic effect lasts about two weeks, and after three or four weeks there is hardly a trace left in soil, and new seeding may be done. 2, 4-D was first discovered as a root-promoting substance when plowed into soil 5 lbs. per acre. At higher concentration of 20 lbs. per acre plant growth was checked.

Slides showing corn experiments, illustrated a cornfield damaged by hurricane winds. Corn in soil treated with 2, 4-D had developed brace roots of sufficient strength to prevent them blowing loose. 2, 4-D placed in soil controlled 95% of weeds, although some seeds are resistant. The present limiting factor of using 2, 4-D

as a soil weed seed sterilizer is the cost of application due to lack of proper equipment to apply very small dosages. The cost to apply has run as high as $10 per acre. However, a wheelbarrow rig with spray boom for hand operation was made up, and a manufacturer is working on developing this for general use.

Balanced Course Design

The Fundamentals of Golf Course Design as set forth in the interesting talk of Stanley Thompson, noted golf architect, gave the greenkeepers a close-up on the architect's design problems. An expert study needs be made of the balance of holes on a course. Over 90% of players score 92 average. This type player pays the costs and should be catered to in designing. A compromise needs be made between playing and maintenance conditions. Study of an air photo is advised by Thompson prior to laying out the course. He usually takes at least a week to lay out a course on paper, with the architect and two engineers. Do not build a course around a few feature holes, Thompson warned. There should be two or three easy starting holes and the holes stiffened up as the layout advances.

"Use of Visual Education in Turf Maintenance" was detailed by Albert E. Cooper, Extension Agronomist, Penn State College. He showed colored motion pictures used in the extension job which carries the college to the people of the state. Motion pictures and slides are used to great advantage and clarity to explain methods and give demonstrations, Cooper said and noted especially that the results of experiments are greatly clarified. The three reels shown at the convention were of course maintenance practices, equipment, etc. at Philadelphia and other Pennsylvania courses.

"Behind the Scenes," movie of the PGA 1947 Championship at Plum Hollow GC, Detroit, were shown after preliminary remarks by Emil Beck, secy. Michigan PGA.

Keen Interest in Turf Program At Philadelphia Meet

One hundred fifty turf enthusiasts attending the 16th annual Philadelphia Turf Conference at Llanerch CC, February 18, adopted an aggressive turf improvement program for all sports and recreation areas as well as golf. Alta fescue was reported to show more promise for this purpose than any other basic grass with ten superintendents adopting a plan to seed playing fields this spring with 75 lbs. per acre after lime and fertilizer applications.

Discussion leader for the meeting arranged by the Phila. Assn. of GC Superintendents and the Phila. branch of the Nat'l Assn. of Gardners in cooperation with the Agri. Extension Service was Charles K. Hallowell, Ext. Ser. representative.

Other highlights on greenkeeping problems reported by those in attendance included the following:

Sodium arsenite sprayed on greens at the rate of one ounce per 1,000 sq. ft. at Green Valley CC during last year removed weeds and browned the bent grass for only a few days without noticeable damage thus saving several days of hand weeding.

Charles Wilfong, Supt., Green Valley CC, is working toward a weed free golf course. The entire course was sprayed with 2, 4-D in 1946 and all fairways were treated with