WEEDS TREES & TURF

TURF MANAGEMENT SERIES/PART 4

Turfgrass Maintenance

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Turf first boomed in the late 1920's. Much of the progress made prior to the Depression is the basis for today's methods. In this part of the Turf Management Series, we trace chemicals, equipment, and practices back to their origin in the United States.

The next two parts of the series cover turf disease and insects. For that reason some of the material on these subjects is missing in this part. Furthermore, this section had to be abbreviated to fit the magazine format. As you know, the six parts of this series will be published as a book in 1981.

I hope that you will pass on your historical knowledge to us for inclusion in the book. Please don't hesitate to write to us about your days in turf maintenance, whatever field. Already I've received dozens of letters telling of important events in turf which I had overlooked.

This project has been a labor of love. It has made me tired but fulfilled. Please join me in trying to record our historical legend for the turf managers of the present and future.

Bruce F. Shank

Bruce F. Shank, Editor

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THE EARLY YEARS

"At first sight, the growing of a piece of fine turf seems to be a simple matter, and this has misled many persons to underestimate woefully the difficulties to be overcome." These remarks were made in 1917 when growing a piece of fine turf may not have been simple, but certainly simpler than today. They are the words of Piper and Oakley, USDA turf scientists in Arlington, Virginia, in their book *Turf for Golf Courses*, now out of print.

In the past 63 years the turf industry, largely propelled by the needs of golf and sod production, has solved many of the conditions once considered Mother Nature's ire. In some cases our solutions have created new problems. Some suggest the amount of new knowledge is too much to expect a turf manager to know, inferring the value of the turf does not warrant the effort.

A few authors have estimated the value of the turf industry to dramatize the need for research and the importance of the science. Nutter and Watson estimated a 1965 value for turf expenditures at nearly $4.5 billion in the American Society of Agronomy publication *Turfgrass Science*.

Money is not the only reason to pursue answers to questions raised by practicing turf specialties. The main reason should be to provide a complete set of facts on turf biology to develop logical, scientific answers to problems encountered in the field. We still can't claim to have enough information to solve such problems as disease, weeds such as nutsedge and *Poa annua*, and insects such as *Aetenius spretulus* and the Greenbug aphid. We are playing with less than a full deck much of the time.

With needed support, there is little reason why many of these still unsolved problems can't be tackled during the 1980's.

Tom Mascaro

Founder of West Point Products, the company that introduced the aerifier, verticutter and three-wheel turf vehicle.

Consider what turf management problem solving was like 60 years ago. Actually, what superintendents noticed back then is the backbone of today's knowledge. Piper and Oakley reported in 1917 that alkaline soil encourages weed growth. In 1917, following a severe epidemic of Rhizoctonia brown patch on turf (as identified by Piper) an agricultural fungicide developed in the late 1800's called Bordeaux mixture was used on turf. Reel mowers pulled by teams of horses mowed golf courses until the first gasoline tractors were developed and applied to mowing in the early 20's. The reel was a British invention dating back to 1830.

The compost pile was a major source of fertilizer for early golf superintendents, then called greenskeepers. In addition to topsoil, manure and compost, turf managers used bonemeal, cottonseed meal, dried blood, hoof meal, nitrate of soda, sulfate of ammonia, acid phosphate, rock phosphate, and muriate and sulfate of potash.

Herbicides were virtually nonexistent. Sulfate of ammonia was said to help control white clover, arsenite of soda was used for chickweed control, and even sulfuric acid and gasoline were injected or brushed on the crowns of weeds. Arsenicals were used for worm and insect control.

Weed control, grass cutting, and installation were performed totally by hand. Labor was cheap. Scythes, aerifying forks, sod spades, and numerous other hand tools preceded the mechanical versions of today. Many superintendents held their maintenance tricks secret from golfers and other superintendents. This was their method of job security. It was also one of the main targets of early organizers of greenskeeper associations.

Topdressing with sand and organic soil was practiced in the first 20 years of the Twentieth Century. In some cases greens were topdressed weekly and fairways at least annually. Greens were sliced prior to topdressing with crude carts dragged across the green which had many small blades on the bottom to cut the surface.

Large drop-type seeders were available and pulled across golf courses by horses. Horses provided the muscle on many courses into the 30's. They wore special steel or leather boots to prevent damage to the turf. Greenskeepers were very careful to keep heavy horses and later machinery off their greens.

Spot sodding was the solution to weed infestation and disease. One foot squares of bentgrass were cut from areas in good condition, trimmed to the proper thickness, and carefully placed where poor turf had been removed.

Irrigation was either by flooding or surface hosing. Irrigation was by

Toro Junior Tractor *and five-unit gang mower on well-groomed golf course in 1936.*

no means a new concept, dating back to Egyptian and Greek cultures. But it would be another 30 years before pressurized, quick coupling systems would take over.

The United States Golf Association Green Section was established in 1918 to solve turf problems. During the next ten years, three valuable publications were started to serve golf courses *(USGA Green Section Bulletin, Golfdom* magazine, and *The National Greenkeeper).* The *Bulletin* was published by The Green Section from 1921 to 1933 when the Depression forced staff cutback. 1926 was the founding year of the National Association of Greenkeepers of America, predecessor to the Golf Course Superintendents Association of America. NAGA started *The National Greenkeeper* in 1927 for its members. A third publication was launched in 1927 by Herb and Joe Graffis, *Golfdom.* It was the only private business publication and it was designed to serve all needs of the golf course, not just the turf needs.

1927 was also the year of the first educational program for turf managers at Stockbridge Winter School, part of the University of Massachusetts. This eight-week course was taught by Professor Lawrence Dickinson during January and February. Greenskeepers from as far west as Illinois and Ohio attended this concentrated course on turf maintenance.

Lawrence Dickinson
Taught first school for greenskeepers at the University of Massachusetts in 1927.

Between 1920 and 1931 the number of golf courses in the U.S. exploded from 500 to more than 5,000. Equipment and chemical companies quickly took note of this growth market and started designing products for it.

Consequently, companies such as Toro, Jacobsen, Worthington Mower Co., National, Roseman, and Buckner started making products for the golf maintenance market. World War I had pushed the gasoline engine into use over steam. Engineers, like National Mower Company's R.S. Kincaid, refined the tractor/mower combination into a practical tool for golf courses. Although greenkeepers had reservations about compaction with heavy mowers, they bought the gasoline tractor mowers as fast as companies could make them.

Mallinckrodt, Du Pont, and Bayer developed improvements to the Bor-

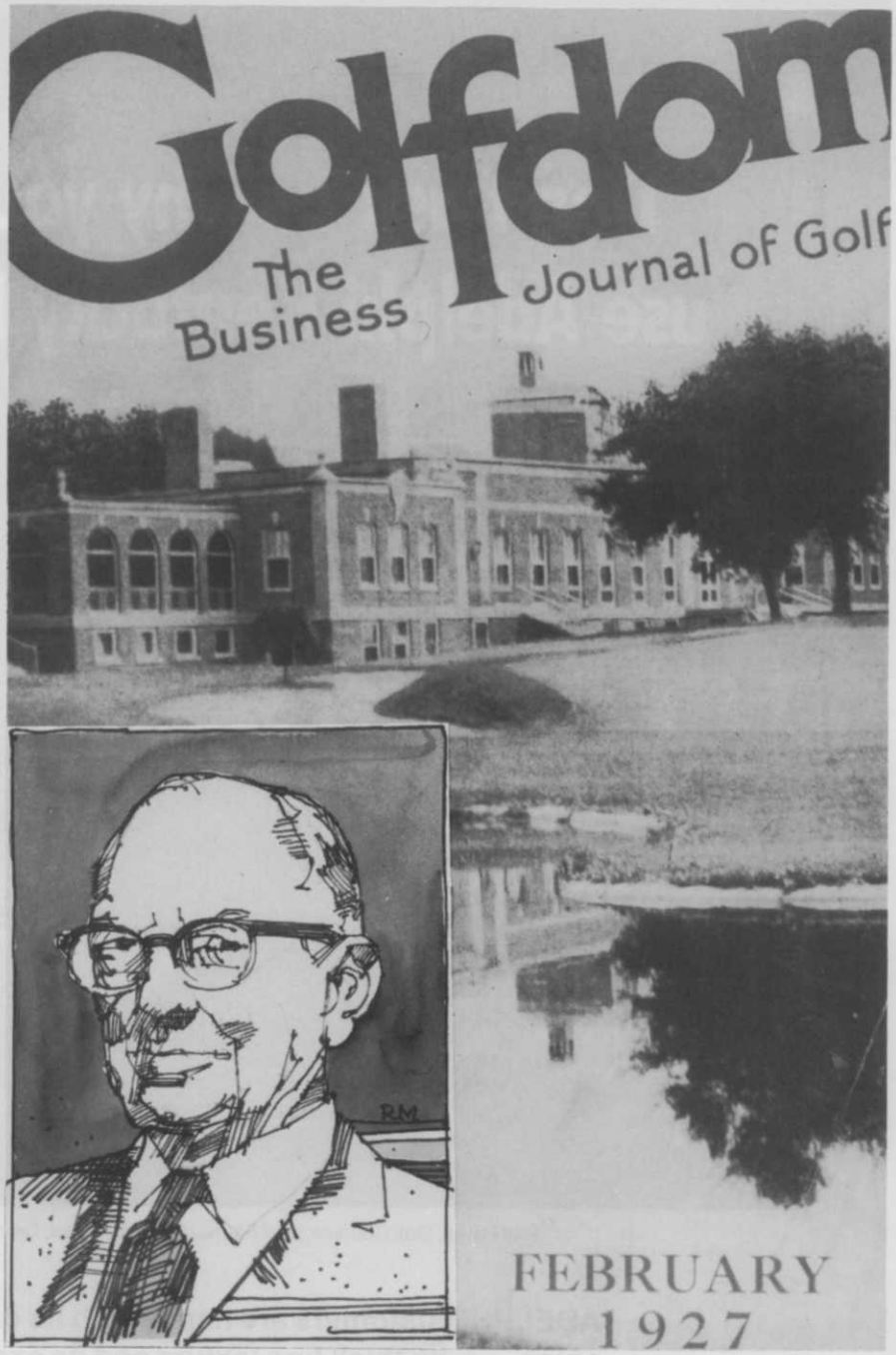
deaux mixture for disease control. Mallinckrodt developed Calo-Clor and Calogreen, mercuric chloride compounds. Bayer produced Uspulum Nu-Green and Du Pont offered Semesan, a chlorophenyl mercury compound. These fungicides were used for many years.

By the late 20's the golf industry was very healthy. Other sports were gaining strength on a college and professional level. The concept of a well-groomed memorial park instead of standard cemetery originated in the 20's. Scotts' publication *Lawn Care* was launched and created more residential interest in turf. Turf was booming. It was another 30 years before turf regained its momentum after the Depression and two wars. During that period, however, progress continued.

John Monteith, director of the Green Section, spearheaded much of the technical progress in the 20's by working in conjunction with the USDA facility at Arlington. The *Green Section Bulletin* kept turf managers current. It was a blow when USGA was forced to lay off everyone in the Green Section except Monteith and stop publication of the *Bulletin* in 1933. Among those let go were Arnold Dahl, who had coauthored *Turf Diseases and Their Control* with Monteith in 1932 and Fred Grau, a graduate of the University of Nebraska turf program. Dahl became a turf consultant and Grau began his Ph.D. work at the University of Maryland.

Progress did not come to a complete halt in the 30's. Du Pont introduced the fungicide, Thiram, in 1931. Research continued on weed control and turfgrass selection at universities. Combinations of fertilizer and lead arsenate were proving effective. Merion Golf Club superintendent Joe Valentine selected the first quantities of Merion Kentucky bluegrass in 1936, the same year Grau joined up with Burt Musser at Penn State after completing his Ph.D. O.J. Noer, a progressive businessman with the Milwaukee Sewerage Commission travelled the U.S. touting Milorganite and Milarsentie for turf.

The preservation of the science can be attributed to regional personalities, whether they were golf course superintendents, suppliers, university specialists, or association leaders. Without them, the turf market would have lost ground. The hard times may have unified turf



Turf and golf growth in the 1920's *was recorded by a number of new publications including Golfdom, founded by Herb Graffis (inset) and his brother Joe in 1927.*

managers, especially golf course superintendents, and caused continued progress through discussion of mutual concerns. This unity kept healthy manufacturers interested in the market and encouraged inventiveness in those that had mechanical talent.

In 1936, Tom Mascaro launched a topdressing supply business in West Point, Pennsylvania. He quickly made acquaintance with superintendents and turf specialists, such as Monteith, Dickinson, Musser, DeFrance at Rhode Island, and Sprague at Rutgers. It was already understood that some type of cultivation prior to topdressing was beneficial. Removal of thatch by hand raking was also practiced. Ten years after it began, West Point Products, with the technical assistance of Grau, developed the first commercially produced aerifier and verticutter. The first aerifier was tractor drawn and used a series of spoon-shaped rods to pierce the soil surface. His technology was purchased

in 1969 by Hahn Inc. of Evansville, Indiana. Turf technology regained momentum in the late 40's and has yet to stumble like it did in the 30's.

After World War II there was a flurry of activity in the turf market. Fanny Fern Davis, Green Section director during the war, supported the use of a new herbicide, developed in 1941 to be a fungicide or insecticide. It was a substance that selectively affected the growth of plants, specifically broadleaved plants, without harming grasses. 2,4-D was the start of a chemical revolution in weed control. It was the basis for the new commercial applicator market, treating roadsides, drainage ditches, rights-of-way, and lawns.

The 40's was also the first identification of turf as a special committee in the American Society of Agronomy. This was an important event since now turf related research would be reported in the *Agronomy Journal*. The creation of the committee was pushed by then director of the Green Section, Fred Grau, who returned to USGA for eight more years of service.

Progress was also made with fertilizers. It was discovered in the early 20's that combining the hydrogen in natural gas with nitrogen produced ammonia. By reacting ammonia with carbon dioxide gas, a more stable source of nitrogen was created, urea. But urea was volatile and did not persist in the soil as a source of nitrogen to plants for very long. It was discovered that by chemically reacting formaldehyde with the urea a longer lasting product was obtained, ureaformaldehyde. Both Du Pont and Nitroform Agricultural Products introduced UF products in the 40's, Uramite and Nitroform.

This chemical revolution extended to growth retardants. Giberellic acid was the first to receive attention for turf use in the late 40's. Growth retardants required very precise use and exhibited side affects which were unacceptable to major turf markets.

The chemical that really started the revolution was the insecticide DDT. Commercial production of this chemical began during the War and continued until environmentalists, spurred on by Rachael Carson's *Silent Spring* , stopped its production and sale in certain countries. DDT was the first major breakthrough with insecticides since the discovery of the arsenicals, nicotine, and pyrethrum decades before.

Subsurface irrigation began to gain acceptance in the 40's. California companies set equipment standards which spread rapidly to the Southeast and slowly northward. Quick coupling systems of the 40's were installed with galvanized metal, copper, or asbestos pipe. Automatic controls (electromechanical) were introduced in the late 50's. In the 40's and 50's regional agricultural irrigation suppliers were a major factor in turf, such as Skinner and Thompson. Toro purchased the California company Moist-O-Matic in 1958 and provided a national source for turf irrigation equipment in addition to Buckner and Rain Bird.

Eb Steiniger
Superintendentof Pine Valley Golf Club in Clementon, New Jersey, since the 30's.

Permanent irrigation heads slowly gained share of market with quick couplers, especially in arid/semi-arid regions where daily irrigation was necessary. Spray, impact and eventually gear-driven heads were developed. Plastic began overtaking metal and asbestos in the 60's for pipe and heads. Installation was simplified by the use of flexible plastic pipe. Computer technology has added flexibility to the controller in the past decade.

While the chemists worked on new fungicides, herbicides, and insecticides in the 50's, a second generation of turf specialists were studying under the first. These new investigators tested the new chemicals as part of their research work. The result was a very productive 60's. Butler, Burton, Daniel, Duich, Engel, Indyk, Kozelnicky, Kneebone, Miller, Murray, Reike, Shoulders, Skogley, Watson, and Youngner improved the market's data base. At the same time they coordinated regional turf field days and conferences further strengthening the turf industry.

They reported on new preemergence herbicides such as DCPA, DMPA, bensulide, siduron, trifluralin, and terbutol. They tested the postemergence herbicides mecoprop, dicamba, dalapon, simazine, and the methanearsenates. They pinpointed the role of nematodes in turf disease and studied the new contact and systemic fungicides. IBDU was evaluated as the second major slow-release fertilizer. They helped turf managers understand the new chlorinated hydrocarbons, organophosphates, and carbamate insecticides.

The 50's and 60's were the introductory years of many improved turfgrasses selected and produced by seed. The first fulltime turfgrass breeding position of Dr. Reed Funk at Rutgers was experiencing great success with new possible grasses.

During this time, the Green Section narrowed its scope of service and established regional technical areas each staffed with an agronomists. Al Radko took the reins from Fred Grau in 1953. At Beltsville, Felix Juska headed turf research until Jack Murray stepped in. Professional golf reached new levels of spectatorship with the skills of

Early gasoline-powered single reel mower. *Circa 1920. Courtesy Toro Co.*

Hogan, Sneed and Palmer.

Events receiving little attention but important nonetheless were the development of wetting agents for turf, additives for better spray coverage and adherence, colorants, and high impact plastics and fiberglass.

By the end of the 50's, it was clear turf was back on its feet and ready to grow rapidly. To serve the turf manager in areas other than golf, *Weeds Trees & Turf* was launched in 1962. Four years later, *Grounds Maintenance* was started. These publications published news and interpretive articles on the mass of technical data being produced. The market was gaining in professional stature and drew the attention of potential suppliers. Commercial publications assisted these suppliers in reaching the new market.

The graduate students of the 60's are now attaining professor status. It has become their challenge to put all the progress into a digestable and logical form. Stiffer environmental regulations make their tests more intense and involved. Among this group are Beard, Dunn, Gibeault, Hall, Larsen, Shearman, Smiley, Turgeon and Turner.

Jim Watson

Studied under Musser at Penn State and went from there to Texas A & M and Toro to solve irrigation turf irrigation needs.

The commercial sector began to provide attractive employment for some of these new graduates. It began to pick up some of the research load previously left to the university. Examples are ChemLawn's Miller, Joyner, Martin and Wilkinson; Davey's Funk; Turf Seed's Meyer; International Seed's Pepin; and Loft's Hurley.

The 70's was a decade of questioning existing turf practices. Loss of certain chemicals, resistance to others, and rising costs of water and petrochemicals forced a reevaluation of turf maintenance. Integrated management and lower maintenance levels are being studied for practicality. Better attention to basics like rootzone construction, pH, and drainage may lower dependence on corrective measures.

Maintenance Practices Today

The pioneering days of turf management are for the most part over. Efforts are now directed on improvement of existing equipment and new uses for existing chemicals. The primary goals of engineers and chemists now are saving labor and fuel. Even water is becoming a critical limiting factor in turf maintenance in some areas.

Safety and environmental regulations for chemicals and equipment have increased cost without increasing productivity or efficiency. At the same time, they have greatly discouraged new suppliers from entering the market. Ingenuity is too often suppressed by the liability of manufacturing today.

After ten years of trying to meet unclear and constantly changing demands by the Environmental Protection Agency, chemical manufacturers have at least a few precedents to go by in chemical registration. As a result, more uses for existing products are becoming available. However, some of the chemical workhorses of turf management are floundering in EPA's Rebuttable Presumption Against Registration Process (RPAR). In this evaluation, products with suspected dangerous side effects are prosecuted under the full weight of environmental groups. This process forces the manufacturer to reevaluate the profitability of keeping older chemicals on the market when expensive testing is mandated. If the chemical is placed in a restricted category and the market for the product is reduced considerably, the manufacturer will be forced to raise prices to cover the cost of manufacturing smaller quantities.

The equipment manufacturer will soon face new safety regulations. Mower manufacturers are being required to add a blade brake which will supposedly prevent injury to feet and hands when the mower is not in motion. This precaution will add more than $30 to the cost of a trim mower. It is likely that similar safeguards will spread to machinery such as power trimmers, vacuums, and snow blowers.

Despite this burden of protecting the buyer against himself, manufacturers are making progress. Products are evolving which do cut labor time, gasoline consumption, and down time. Much of the savings however is lost in the price of the product.

The key to turf management efficiency is combining all known money saving measures into one in-

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Thoughtful superintendent *at Merion Cricket Club in Haverford, Pennsylvania, in the 20's rigged reel gangs in front of Toro tractor so that grass would be cut before heavy tractor wheels compressed it.*

EQUIPMENT

Jacobsen Division of Textron Inc.

A couple brothers, Knud and Oscar Jacobsen, and AJ Dremel founded the Jacobsen Co. in 1921 with the development of the "Four Acre," a lawn mower which could cut four acres in one day. This machine weighed 275 pounds and sold for $275. The following year, the founders took back all 75 pieces that were sold and checked and reconditioned them to make sure they were working smoothly.

The Four Acre was the first mower with an engine designed for parks, cemeteries, and other heavy-duty operations. The second Jacobsen model arrived in 1923, called the "Estate." The next year the company introduced the first cast aluminum, power engine greens mower. Golf course superintendents hesitated to use the greens mower but soon realized it was ideal for cutting bentgrass.

The industry's first automatic recoil starter came out of the Jacobsen workshop in 1928, the same year the company unveiled its own fairway gang mower. That year Einar Jacobsen, Knud's son, joined the company and later became president.

In the years following, the company introduced many firsts to aid those involved in turfgrass maintenance: the first polyethylene grass catcher; the first mower with four reversible, replaceable, retractable blades from rotaries; the first with pneumatic tire equipment; the first mower with hydraulic tri-plex screens; and the first out-front hydraulic fairway mower.

Before 1929, someone cutting turf of any expanse had to walk behind the mower. Thus Jacobsen saw the need for and invented the sulky, an interchangeable riding attachment for power mowers.

In the spring of 1939, the company introduced the Lawn Queen for $87.50. It was the first homeowner-type power mower for lawns and cut an 18 or 21-inch swath.

Jacobsen bought the Johnston Lawnmower Co. in Otumwa, IA, which built all-steel hand mowers. World War II halted lawn mower manufacturing for all but a few companies and Jacobsen built generators and other defense equipment for the Army.

The company continued to develop more products for golf courses and homeowners and in 1953 introduced power snow removal equipment to its line of other products. Jacobsen merged with the Allegheny Ludlum Co. in 1969 and two years ago Textron Inc. bought Jacobsen from Allegheny Ludlum.

tegrated plan. The turfgrass breeder, engineer, chemist and practitioner must consolidate their knowledge into a program which can be considered low maintenance and yet impressive from a quality standpoint. Since these factions have operated independently for the most part, a new panel approach must be organized. One way to start would be to select one golf course, one park, one shopping center, one office plaza, one cemetery, and one highway right-of-way to implement all known labor and energy saving technology. Since associations are mainly concerned with specific fields, this coordinated program would most likely be taken on by a state university.

Of course, individual superintendents and turf managers could implement a combination of labor and energy saving methods at their facilities.

Some of these methods are included in the following description of progress in specific turf areas.

Aerifiers

The original aerifier was designed to be pulled by a tractor. It used a series of spoon-shaped rods attached to a central axle to pierce the soil. Soon afterward a gasoline powered aerifier was developed, both of these firsts came from West Point Products. Today, this technology is the property of Hahn. Other methods of coring were developed to reduce the unsightly appearance of cores remaining after aerifying. Hollow rods attached to a drum and dragging after aerifying are examples. Dedoes, Cushman/Ryan, Jacobsen, Toro and Turfco have all included aerifiers in their turf lines. Cushman makes one model that uses rows of upright rods to alternately punch the surface of greens.

Soil modification through topdressing is regaining strength as a turf practice. Aerification and sand topdressing offer potential for golf as well as other turf uses. The role of well-aerated soil in disease, compaction and irrigation efficiency is being rediscovered. Its role in *Poa annua* control is being restudied.

A drawback to the aerifier is its infrequent use. An aerifier attachment for a tractor may be more sensible on a cost basis. The multi-use turf tractor may be a key factor in equipment efficiency in the future.

Drainage

Proper site preparation makes

correctional drainage unnecessary. On the other hand, improvements in trenchers and the development of flexible plastic drain tubing have greatly reduced site disturbance and installation cost. Very few good farmers have yet to tile their fields. Turf managers should follow suit realizing the installation cost can be recouped in better drained and playable turf. Drainage also provides the manager with better control over the environment of the turf. Excessive surface moisture encourages disease and *Poa annua*. A savings in fungicides and herbicides is a possible result.

Fertilizers

The most recent development in fertilizers has been liquid formulations of ureaformaldehyde. Sulfur-coated urea preceded liquid UF.

The latest intent of chemical manufacturers has been to provide convenient nitrogen sources for applicators of liquid materials for turf, primarily the lawn care market. Their developments could be applied to fertigation, an area of large potential for well-irrigated turf areas. Liquid lawn care to golf courses has not proven practical so far.

Granular fertilizers remain the dominant nitrogen source. Some dry materials are available in a form suitable for liquid application.

Slow-release fertilizer technology currently exists which enables managers to reduce the number of seasonal fertilizer applications.

Combining fertilizer with insecticides and herbicides to reduce the number of applications is desirable. Large users may economize by buying quantities of individual chemicals and mixing them. This is simpler in liquid form. Buying custom blended dry products is less economical. Distribution of dry materials from broadcast spreaders may not be even if particle sizes and weights vary considerably.

Guidelines to mixing various dry materials to consolidate applications would be well received.

Growth Regulators

If you remember that growth regulators were actually the materials used to develop herbicides from, you wonder why they haven't progressed more than they have. Scientists have worked decades to reduce the yellowing effect of most growth regulators on turf. Managers of fine turf still hesitate to use them. Establishing low maintenance areas will encourage the use of growth retardants for roughs, roadsides, and parks.

Herbicides

The biggest headache in selective weed control remains grassy weeds such as yellow nutsedge and *Poa annua*. Basagran is registered for nutsedge but must be used with care to prevent burning desired turf.

Some specialists say we create our own weed problems with excessive fertilization and irrigation. Adjusting these maintenance practices should then help.

Properly timed use of preemergence herbicides certainly reduces postemergence treatments. Weed control is one of the areas that can benefit the most from integrating management practices. Keeping a good eye on the turf to identify problems early is advised, as is eliminating adjacent weed seed sources. Renovating a nearby field to tall fescue may be cheaper than endlessly fighting airborn weed seed. Hand removal of a few isolated weeds may eliminate the need for large area treatment later.

EQUIPMENT

National Mower Company

The historical flavor of the mower market can be sensed from the background of the National Mower Company of St. Paul, Minnesota, and its founder Robert Stanley Kincaid.

Kincaid received his degree in mechanical engineering from Purdue University in 1908. He grew up in Kentucky and appreciated the beauty and needs of turfgrasses. Kincaid's father became ill at the time of Stan's graduation and was hospitalized in Rochester, Minnesota. Since he hadn't yet taken a job, Kincaid decided to look for work in the Rochester area. He took a trolley to Minneapolis. When the conductor asked for additional fare he got off to look around. He noticed a manufacturing plant across the street and decided to check the company for job opportunities

Although he was an engineer, he accepted an apprenticeship at the plant for $1.25 per day. That company was Gas Traction Company, the first manufacturer of gasoline powered tractors in the world. Engineering developments there were applied to nearly all gasoline tractors to be built in the next 20 years.

Kincaid later worked in cooperation with John Deere, the early founders of Toro, and Briggs & Stratton. The northern central states were a hotbed of gasoline powered tractors in the teens. In 1916, a demonstration of tractors from Ford, International Harvestor and others was held in Nebraska. The conversion from steam to gasoline was now certain.

At this same time Kincaid began experimenting with gasoline-powered reel mowers. He developed a 40-inch mower for estates and helped solve early engine lubrication problems. All efforts were directed at war for the end of the decade.

In 1921, two years after he returned from the war, Kincaid began making small numbers of gasoline-powered mowers. He always resisted fancy and unnecessary cowling and concentrated instead on the engineering strength of his mowers. Gradually he built up production and his son John joined him.

Today, National makes some of the most rugged riding reel mowers in the business. These mowers had their origins with Toro's Bull Tractor and continue to play a growing role in mowing of fine turf. Kincaid strongly believes in doing a few things well rather than many things poorly.

Irrigation

Many turf specialists are suggesting irrigation has been misused, especially in the north and northeast. Battles with *Poa annua* , bentgrass in a stand of bluegrass, and turf disease are thought to be related to misuse of water. Much research on healthy irrigation levels for turf is needed. The practicality of using irrigation systems for chemical applications needs to be considered more seriously. This might well be a reason to install or upgrade an existing irrigation system since coverage would be critical for such use. Wetting agents may be one of those chemicals applied to improve the utilization of water by the turf.

Use of effluent or even city water may prove more economical than drilling a well or building a lake. In some areas, an extra meter can be installed on the system and sewerage treatment fees deducted from the water bill. If use is limited to necessary times water use can be curbed.

Mowers

Hydraulics have gained a strong position in the mower market. Original resistance caused by extra maintenance for hoses and pumps is being overcome. Use of larger mowers is more practical due to hydraulics. Transporting large mowers no longer requires stopping the mower to pick up side units.

Hydraulics have helped the use of flail mowers for turf. Manufacturers offer fine edged blades for flail mowers. Benefits are said to be reduced blade sharpening and adjustment.

Hydraulic reel mowers offer an alternative to PTO driven versions or wheel driven versions. Gangs provide the extra flexibility of freeing the tractor for other jobs. Rotaries remain the modern workhorses due to high maneuverability and low maintenance. Hydraulics have eased some of the problems with belts on rotaries.

The sickle bar mower has slowly faded into almost strictly agricultural use.

Seeders/Spreaders

The technology of seeders and spreaders has not abandoned the drop spreader, although broadcast and hydraulic seeders are dominating commercial use.

Convenience of size and speed often outweigh the accuracy of the drop spreader. Broadcast spreaders throw a wide swath of material in a short time. Distribution is less uniform, however. Large broadcast spreaders have greatly increased the practicality of topdressing with sand.

The hydraulic seeder quickly solves large seeding jobs. The seed can be applied with the fertilizer and mulch at one time. Blowing straw becomes unnecessary. Seeding rates are higher but instant protection against weather is provided and the job is completed quickly. Mulch quality must be carefully watched. Always use the well-known brands to avoid problems.

Verticutter

More aggressive Kentucky bluegrasses have increased the need for vertical mowing. Increasing popularity of overseeding and topdressing also encourages the use of vertical mowers. Like the aerifier, the verticutter is used only occassionally. Combined with turf vacuums, verticutting can be a fairly quick form of turf improvement. Verticutting large areas remains a

EQUIPMENT

The Toro Company

Toro began as the Toro Motor Co. in 1914 when the Minnesota-based operation was commissioned to build engines for a manufacturer of farm machinery. It turned from its agricultural orientation in 1922 when the golf course superintendent of a local course suggested the company design a tractor-towed gang mower for fairway maintenance. By 1925 Toro turf maintenance machines were in service on nearly every major golf course in the country and on parks and large estates as well.

Toro produced its first power mower for residential use in 1939 but it was not until 1945 when it began to move into the home lawn market. Through a combination of acquisitions and research and development Toro began to expand operations around the country. Plants now exist in Bloomington, Windom, Shakopee, Fairmont, and Willmar, MN; Tomah and Hudson, WI; Riverside and San Marcus, CA; Columbus, OH; and Mason City, IA.

The company entered the rotary mower market with the purchase of Worldwind Inc. in 1948. Soon after Toro developed its wind tunnel housing, a major step in its technological growth. Toro was the first manufacturer to develop a mower with electric starting, the first to offer a rotary lawn mower with a bagging attachment, and led the way in establishing safety features for mowers.

Toro entered the snow thrower market in 1951, a major step in transforming the company from a seasonal business to a year-round supplier. It pioneered the development of compact, lightweight snow throwers and is now the leading manufacturer of snow throwers.

From snow equipment, Toro expanded into the irrigation field with the purchase of Moist O'Matic in 1961. Toro made extensive use of plastic in place of metal for irrigation equipment. Other innovations in irrigation include valve-in-head sprinklers, rotary gear driven sprinklers capable of sending a stream of water a diameter of 150 feet, pop-up pop-down sprinkler heads which virtually eliminate vandalism, and vibration-free easy-to-service sprinkler heads for all types of farm irrigation.

In 1979, Toro entered the lawn care service with the acquisition of Barefoot Grass, Columbus, OH. Its consumer yard care line which included both rider and walk-behind mowers has been broadened in recent years to encompass tillers, lawn debris pickups, flexible line trimmers, garden hoses, chain saws, and other outdoor appliances.

Toro's line of turf maintenance equipment ranges from a 21-inch walk-behind rotary mower to the giant HTM 175 that operates up to seven reels hydraulically and mows up to 80 acres a day. A total of 56 distributors in the United States and 56 in the rest of the world distribute Toro products.

time consuming job. Hydraulic drive could make larger units more practical than in the past.

The Future

Managers of valuable turf areas in the future will face a complex set of considerations for problems that used to seem simple. Efficiency, application rates, chemical/biochemical interaction, water consumption, water content, precise rootzone condition and drainage control will be cross-checked for exact corrective measures. Turfgrass cultivar, disease organism identification, and soil chemistry would be the least number of factors to be considered and they would have to be considered in greater detail than today.

A computer may be required to manage the number and complexity of details for turf management. Research data bases will be developed by universities and large associations. Test results will be inputted by minicomputer at the site and transmitted via telephone for evaluation and recommendations. Demographic data will customize the answer for the computer user.

Bill Lyons, *former superintendent of Firestone Country Club in Akron, Ohio, and now owner of Lyon's Den Course, continues to apply 50 years of turf knowledge to the game of golf.*

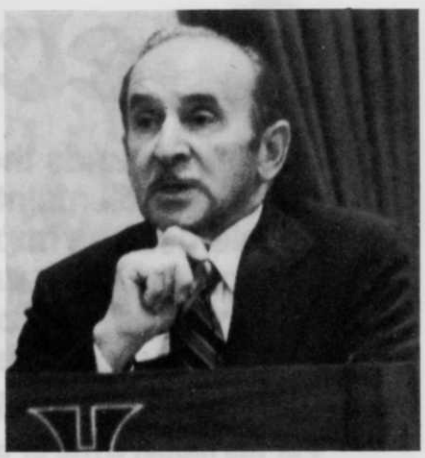
Such programs exist in simplified form today. Soil test facilities in Wooster, Ohio, provide a computer printout of recommended application rates for nitrogen and all other elements, including pH correction. The professional provides a soil sample and fills out a card listing type of turfgrass or tree, whether the sample is preplant or postplant, and county. The results from the lab are sent to the county extension turf specialist for filing and for delivery to the sender. If additional information is needed, the person can call the extension agent and he will have a record of the soil sample. Based on this information he can make fairly accurate recommendations in addition to those on the printout. This service costs less than $10 per sample.

In this fashion many more factors can be considered and processed through the extension agent or association technical specialist. One problem with this system is the two to three-week turnaround time. Direct access to a data base could provide instantaneous results. Access to the computer could be limited to subscribers of a system by a minicomputer which is programmed to communicate with the central processing unit.

Although it may sound like a great deal of money, $6,000 for a minicomputer is not excessive if it can help prevent the loss of a green before a major tournament, or the failure of a large seeding installation by a landscape contractor. The cost to the university or organization for the central processing unit is higher, it could be paid by subscriptions from users.

Another use for the computer is the implementation of integrated pest management programs. IPM can be very complicated if you fully consider chemical controls, biological controls, and site conditions. Natural predators for disease hosts and damaging insects are not well understood at this time. Since the Environmental Protection Agency is behind the implementation of IPM, perhaps it can supply data base needs to extention agents. Regulating IPM would be nearly impossible without computer assistance.

To really get control of chemical use by agriculture and turf, not that it is out of control, EPA will have to provide practical solutions and assistance in addition to enforcement. And, rather than building local bureaucracies with EPA control support of the existing extension service should be mandated. Extension specialists know the industries whereas EPA agents know only enforcement of rules. They too often misinterpret local uses due to vague national standards. For the Special Local Needs program, EPA has rightly sought the assistance and advise of Land Grant universities, the very source of information for extension agents. There may be a case for integrated government management.



Al Radko *has directed the USGA Green Section for the last two decades. He has edited the Green Section Record during that period.*

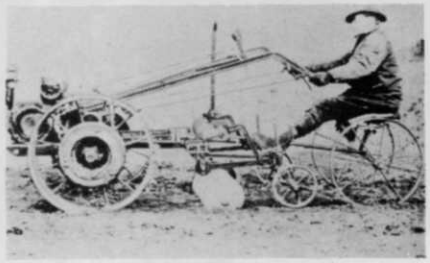
Solid state technology, already employed in irrigation, can be extended to other turf uses. Moisture sensors let the controller know irrigation is unnecessary after rain. Soil temperature sensors may indicate that syringing during hot weather is unnecessary. Phone communication with controllers can eliminate or change cycles. The uses of computers are limitless.

Use of infrared photography to indicate water or disease problems in turf may play a part in the future. Perhaps subtle differences in temperature of turf areas may pinpoint problems before they become detectable to the eye.

Effluent water (partially treated)is a good example of integrated management. It solves the turf managers problem with water costs and helps the sewerage department safely distribute water not needed for domestic or other industrial use. Wastewater control is another function, the biggest, of EPA. Its support for use of effluent for turf would help speed up conversion.

Growth regulators and water conditioners have a major role to play in the future. So does native material, such as wildflowers and prairie grasses. Here again, proper use depends upon full consideration of cost and site conditions. The benefits of lower maintenance products suffer from lack of comparison with alternatives. By planting native materials, mowing may be eliminated, but that doesn't eliminate the need for other maintenance to the right-of-way such as trash removal, fence repair, and shoulder maintenance. Maintenance based upon these other needs may be adequate for mowing less expensive grasses.

By improving turf maintenance technology we have uncovered new problems and raised new questions. Assembling data on all aspects is possible with the computer. In the future the computer will eliminate much of the doubt about modern methods, contribute to the sophistication of the industry, and prevent unnecessary losses caused by lack of information. **WTT**



Sulky reel mower *at Mount Vernon, Virginia, in the early 50's (top).* **First riding garden tractor** *was designed by Bolens in 1931 (bottom).*