Moon rises over Moon Valley on summer evening.

Bentgrass Beats the Heat at Moon Valley

18th green in front of newly renovated clubhouse.

In 1956, L.S. "Dick" Wilson had just finished redesigning the Inverness Club in Toledo, OH. He was thrilled to be able to add to the beauty and challenge imparted to Inverness by his famous predecessors, Donald Ross and Albert Tillinghast.

The Pennsylvania native had cut his design teeth in the East and Midwest with the golf course construction firm of Toomey and Flynn in the mid-'20s. One of his favorite projects was the redesign of historic Shinnecock Hills Golf Course on Long Island in 1931.

When the Depression put a halt on golf course construction, Wilson was able to use his contacts to gain the superintendent's position at Delray Beach Country Club in Florida. Wilson brought to the South his exceptional knowledge of bentgrass, a far superior putting surface to the bermudagrasses available at the time.

The desert is not kind to cool-season grasses. From June through October, maintaining bentgrass greens is a constant process of hand watering, careful mowing, and judicious fertilization.

Until World War II, Wilson tinkered with bentgrass, trying to help it survive the hot, humid summers of the South. He took a few design and construction jobs on the side to keep his creative skills sharp.

The postwar boom in the popularity of golf encouraged Wilson to reenter the design business full-time. He started off with a bang, designing West Palm Beach Country Club. It wasn't long before word of his talent spread. He found himself back in the East designing courses with his favorite, bentgrass.

He was aware that Dr. Burton Musser at Pennsylvania State University had developed an improved creeping bent that could be propagated by seed called Penncross. It had distinct advantages over colonial bents, vegetative varieties of creeping bents, and Seaside, the only seeded creeping bent of consequence on the market. Wilson was anxious to put Penncross to use.

Inverness was nearly ideal for cultivation of bentgrasses. Canadian breezes crossing Lake Erie swept over the course much of the year. However, when they stopped and the temperature and humidity rose, dollar spot, brown patch and other diseases would take their toll. To combat this problem, Wilson specified Penncross for Inverness and the results were quite dramatic.

When he stepped off the train in Phoenix, AZ, in 1956 to design a new private course for developer Bob Goldwater (Barry's brother), Wilson was shocked by the stark miles of desert and the rocky, arid canyons. He thought growing bentgrass there would be like growing it on the moon.

He discovered that some private and resort courses did have bentgrass greens but went through hell during the summer to keep it alive. Since summer damage was common, superintendents favored Seaside because they could reseed in the fall.

Ironically, the name of the course he designed became Moon Valley Country Club. Thanks to Wilson, it was one of the first courses in Arizona to have Penncross greens. Moon Valley's greens stood out because they were darker, denser, and recovered faster. They also didn't segregate into patches, something common for other creeping bentgrasses.

Today as in Wilson's time, the desert is not kind to exotic, cool-season grasses. When the summer temperature hits 115 degrees, bentgrass demands intensive care.

Calvin Cross, superintendent of Moon Valley, has been babying bentgrass in Phoenix for more than 30 years. From June through October, maintaining bentgrass greens is a constant process of hand watering, careful mowing, and judicious fertilization. "Once it starts to wilt, it's too late," advises Cross. "And if you don't have good greens, you don't have a golf course. During the summer, you do everything you can to protect the bent and keep your fingers crossed."

In 1985, the 18-hole private course was struggling to survive. Goldwater sold Moon Valley to the membership after he completed the residential development around it. Competition from newer courses was taking its toll. The clubhouse no longer compared to other private courses. The quick-coupler irrigation system needed to be updated at a cost of nearly $1 million. The members simply couldn't afford that kind of investment without selling part or all of the course. Moon Valley was put on the market.

Karsten Solheim, who is most famous for his Ping golf clubs, was a member of Moon Valley and lived next to the course. He had watched the course and its bentgrass suffer from tight budgets and was concerned that it might be sold to a developer.

Throughout his career, the inventive engineer had overcome numerous roadblocks to technology. The square groove on Ping irons, which increases the backspin on chip shots, is just one example. The 78-year-old innovator had witnessed or taken part in numerous technological breakthroughs at Hughes and General Electric before he started his own company in Phoenix.

Solheim kept asking himself why Moon Valley could not be restored to championship condition. He was deeply committed to golf, especially junior golf. Any contribution he could make to golf course maintenance would benefit the sport. What were the roadblocks? And could he remove them through science and engineering? He needed a laboratory to explore new theories. Moon Valley could serve as that laboratory, so he bought the entire 160-acre facility.

For the first time Solheim found himself on the receiving end of members' complaints. An avid golfer himself, he appreciated their remarks. He knew the old irrigation system was inadequate, and the clubhouse no longer compared to the competition. He made a promise to the members that he would do whatever necessary to make Moon Valley rank among the top private courses in the Valley of the Sun.

During the Masters at Augusta National that year, Solheim met Alex Rohoza, a member of the famous course's greens committee. For 45 years, the Pennsylvania sod grower had specialized in bentgrass sod for greens.

Rohoza was one of the first to grow Penncross sod for golf courses, and in the process has installed greens at prestige courses across the country. As a result, he is widely sought after for his advice on bentgrass management. Before leaving Augusta, the two men struck a deal for Rohoza to rebuild two greens at Moon Valley and install 18 more for a new executive course Solheim had decided to add to the club.

Solheim made it clear to Cross that he wanted Moon Valley to benefit from all available technology. Cross had never been satisfied with the common bermuda fairways, tees and roughs during the summer. "With a quick-coupler system, your course is only as good as your night watermen," he states. "You never have the kind of control you need to solve localized problems."

A Toro VT3 system was installed the first year. More than 2,200 valve-in-head model 650 sprinklers were linked to 42 satellite

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Tissue testing, fertilization and an improved irrigation system have produced results at Moon Valley.

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controllers. "Three-fourths of the heads are part-circle," Cross reveals. "Three rows of fairway heads follow the contours and don't overlap into the roughs. There are one or two rows of heads in each rough. The heads are grouped in stations of three, but we can run one head at a time if we need to. Greens, banks around the greens, tees, fairways, and roughs can all be programmed separately."

From June through October, Cross assigns two crew members to do nothing but hose down greens. "I guess I'm old fashioned when it comes to greens," he admits. "They are watered every night by the irrigation system, and we can syringe during the day. But I want a trained turf man out there when it's over 100 degrees to touch up dry spots.

"Our soil is tight, so it holds water longer than the soil at some other courses. I check the ET (evapotranspiration rate) listed in the newspaper each day. Our central does not have master water budgeting, so we have to go to every satellite to make adjustments. But I like that. It forces us to look at each hole before we make any changes."

Everything was progressing fairly conventionally until 1986. The irrigation system was having a visible impact on the condition of the fairways. Rohoza was due out to rebuild the greens. Cross purchased new mowers for the fairways and greens. Things were shaping up.

Solheim shared his new challenge with his three sons, Allen, John and Lou. The golf course became a regular topic of discusion among family members. They, in turn, solicited opinions from others in the company. An informal "think tank" on turf started to develop. Each new idea was considered without prejudice.

Bernie Atutis, a specialist in computer-aided design (CAD) technology for Karsten Computer Systems, began to adapt CAD to golf course management. He could produce an image of any part of a course on a computer screen and print it out. The idea was to give the superintendent quick access to important information, including as-built plans for irrigation, utilities, course features, supply inventory, etc.

The deeper Atutis got into the project, the more involved he became in turf management. He had been a dairy farmer and was also an avid grower of vegetables. It struck him that much of the latest research into the nutrient content of forage grasses for dairy and beef cattle could be applied to golf course turf.

Farmers keep close track of protein and other nutrients in feed. Advances in analyzing the tissues of forage grasses enabled suppliers to custom blend feed. By controlling the diet of their herds, farmers achieved greater milk and beef production.

Allen Solheim encouraged Atutis to dig deeper. With a green light to explore, he happened onto another development in agriculture: custom blending of foliar fertilizers. While this was not new to turf management, a line of fertilizers made in Phoenix was. These "probiotic" nutrients, as Atutis calls them, are not only absorbed by plant tissue, they appear to enhance the natural biological processes in the soil. By improving the environment in the soil for exchange of nutrients, air, and water, the plant's natural defenses against heat, drought, diseases, and insects might also be improved.

When Rohoza arrived in Phoenix to rebuild two greens at Moon Valley, Atutis showed him test plots where the probiotic fertilizers had been sprayed. Improvements in the density and color of both bentgrass and common bermudagrass were evident. Rohoza was impressed and took samples of the fertilizer back to Pennsylvania for testing.

Atutis reasoned that the diet of golf turf, like that of dairy cattle or vegetables, could be controlled to make up for any deficiencies in nutrients revealed by tissue testing. But the nutrients had to be available, and the superintendent had to have a fast and accurate way to test the nutrient content of turfgrass tissue.

Tissue testing had a reputation for producing inconsistent results. Soil testing can tell the turf manager what nutrients are present in the soil, but not always whether they are available to the plant. Rohoza believed that peaks and valleys in nutrient availability made bentgrass vulnerable to its enemies. If there was a way to provide a consistent level of nutrients to the turf, it could rally its natural defenses with the greatest effectiveness.

Dr. John Shenk, professor of agronomy at Pennsylvania State University, had developed a more accurate method of analyzing the tissue of forage grasses called nuclear infrared (NIR) spectroscopy. Instead of chemically measuring nutrients, Shenk took samples of tissue, dried them, ground them into a powder, and bombarded them with infrared light. The light reflecting off the sample creates what's called a spectrum, which can be recorded by a computer. A rainbow is a simple type of spectrum reflected off moisture in the atmosphere following rain.

The spectrum for plant tissue changes according to its nutrient content. By testing samples of healthy and unhealthy turf, a desirable spectrum could be established. Rohoza and Atutis provided samples to Shenk for analysis. It took hundreds of these samples to identify the spectrums for various deficiencies.

Moon Valley stretches 7,400 yards among mature trees, bunkers and water hazards.

Utilizing the results of Shenk's analysis, Rohoza adjusted the blend of the foliar fertilizers he sprayed on the bentgrass plots to overcome any deficiencies. He noticed an improvement in the establishment rate, density, and overall condition of the Penncross. Meanwhile, Atutis sent common bermudagrass samples from Moon Valley to Shenk for the same type of analysis.

The test results from Rohoza in Pennsylvania and Moon Valley in Phoenix were very positive. Rohoza found that by using the program he could produce two crops of bentgrass sod each year, with very little interference from diseases and insects. By keeping a constant eye on the nutrients in the tissue of the turf, he was conquering many of the problems commonly associated with bentgrass.

At Moon Valley, Cross was noticing a significant improvement in his fairways. "It's not something you see overnight," he points out. "You don't get a flush of growth like you do with ammonium sulfate. You only put down a quart or so per 1,000 square feet each time. First you apply it weekly until you get the turf to the condition you want, and then cut back to once a month or so."

Satisfied his team was onto something, Solheim created Karsten Turf Company in 1987 and bought the marketing rights to the fertilizer for golf courses. He placed Allen in charge of the new company and moved Atutis over from the computer division. The company's first product was a line of fertilizers they named Turf Anser.

As each green at Moon Valley was rebuilt, Karsten refined its technology. Injector pumps were added to the irrigation system to feed the turf without spraying. Based upon the tissue tests, Cross could inject specific amounts of four or more different nutrients into the water. The valve-in-head sprinklers gave him the ability to control the diet of the turf at up to 2,200 different locations on the course.

Atutis realized that keeping track of such a wide range of information for an entire golf course required the help of a computer. He wanted to make the superintendent's job easier, not harder. By assigning color codes to different nutrient levels, he was able to produce on the computer screen or in a printout the nutrient status of any part of the course. Furthermore, the status of each test site could be tracked over time to gauge improvement or make adjustments in diet. To Atutis this was much like keeping a record for each cow in a dairy herd. "The dairy farmer today can track the production of any cow and compare it to its diet, age, and weight," he states. "Instead of cows, we're dealing with individual greens, tees, fairways, roughs, or any particular site where turf samples are taken. That type of information has led to a tremendous increase in productivity in the dairy industry and can produce the same type of improvement in turf for the golf course superintendent."

The missing link in the system was a convenient and reliable method of tissue testing, one which a superintendent could use without sending samples to a laboratory. Up to that point, the NIR spectroscope was a sophisticated and expensive laboratory instrument. However, just as the computer industry has miniaturized and simplified the personal computer, Karsten was able to simplify the NIR process so a golf course could use it.

With the help of Dr. David York, Karsten's plant geneticist, Atutis developed the necessary software and spectrum data to analyze turfgrasses. Now, a golf course superintendent can take turf samples from the course, dry them in a normal microwave oven, grind them into a powder, put them in a tray, and insert the tray into a small NIR scanner in his office. The information from the scanner is fed directly into a 386-type personal computer. In less than ten minutes he knows what nutrients are deficient in that turf sample. Then the superintendent can inject the missing nutrient(s) into the irrigation system for the heads where the sample was taken.

"It easier than it sounds," Cross adds. "I've been a superintendent for more than 30 years, and I never thought I'd see anything like this. The system has a lot of

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potential and really seems to be something that can help superintendents."

Moon Valley now had a tight grip on the fertility of the course. Solheim and Atutis wanted to extend that grasp to water use. There is a sizable difference in the ET rate between a summer day where the temperature breaks 100 degrees F. and a spring day when the temperature never gets above 70. By using the water budgeting feature on his satellite controllers, Cross increases the cycle times to provide more or less water to fit the ET. He knows that if he applies too little water to the turf in the spring it will enter the summer with a poor root system. If he overapplies water he risks problems with anaerobiosis and disease.

"This summer we tied the record of 118 degrees on July 4!" Cross exclaimed. "There were also more consecutive days over 100 than ever before." With such high ETs, golf courses in Phoenix were using up their water allotments faster than normal. Conservation was never so important.

Even slight changes in ET can save large amounts of water. Superintendents in Phoenix were beginning to appreciate the value of weather stations in measuring ET just for their courses.

Moon Valley installed a weather station this year. Data on wind speed, solar radiation, temperature, and rainfall is fed into the computer for tracking and analysis. Atutis is now focusing his attention on expanding the types of analysis the computer can perform related to ET and water use.

The next item on the Karsten Turf agenda is developing technology to increase the moisture reserve of golf course soils. "The industry has only begun to touch on some of the benefits of improving the soil environment," adds Atutis.

Wilson would be pleased to see the condition of Moon Valley today. The 7,400-yard course with its healthy Penncross greens and emerald-green common bermudagrass tees, fairways, and roughs is once again looked upon with pride by the membership. This month Cross begins the process of overseeding with a blend of Palmer and Prelude perennial ryegrass. In March, Moon Valley will once again host the LPGA Tournament.

Karsten Solheim has kept his promise to the members. In the process, he has also expanded the technology of golf course maintenance. Moon Valley continues to serve as a laboratory for turf management. Solheim has also donated funds to help Arizona State University construct its own golf course for turf research.

The members of the Karsten Turf "think tank" continue to search for new technology, as they did at IBM, General Electric and Hughes. They feel as strongly today as Wilson did 34 years ago that bentgrass can be grown in the desert, or on the moon for that matter, as long as there is a desire and a curiosity that leads people to keep expanding the boundaries of technology.