Science:

A Lifetime of Controversy

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THE PLANT DOCTOR, LLC

ABOUT THE AUTHOR:

Dr. Roberts retired from Michigan State University in 2018 after committing four decades to advancing MSU's Land Grant Mission, originally signed into law by President Abraham Lincoln during the midst of the American Civil War. He has published hundreds of articles and has taught hundreds of lectures and workshops.

Dr. Roberts has researched many issues in Michigan's plant industry, including Oak Wilt, Dutch Elm Disease, Diplodia Tip Blight of Pines, along with a variety of cultural problems such as plant nutrition and herbicide toxicity. During his career, he has discovered a variety of new diseases and pests such as Phomopsis Canker of Spruce and the first bacterial wilt disease of turfgrasses in North America.

In the early 2000s, his research on Ash Decline in Southeast Michigan led to the discovery of the invasive Emerald Ash Borer in North America.

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INTRODUCTION

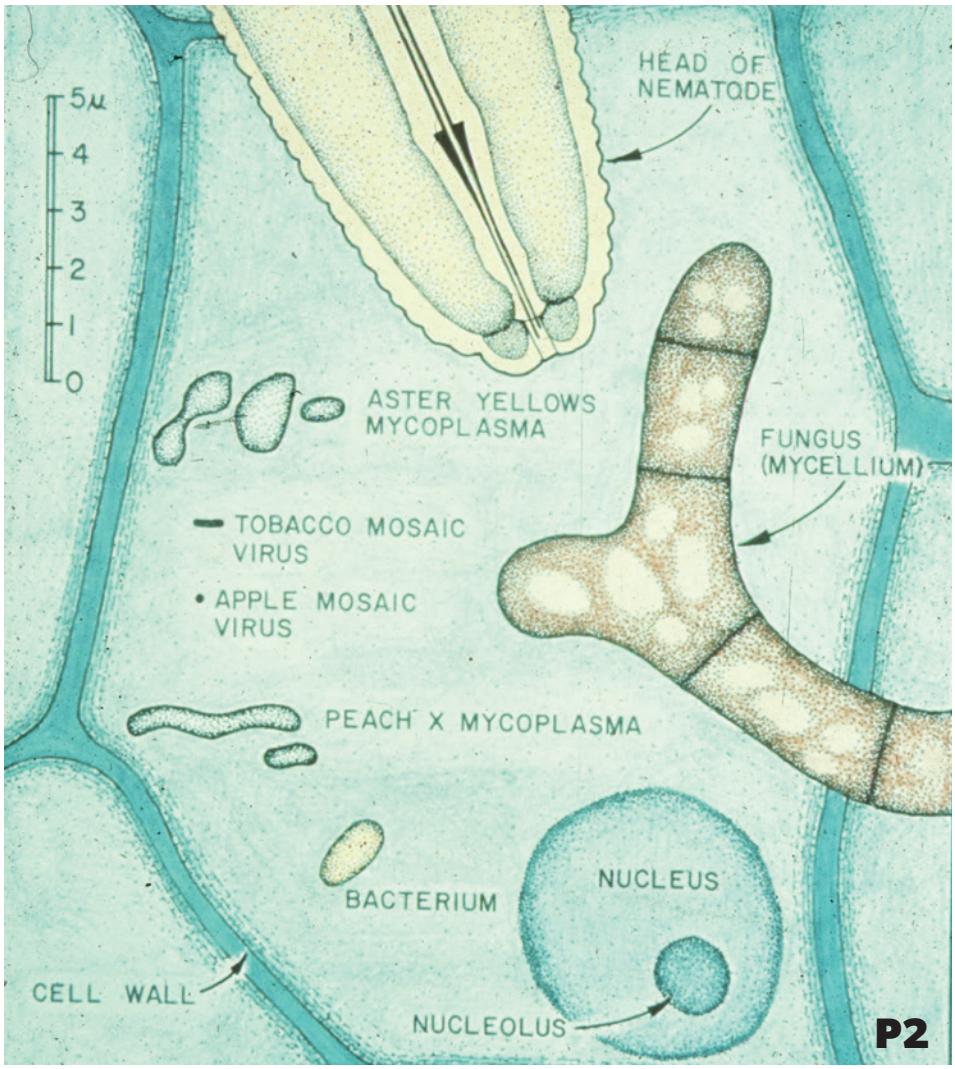
According to the Oxford Dictionary, Science is defined as, *"The systematic study of the structure and behavior of the physical and natural world through observation, experimentation, and the testing of theories against the evidence obtained."* Another broad ranging definition is, *"Knowledge of any kind."*

So, why do we want to learn about the natural world? I think a logical answer might be that if we understand living entities such as plants, animals, microorganisms, and non-living things such as soil, elements, and chemical/ biochemical compounds, humans can better manage our environment not only for our pleasure and benefit but for the environment's sake as well (Photo 1).

For centuries, Science as a means of understanding our natural world was exceedingly slow in development. For example, the Miasma Theory was accepted for millennia as the reason people, animals, and plants contracted maladies and succumbed in death. The Miasma Theory supposed that poison air was responsible for the afflictions of humankind. Lethal diseases such as cholera appeared spontaneously and could not be prevented, except, perhaps, by the grace of God. It is estimated that during "Black Death" (Bubonic plague) in the middle 1300s C.E. that as many as 50 million people (about half the population of Eurasia and North Africa) perished due to this polluted, poison air, which they believed likely originated from rotting matter. Later, of course, it was discovered through Science that a bacterium spread by fleas was the culprit for "Black Death".

P1 Whether natural woodlands, forests, landscapes, or nurseries, Science has enabled us to address challenges to better understand the nature of diseases and pests, and the needs of plants for a healthy environment. Many people in the plant industry and public may not always realize how Science has shaped our world and daily lives. This large ash tree in northern Michigan was saved from Emerald Ash Borer by treatment methods derived from scientific inquiry.

P2 This sketch from the American Phytopathological Society illustrates the relative sizes of microorganisms in relation to the size of a single plant cell (blue-green outline), which is also microscopic. Little wonder that people in ages past were superstitious about their natural world and the maladies that affected them.



For centuries upon millennia, superstition played the predominant role in influencing people's thinking about their daily lives. Eventually, curiosity about matters befalling people led to enquiries and investigations. Hence, the development of "Science". Ironically, even though religion was sometimes involved in disseminating superstitions because it was automatically presumed God intervened in people's everyday lives, it was sometimes the clergy of religious centers in Europe that advanced discoveries about the natural world (not to dispel advances by other cultures, i.e. China and India, etc.). Why Clergy? Because People of the Cloth had time on their hands, and they could read and write to exchange knowledge among intellectuals of the day, who were generally few and far between. The average "Joes", who could not read or write, spent much of their time just scrounging for the basic things needed for survival, largely at the mercy of Mother Nature. Or, as they were told, by the Grace of God.

The Germ Theory:

In the 1500s, the underpinnings for the Germ Theory were proposed and later expanded upon in the 1700s. However, throughout this period, the Germ Theory did not assume credibility because the Miasma Theory was widely held as truth by most "scientists" and medical experts of the day. The formal Germ Theory is generally attributed to French Chemist and Microbiologist Louis Pasteur (i.e. of pasteurization fame) in the mid-1800s, although others were also involved. Please note that it took more than three centuries for the Germ Theory to be formally proposed but still not widely accepted. Pasteur demonstrated that fermentation (for wine, ale, grog) and/or putrefaction (spoiling) of food products and liquids occurred by microscopic organisms carried in the air. These microorganisms could not be seen by humans without the aid of magnification (Photo 2, Photos 9B & 9C); their microscopic nature is largely the reason diseases were "mysterious" and

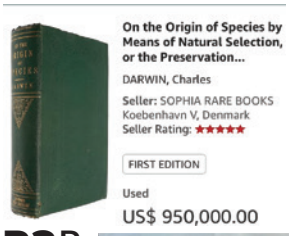
supernatural for most millennia prior to the 19th and 20th centuries. The Germ Theory proposed that microorganisms (germs, which in my youth were called "cooties") known as pathogens could initiate diseases in humans. These pathogens, eventually identified as bacteria, fungi, viruses, mycoplasmas, virions, etc., were believed to be responsible for "infectious disease", according to the Germ Theory. Like many new ideas, the Germ Theory was slow to take hold despite the evidence. There are people to this day who do not believe in "germs" or microorganisms (after all, you can't see them!). Some of these disbelievers often belong to the Flat Earth Society; a Flat Earth was considered the physical design of our planet until Christopher Columbus sailed off into the sunset in search of an easier route to China. In disappearing over the horizon, it was assumed Columbus sailed off the edge of the world. But he returned to Spain the following year after discovering the Americas. Some disbelievers also hold that the moon landings were faked.

Plant Pathology:

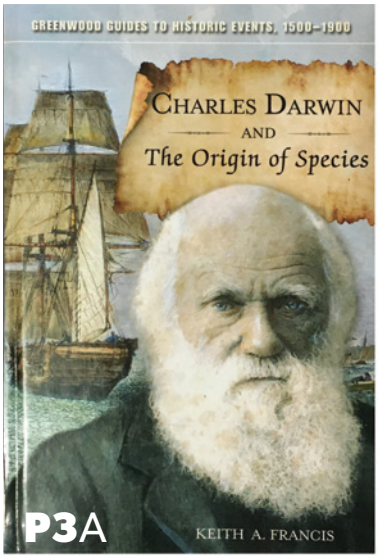
Botany and Mycology had been developing for centuries, largely because the life forms in these disciplines were macroscopic and could be seen with the naked, human eye. In the United States, the field of Plant Pathology (=Phytopathology, the study of plant diseases) got a boost partly out of a scientific clash of theories between young, upstart American Erwin F. Smith and well-established German Botanist Alfred Fischer. This became known as the Smith-Fischer Controversy. Smith held that bacteria could cause plant diseases while Fischer believed in the more traditionally accepted idea that aligned with "supernatural" events. Eventually, Smith was proven correct and is considered the Father of Phytobacteriology. The bacterial disease agent, *Erwinia amylovora,* which causes Fireblight of Rosaceae plants, was named after him.

Other Controversies:

Evolution: Controversies are numerous in Science. One of the most prominent controversies is, naturally, Evolution (Photos 3A & 3B), presented by Charles Darwin in his book "On the Origin of Species (by Means of Natural Selection, or the Preservation of Favored Races in the Struggle for Life)", published in 1859, just before the start of the American Civil War. Even though there is extensive scientific evidence for adaptations in living beings, Evolution is still a highly controversial concept in our modern era society. It is important to note that in the scientific community, a "theory" isn't something that is hatched one day by a mad scientist. To be considered a "Theory" in Science, something must undergo extensive research and gather an abundance of evidence for its existence.



P3B

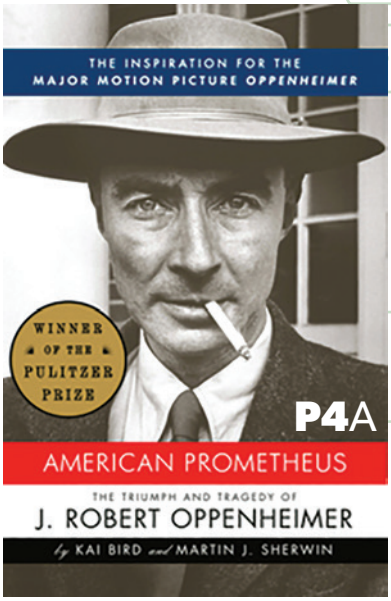


P3A

Scientific Theory (Defined): *A scientific theory is an explanation of an aspect of the natural world and universe that can be repeatedly tested and corroborated in accordance with the scientific method, using accepted protocols of observation, measurement, and evaluation of results.*

So, even though there is exhaustive scientific evidence for the formation of new species through natural selection, the process is still referred to as "The Theory of Evolution". The Theory of Evolution can never be considered "The Fact of Evolution" because we will never be able to find all of the transitions, which may be referred to simply as "missing links". In an analogous example, most of us do not question gravity just because the phenomenon is referred to as "The Theory of Gravity".

The Atomic Age: The development of the atomic bomb by American scientists in The Manhattan Project during World War II is still a highly controversial issue. The movie "Oppenheimer", based on the book **"American Prometheus"** by Kai Bird and Martin J. Sherwin, did



P4A

P4B

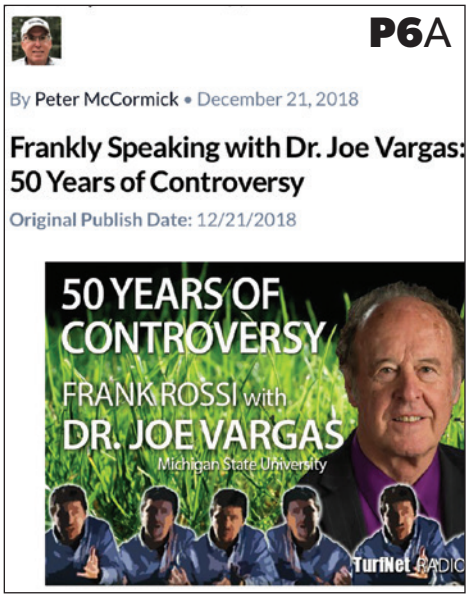
P3 A&B One of the most controversial scientific discoveries was Evolution, which is still quite controversial 165 years after the publication of "On the Origin of Species…" by Charles Darwin in 1859. There are numerous books about Evolution that provide various renditions for understanding (Photo 3A). Photo 3B shows a 1st edition of Darwin's book in excellent condition and offered from Denmark for $950,000. Shipping is free!

P4 A&B Another scientific controversy was the development of the atomic bomb via the Manhattan Project during the midst of World War II. The book 'American Prometheus' and 2023 movie 'Oppenheimer' attempted to document this historical Scientific development (Photo 4A). The Allied forces, especially the United States, were worried that the Axis Alliance would develop The Bomb first and possibly win the war, or destroy humankind. My Uncle Edgar (right, kneeling) completed 50 missions over Europe in the B-17 Flying Fortress appropriately named Flack Dodger (Photo 4B), before returning home to train crews on the B-29 Superfortress. The B-29 would be the delivery instrument for the nuclear warheads. The development of nuclear bombs presaged nuclear energy, which also proved to be another controversial issue created by Science.

a credible job (in my opinion) of revealing the science and scientists surrounding the urgency of developing "The Bomb" to thwart the prospect that adversaries of the Allied Forces in World War II might develop it first (Photo 4A). Considering that human flight began (early 1900s) only several decades after the Germ Theory was proposed and that aircraft advancements were startlingly fast, the atomic age came upon us at light speed. My Uncle Edgar, as the Pilot of a B-17 Flying Fortress named Flack Dodger, completed 50 missions over Europe during World War II (Photo 4B). The 50-mission accomplishment was remarkable because the attrition rate for B-17 planes and their crews over Europe was extremely high. After returning home with many medals, he started training crews on the B-29 Superfortress. It was the B-29 (Enola Gay & Bock's Car) that dropped the nuclear bombs on Japan, a highly volatile and controversial decision to this day. For decades, the Enola Gay was kept hidden under lock and key by the Smithsonian Institute (National Air and Space Museum) because of the controversy surrounding the atomic bombs. Whether good or bad, the development of nuclear energy by scientists for bombs or energy will likely be controversial ad infinitum.

56 Years of Controversy:

Recently, I was asked to speak briefly at a turfgrass conference where Dr. Joseph Vargas was being honored upon his retirement from Michigan State University (Photo 5). It was this request that served partly as the impetus for this article. Furthermore, I think that most non-scientists, i.e. the public, do not understand Science very well, likely because scientists do not promote what they do as effectively as they should. Dr. Vargas came to MSU in 1968 as a Turfgrass Pathologist. He put Turfgrass Pathology on the map not just in Michigan but nationally and internationally. He has visited countries on every continent on the planet when requested for his advice on turfgrass issues. Dr. Vargas will be the first to admit that his distinguished career was sustained by his graduate students and especially his devoted, long-term assistants, Ron Detweiler and Nancy Dykema. In 2018, he was interviewed at his 50-year Anniversary with MSU and asked to surmise his career, which is often described as "highly controversial" (Photo 6A). I thought it might be useful to describe just a couple of examples of controversy with which Dr. Vargas was involved over the years.



Before I delve into some controversies surrounding Dr. Vargas, I would be remiss if I didn't relate an unresolved mystery. Over many years, there have been sightings of an USP (Unidentified Singing Phenomenon) who has been described as "Elvis Vargas". There is no Scientific Proof of a connection between Elvis and Dr. Vargas, but Photo 6B, even though of poor quality like many photos of UFOs, lends some circumstantial evidence… even though it has not been subjected to peer-review scrutiny.

The C-15 Problem (aka "The Creeping Crud"): I joined the Vargas lab in 1979 (after a year or two in the onion research lab) as a candidate for the Ph.D. degree. As Joe's first student (Photo 7), I elected to work on an issue that was plaguing many golf courses throughout the Midwest. 'Toronto' Creeping Bentgrass (C-15=Selection #15 or Cultivar #15) was considered the Cadillac of turf for golf course putting greens (and fairways), which is the reason it was utilized on so

P5 Dr. Joseph Vargas had a highly successful career at Michigan State University for 56 years. The Joe Vargas Endowed Chair in Turfgrass Pathology is being created in his honor. Contributions are welcome.

P6 A&B In 2018, a special production entitled "50 Years of Controversy" was created from interviews with Dr. Vargas. Joe was involved in controversy for much of his 50+ years as a scientist at MSU (Photo 6A). Good scientists do not acquiesce to popular aspects or prevailing beliefs just to "get along". Science is about seeking "The Truth" regardless of how popular or unpopular the research is. A slight modification to Cyndi Lauper's hit song is, "Scientists just wanna have fun". Perhaps as a part of his controversial charm throughout his career, "Elvis Vargas" was known to make surprise appearances as this poor-quality photo from a 1986 Christmas party newsletter proves (Photo 6B).

many golf courses. Because a mysterious disease was affecting so many prominent golf courses where tournament play was televised on weekends in the 1970s, the "Creeping Crud", as it was called, gained abundant media attention both locally and nationally (Photos 8A & 8B). Many scientists looked at the problem but were unable to find a cause of the malady, let alone a solution. Even so, in an effort to stop the disease, recommendations of the day included dumping copious mixtures of fungicides on the turf *daily*, to no avail. The United States Golf Association (USGA) established a substantial grant and awarded the funds to a three-university team of scientists: Virgina Polytechnic Institute (now Virginia Tech), The Ohio State University, and the University of Illinois. The USGA referred to the awarded project as "The Team Approach". Please note that MSU received none of the funding. In the Vargas lab investigations, we were able to determine that a bacterium was likely involved in the C-15 Problem by aid of Electron Microscopy (Photos 9A, 9B & 9C). The finding of a bacterium as the incitant of the C-15 problem would in some ways be considered revolutionary in the turf world because it would represent the ***First Bacterial Wilt Disease*** ever found on turfgrasses in North America (Photo 9D). Other scientists, including "The Team", had never considered the possibility of a pathogen other than fungi as the causal agent of turfgrass diseases. Although there was much research into identification of the bacterium through many


DAILY Suburban Trib **Sports**

NORTH DuPAGE COUNTY — WEDNESDAY, AUG. 5, 1981

Toronto C-15 is on its way out

Creeping crud

Mysterious disease eats away at golf course greens

P8A


Greens Disease Mystery

OAK BROOK (AP) — Butler National Golf Club wants to avoid any unpleasant surprise for PGA Tour pros arriving here this week for the $300,000 Western Open.

So there will be a press release handed to each player giving him the bad news: Red Leaf Spot got here first.

The mysterious malignant disease affecting most of the greens at Butler has the club's chairman for the tournament embarrassed and several top agronomists baffled.

"We flew in seven of the top agronomists in the nation, and none can tell us what's wrong," said Dick Martin, Butler National chairman for the Western Open. "These are real experts in the grass industry."

"We've tried everything, but this is just an act of God that we can't help."

All 18 greens have been infected with the strange malady. The worst have no grass at all. The only spots of true green on most are from poana, a weed that doesn't belong there.

Despite the lack of greenery, Martin says, the greens are "putting reasonably well with the exception of Nos. 2, 7, 9 and 18."

"They are really bad and bumpy, and the putts don't roll true there."

At least 10 other of the best courses in the Chicago area, including Medinah, have been affected by Red Leaf, which was first spotted about three years ago but didn't become a blight until this spring.

But the malady is affecting Butler to such a degree that golf professionals at other clubs have urged players who recently were on the Oak Brook course to use special cleaning measures on their shoes before using other courses.

Officials planned to have the bad-news press release ready for arriving players on Monday and will spray the greens over the weekend and again on Tuesday night before the pro-am.

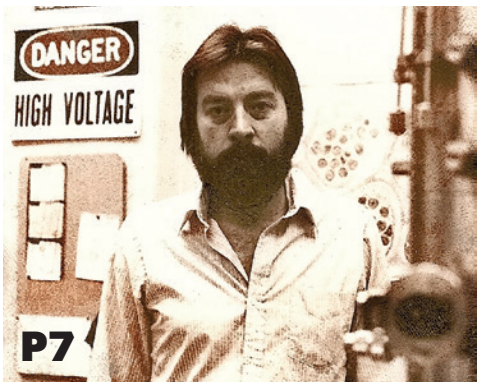
"We realize this isn't the best situation for players," said Ed Fischer, course superintendent. "We're trying to make the greens as smooth as possible for putability.

"They won't be nice to look at, and one or two may have bumpy [illegible] got them as good as we c[illegible]

P8B

P8 A&B As my Ph.D. Dissertation research, I tackled a highly controversial turfgrass disease, which no one had been able to resolve. The malady gained national attention in many media outlets, especially because many renowned Midwestern golf courses were affected by the disease in national tournament play televised on weekends. The titles of these news articles appropriately described The C-15 problem as "The Creeping Crud" and "Greens Disease Mystery".

P9 A, B C&D With a Transmission Electron Microscope, we were able to determine that a bacterium was the cause of the "Creeping Crud", setting the turfgrass world on its rear. It would become the *first* Bacterial Wilt Disease of Turfgrasses ever found in North America. The disease was named Bacterial Wilt of Toronto Creeping Bentgrass ('Toronto' aka selection C-15). In Photo 9A, Karen Klomparens (Director of the Center for Electron Optics and later Dean and Vice Provost of the MSU Graduate School) and I pose for a photo of the discovery; the "famous photo" on the background wall shows four xylem vessels completely plugged by bacteria (dark objects). I took Photo 9B with a Scanning Electron Microscope in 1980 or 1981. Note in Photo 9B two xylem vessels, one chock full of bacteria and the other free of bacterial infection; the secondary thickenings of the xylem can also be seen in the bacterial-free vessel. Recalling high school Botany, the xylem is responsible for transport of water and nutrients upward to the plant's foliage. Little wonder with millions of bacteria in the xylem that plants would wilt and die. The Scanning Electron Microscope provides a 3D image compared to the ultrathin section 2D image of the Transmission Electron Microscope in Photo 9A. Photo 9C is an image of a single C-15 bacterium magnified 250,000 times. Photo 9D espouses the significance of the discovery of Bacterial Wilt on 'Toronto' Creeping Bentgrass in many national news outlets including *The Wall Street Journal*.



P7


THE WALL STREET JOURNAL.

Another Scientific Marvel: Finding What Turned the Greens to Browns

By Haywood Klein
Staff Reporter of The Wall Street Journal

CHICAGO—Dead grass in the front yard may be just an ugly nuisance. On the putting green, it's a disaster.

Over the past year or so, disaster has been attracting more attention in the Midwest, where the putting greens of hundreds of golf courses sprout a special grass called Toronto C-15. A mysterious disease has attacked the greens of about 50 courses, including at least one course on the Professional Golfers of America tour.

In response, a histopathologist was flown from Virginia to examine the grass fibers. A mycologist in Ohio checked for fungi, and a nematologist searched for worms. A pathologist, a microbiologist and a chemist also tried to diagnose the disease. Houston B. Couch, the Virginia Polytechnic Institute histopathologist who coordinated the investigation, jokes that to pro golfers an epidemic would be like all the Lincoln Continentals and Mercedes Benzes dying at the same time.

Bumps and Bacteria

All the victimized courses can trace their grass to an experimental plot grown in the 1940s on the ninth green at Westmoreland Country Club, Wilmette, Ill. The disease makes greens so bumpy and discolored that some golfers call them "browns."

After other diagnostic tools failed, David L. Roberts, a graduate student at Michigan State University, solved the mystery with an electron microscope. He found a strain of bacteria, the first known to attack golf course grasses. "There were so many in there," he says, "they were stopping the water movement. The plant would wilt and eventually die."

Spikes or Putters?

Researchers suspect golfers spread the disease when they walk on an infected green in spiked shoes and play their next round on another course. Other possibilities: mowers, putters, even birds' feet.

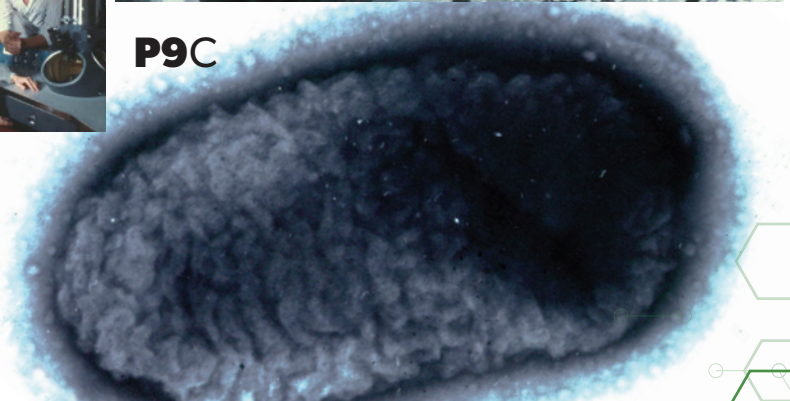
Tetracycline, the antibiotic used to control bacterial infections in people, can cure the grass. But the cure is expensive and probably only temporary; eventually, the bacteria are likely to resist the medication. Reseeding ailing greens with another grass can take years, and the results can leave greens uneven.

The only other known cure: Kill the grass and the soil beneath, and then replant with another variety. That has been done at Butler National Golf Club in Oak Brook, Ill., (site of the Western Open) and, more recently, at the Village Links in Glen Ellyn, Ill. Replanting at Glen Ell[illegible] the course will be closed [illegible] costing the club another $2[illegible]

P9D


P9A


P9B


P9C

biochemical and immunological analyses, I wanted to relate in this summary our further research for possible management of the disease. We received grant funds from Pfizer Corporation to test the potential for antibiotics to control this newly discovered bacterial disease. Two antibiotics were tested: Streptomycin Sulfate (Trade Name-Agrimycin 17) and Oxytetracycline (Trade Name-Mycoshield). Briefly, Oxytetracycline proved highly effective for control while Streptomycin exhibited no verifiable impact upon the disease (Photos 10A & 10B). The suppression of the "Creeping Crud" with an antibiotic also lent further evidence of a bacterial incitant in the C-15 Problem. An Emergency 24C label was granted by the Michigan Department of Agriculture and other states as well, based upon my research. This Emergency Label enabled turf managers to apply the antibiotic to golf greens, serving as a temporary suppressant of the disease, until C-15 could be replaced with a non-susceptible cultivar of creeping bentgrass (Photo 10A). Even though the discovery of Bacterial Wilt on Toronto Creeping Bentgrass was not immediately accepted by everyone, even more controversial was what happened next. In apparent frustration at not being successful at solving the C-15 Problem after receiving significant funding from the USGA, a member from "The Team" visited an exclusive tournament play golf course in Chicago where I had established some of my antibiotic treatments. He had his photo taken next to my plots and declared to the press that he had not only discovered the cause of the C-15 Problem, but the solution as well (Photo 10A)! This violation of ethical standards was a rude awakening for a Doctoral Candidate in Science but not particularly unusual as I was to eventually learn during my 40+ year career in Scientific Controversy.

***Poa annua* and Anthracnose:** Annual Bluegrass (*Poa annua*) is considered the scourge weed of high quality turfgrass, especially for golf courses. Most "experts" claimed *P. annua* was weak and tended to die out in the heat of the summer, leaving fairways and greens in aesthetically and physically displeasing condition. If annual bluegrass was so weak as many claimed, why was this species often encroaching and taking over quality turfgrass areas? So thought Dr. Vargas. In his research with technicians and students, Dr. Vargas found that a fungal disease known as anthracnose was associated with the diseased annual bluegrass turf. Furthermore, he found that well-timed fungicide applications would control the disease. The problem was how to convince the scientific community and turfgrass managers of this scientific development when there was so much disdain ingrained in so many people for annual bluegrass. Whenever Dr. Vargas visited a golf course to assist the superintendent and members with their turf problems, he would try to get them to treat for anthracnose on annual bluegrass. Invariably, the answer was "no budget" for such treatments, because the hatred for *Poa annua* superseded rational thinking in so many minds. Dr. Vargas was often successful, however, at convincing the superintendent to surreptitiously treat half of a fairway. Without fail, the treated fairway half would remain green and healthy all season long. The Board and members would ask the superintendent why that half of the fairway looked so good. After explaining the treatment for anthracnose, the membership and Board seemed to always find a way to provide funds to treat the fairways (and greens) for anthracnose on annual bluegrass. Unfortunately, because of the recalcitrance for change, Dr. Vargas has been engaged in this controversy and others for his entire career.

P10 A&B In this photo (10A) from my Ph.D. Dissertation, antibiotics were trialed with Pfizer Corporation funding in field research to try to control the bacterial wilt disease. Oxytetracycline (OT, right) and Streptomycin Sulfate (ST, left) were applied to 'Toronto' Creeping Bentgrass greens at Chicago area tournament-play golf courses. The results are readily apparent, with Oxytetracycline providing outstanding control of the disease while Streptomycin provided no better control than non-treated areas (Photo 10A). Oxytetracycline was given a 24C Emergency Label by the Michigan Department of Agriculture as a stopgap measure until C-15 areas could be renovated with a different cultivar of turfgrass. Photo 10B foretells the upcoming treatment in the press.

P10A


association news
C-15 Mystery Disease Treatment Near
Uninvited Guests a Dilemma for Canadian Superintendent
P10B

Other Scientific Discoveries:

As I was to find out during my career as a Scientist, I would be involved in a variety of other discoveries and controversies. Following are just a few.

A Biological Herbicide: Because I (and the Vargas lab) had become experienced with bacteriology with the discovery of Bacterial Wilt on 'Toronto' Creeping Bentgrass, we subsequently discovered another never-before-documented bacterium. Ironically, this bacterium attacked *Poa annua,* killing the "weed grass" selectively, without harming any other turfgrass species. The Vice President for Research at MSU was so impressed with this discovery that he procured further research funds and also paved the way for patent procedures (Photo 11). We were able to name the bacterium, *Xanthomonas campestris* pv. *poannua.* Because of this research, we met with Arnold Palmer, Jack Nicklaus and others as possible investors.

Phomopsis Canker of Spruce: In the late 1980s, a malady was affecting nursery produced Colorado Blue Spruce *(Picea pungens)*. Field-potted spruce was one of Zelenka Nursery's primary crops, and the nursery was experiencing over 90% loss during some years (Photo 12A). Some nurserypersons around at that time may remember Zelenka Nursery's Ralph Shugert who was particularly involved in the Blue Spruce dilemma. As one of the largest nurseries in the U.S., Zelenka provided significant grant funds to Dr. Curt Petersen in the Department of Horticulture at Michigan State University. After pursuing possible nutritional disorders and other cultural issues for nearly a year, to no avail, Curt asked me for assistance. I immediately detected a new fungus, *Phomopsis occulta,* that caused a "canker" on spruce. The disease was often lethal on nursery spruce or recently installed landscape trees (Photo 12B). With further investigation, we discovered that only the benzimidazole carbamate class of fungicides (Thiophanate Methyl=Benomyl, Benlate, Tersan 1991, Fungo 50, T-Methyl-G, etc.) would control the disease. Several graduate students completed their degrees on this research

P11 With bacteriology experience gained from the C-15 Problem, we discovered another bacterium that, ironically, selectively killed "the weed" annual bluegrass in mixed turf stands. Here, I am being given the Patent Award by Gordon Guyer (left) and Percy Pierre (background), President and Vice President of Michigan State University, respectively.

P12 A,B &C My research on a spruce disease with Dr. Curt Petersen in the Horticulture Department at MSU led to the discovery of Phomopsis Canker on spruce at Zelenka Nursery in the late 1980s (Photo 12A). Survey work disclosed the disease to be widespread throughout Michigan's Nursery industry. Phomopsis canker proved lethal to nursery spruce and to recent transplants in landscapes (Photo 12B). Years later, the disease was discovered to contribute to the decline of large spruce trees (Photo 12C).

P11


P12A


P12B


P12C

in Horticulture. For years, the disease seemed to predominate on smaller nursery grown and landscape spruce trees but years later was found contributing to decline in large landscape spruce trees (Photo 12C).

Downy Mildew of Creeping Phlox: In the 1990s, Sawyer Nursery in western Michigan propagated field-grown *Phlox subulata* as one of its important crops for flat sales in retail outlets such as Kmart and Home Depot. Unfortunately, the nursery began experiencing around 90-95% plant failure due to some unknown malady. With a grant from the nursery, I began field and lab work to find the reason for the problem. I discovered that Downy Mildew (*Peronospora destructor*) was the cause (Photo 13). The phlox problem became controversial when other investigators believed nutrition and other matters were involved in the decline of field-grown creeping phlox. With adjustments in irrigation and infrequent applications of metalaxyl (Subdue 2E, etc.), the crop returned to great health and sales for the nursery within a season of initiation of my research.

Emerald Ash Borer: With my research investigations into "Ash Decline" in Southeast Michigan in 2001, my research detected the invasive *Agrilus planipennis,* which we named the Emerald Ash Borer in 2002 (Photo 14). The EAB, which originated from Asia, would become one of the more controversial issues of the day. However, the positive side of the discovery is that it brought millions of dollars into Michigan from Washington D.C for scientific studies to learn more about this insect, since Michigan was "Ground Zero" for this invasive pest in North America.

Imprelis Herbicide: When a new herbicide called Imprelis was released into markets east of the Mississippi by DuPont around 2010-2011 as the miracle herbicide for broadleaf weed control in turf, many trees and other plants in landscapes and nurseries were unintentionally affected (Photo 15). It seems that insufficient research had been performed to ascertain possible collateral damage to plants in and near turf areas. I was one of the first scientists to document and publish on the phytotoxic impacts of this herbicide on trees and other plants. Dupont recognized my publications and work, flew me to Washington D.C., and offered me a top consultant position to determine which cases were legitimate for reimbursement from damage by the herbicide; DuPont expected possible false claims to be submitted. Even though this consultantship position with DuPont would be highly lucrative, I declined the offer knowing that my duties at MSU would suffer because of an overwhelming workload

P13 While I could not locate photos of diseased field-grown *Phlox subulata* in time for this article, this flat of *P. subulata* shows initial symptoms of Downy Mildew infection *(Peronospora destructor),* which will ultimately obliterate this crop if left unchecked. The pathogen is difficult to detect because, unlike other fungal pathogens, it is an "obligate parasite" and cannot be cultured in the lab. Its difficulty in detection is why this pathogen can destroy crops such as *Phlox* for years, leading to disagreement and controversy about the cause of a crop's decline. I was able to identify *Peronospora destructor* spores and "fruiting fructifications" on *Phlox subulata* with the aid of a microscope (Photo 13 Inset). This was a new scientific report.

P14 One of my most important career achievements was the discovery of the Emerald Ash Borer (EAB) in North America. The issue became highly controversial statewide and nationally. In this photo taken of a Bloomfield Hills estate, many ash trees are in the throes of death from the invasive pest. Note rare photo of emerging EAB adult (lower left Inset) and the lackadaisical movement of the recently emerged EAB adult until it gets its wings for flight (lower right Inset).

of claim submissions. Obviously, with billions of dollars in plant damage, Imprelis became a highly controversial issue during that time.

Oak Wilt: While Michigan has experienced a variety of invasive species, Oak Wilt and Dutch Elm Disease have been known and studied for decades (Photo 16). With the availability of Invasive Species monies around 2015, Oak Wilt has become a highly controversial issue in the United States. As some entities and individuals scramble for funds and control of the Oak Wilt narrative, Science is being compromised and suppressed by politics. Regrettably, arborists and the public are being misinformed. I expect the controversy to continue.

Conclusions:

Science is often controversial, largely because egos, ignorance, and other characteristics of human nature involving recalcitrance to embrace new ideas and change get in the way. Also, Science is not infallible; there are outside influences, especially "politics", that compromise the integrity of Science. For Science to function properly there are basic tenets that need to be followed. "Dissent" is without question one of the most important tenets in science. We need to be able to disagree and pursue new theories and ideas to advance our knowledge of the natural world without restrictions or interference. In order for Science to pursue its objective of finding Truth, it must remain "unfettered".

Science in the United States essentially follows the 1st Amendment to the United States Constitution, which specifies free speech, free inquiry, and free pursuit of creative (research) endeavors. We need to protect those freedoms even if we don't always agree with their outcomes.

P15 The herbicide Imprelis, released by Dupont before thorough testing, affected many different types of plants. Many were killed. Note browning and deformed growth of these spruce trees near Canton, Michigan, and dead honeylocusts in Wyandotte, Michigan from Imprelis exposure applied to nearby turfgrass.

P16 Oak Wilt is a serious disease in Michigan and elsewhere in the eastern U.S. Unfortunately, the disease has become highly controversial with competition for funds and control of the research and narrative. In this photo, the Oak Wilt fungus traveled overland to fresh wounds created by an unscrupulous "Tree Professional" (NOT!). Only the live, uninfected tree on the left was not trimmed, indicating the lethality of the disease.