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SCIENCE AND NATURAL HISTORY

n o t e s

FROM THE EDITOR

As The American Chestnut Foundation grows, the world of science that encompasses our research fills with close human connections that contradict the enormity of that world.

As Phil Rutter notes in his commentary on the translation into English of Ban Li, a 1979 study of Chinese chestnuts, “I’m constantly intrigued by how events in the world ‘connect.’” When he and fellow TACF founder Dr. Charles Burnham recognized the importance of that Chinese study to their interest in the American chestnut’s demise, he turned to Chinese brush stroke artist Alison Stilwell Cameron for help editing the translation. He’d known her since he was a teenager, long before he developed a scientific interest in chestnuts.

But it didn’t end there. The husband of Phil’s wife’s best friend was head of Oriental Languages at the University of Minnesota. It was through him that Phil and Dr. Burnham located, and then commissioned, Dr. Chengguo Wang to produce Ban Li in 1984.

When Paul Sisco learned that I was featuring the translation in my first edition as Editor of The Journal, he sent me Wilma Wei-Lin Hu’s illustration of Ban Li, the Chinese word for chestnut, which he had asked her to paint in 1998. How did Paul know in 1998 that in 2004 I would consider it the perfect illustration for my first edition of The Journal?

And there’s more. After you read 1979 Chinese Chestnut Study Fascinates and Puzzles TACF Founders, and The road goes ever on……, you will see how American chestnut research has a history of connecting people.

The Memories section features Chris Bolgiano’s talk at TACF’s 20th Annual Meeting, Nittany Lions in a Chestnut Woods: The Past as Prologue, an informative and nostalgic narrative about her longtime interest in the wild cat. Herb King, from Watertown, Connecticut, offers his memories of chestnut roasting on Main Street in Buffalo, New York.

Notes includes a presentation by Paul Sisco to Enhancing the Southern Appalachian Forest Resource Conference in Hendersonville, NC, in October, 2003, an excellent overview and history of TACF. Also in the Notes section you will read the specifications for field testing blight-resistant trees, adopted by our Science Cabinet at TACF's 2002 Annual Meeting. Excerpts from Native Trees for North American Landscapes, a new book by Guy Sternberg and James W. Wilson, tells us that American chestnuts can be an important element of landscape design.

In Science and Natural History, Bill Lord offers an interesting perspective on the relationship between red maple trees and the American chestnut. Terry A. Tattar describes an experimental use of fungicides to suppress blight in a Massachusetts American chestnut orchard.

And everyone who loves to eat chestnuts will learn from Melinda Hemmelgarn, Sandra L. Anagnostakis and Peter Devin that chestnuts are a healthy, as well as delicious, food.

Dale Kolenberg, Editor
Journal of The American Chestnut Foundation

TACF ADOPTS GUIDELINES FOR TESTING BLIGHT-RESISTANT AMERICAN CHESTNUTS

Editor's Note: At TACF's 2002 Annual Meeting in LaCrosse, Wisconsin, the Science Cabinet presented these recommendations to the Board of Directors, which approved their adoption.

Task force members Al Ellingboe, Sharon Friedman, Fred Hebard, Hugh Irwin, Paul Sisco, Scott Schlar-baum, Kim Steiner, Chair

Purpose of the task force (by our interpretation): To develop recommendations for testing the form, adaptability, botanical characteristics, and durability of resistance of chestnut progenies intended for release and deployment as 'blight-resistant American chestnuts.'

Dr. Kim Steiner, at TACF's 2003 Annual Meeting, describing the B_3F_2 seed orchard at Penn State Arboretum. The Penn State and Meadowview B_3F_2 seed orchards will produce B_3F_3 seeds for the first phase of forest planting as outlined by the Testing Task Force. Dr. Steiner, a member of TACF's Science Cabinet, chaired the Task Force.

Assumptions

- The goal of TACF is to bring blight resistance into wild, naturally regenerating populations of Castanea dentata in Appalachian forests and, by doing so, restore the species to its former role. Achieving this goal requires the use of non-native alleles because the genome of Castanea dentata is deficient in naturally occurring alleles for strong resistance. Thus, the specific objective of the breeding program of TACF is to produce backcross trees that will fall within the range of morphological, developmental, and ecological characteristics of Castanea dentata as understood from monographs and voucher specimens. It is anticipated that the B_3F_3 generation may meet this objective

- The goal of TACF will not be achieved by replacing the existing millions of surviving American chestnuts with B_3F_3 trees. Plantings may never be established in some rather large blocks of the chestnut range, such as the Shennandoah and Smoky Mountain National Parks. Also, natural regeneration from planted trees, with accompanying natural selection and the potential for hybridization with native chestnut, will play large roles in achieving the goal of TACF. Finally, it expected that additional sources of blight resistance must be incorporated into the breeding program, and it is expected that additional backcross generations may be warranted to achieve a higher average proportion of American chestnut alleles in the genome.

- For these reasons, future breeding will be required to bring new sources of resistance into the breeding pool and carry the existing backcrosses to additional generations. Also, it is expected that future breeding programs will place ever increasing emphasis on regional adaptation by employing local, autochthonous sources of American chestnut parents.

- The purpose of testing the B_3F_3 generation is to determine how well we have progressed toward our goal at a stage that is expected to yield a tree that bears strong resemblance to Castanea dentata and has good resistance to blight. In other words, the principal objectives of testing are to determine 1) to what degree the B_3F_3resembles American chestnut, especially in a natural forest setting, and to what degree Asiatic characteristics (other than blight resistance) may remain, 2) to what degree the B_3F_3 is resistant to blight, and 3) how long resistance persists in B_3F_3 plantations. Subsidiary objectives are to determine if there are differences in performance among the progeny sets of different B_3F_2 parents, to measure the extent of genotype x environment interaction, and to identify differences in regional adaptability as suggested by growth, survival, and phenology.

The purpose of testing the B_3F_3 generation is to determine how well we have progressed toward our goal at a stage that is expected to yield a tree that bears strong resemblance to Castanea denta-ta and has good resistance to blight.

- Although test plantations might later be converted to seed orchards, test plantations should not be designed with the purpose in mind of converting them to seed orchards at a later date. The creation of seed orchards should be pursued separately from testing.

- Testing should precede public distribution or sale of seed with implied genetic qualities.

- Future breeding and deployment efforts should be guided by test results.

TASK FORCE RECOMMENDATIONS:

- Testing will involve finding and preparing planting sites, getting labeled trees from TACF, planting them, mapping their locations, protecting them, and measuring them. It is expected that test plantations will be arranged, installed, maintained, and measured by chapter volunteers and other cooperators.

- Given the goal of the breeding program, testing shall be done on:
  - naturally forested sites (which may be temporarily devoid of trees because of recent harvest),
  - on soils that are considered suitable for American chestnut, and
  - in close (a few hundred yards maximum) proximity to existing sprouts of American chestnut.

  This latter requirement, which may not always be possible to meet, ensures that the soils are appropriate for American chestnut, provides the opportunity of directly comparing phenology of backcross trees as one indicator of environmental adaptation, and provides the opportunity to determine whether resistance alleles from TACF backcrosses can move into other American chestnut by natural crossing.

- To the extent possible, test sites shall be scattered throughout the original distribution of Castanea dentata, or at least the region of its greatest abundance (Massachusetts to North Carolina and Tennessee). Although B_3F_3 material now under development was derived from central Appalachian provenances of American chestnut, it is important to learn about regional adaptability in this species and in the likely products of the TACF breeding program.

- Test sites should be evaluated and approved prior to planting by someone from TACF. Corner coordinates shall be established by accurate GPS measurement.

- Cooperators shall agree to the use of standard protocols for the design and measurement of test plantations. It may be desirable and even necessary to underwrite these tests with research grants from TACF.

- Test plantation design shall conform to the following criteria:
  - 8- x 8-foot spacing between trees (square grid arrangement),
  - minimum of 25 single-tree replications of each experimental unit (“treatment”) (see below), and
  - completely randomized design.

- Each test plantation shall contain the following experimental units:
  - pure American chestnut of local provenance at double replication (minimum 50),
  - one or more designated Asian chestnut varieties at double replication (minimum 50),
  - a core set of at least five B_3F_3 families (open-pollinated progenies of B_3F_2 lines) common to all plantations, and
  - additional B_3F_3 families as availability and space allow, including if possible families from different regional breeding programs.
  - advanced generation backcrosses (other than B_3) if available.

- Plantation sites shall have minimal overstory (30 sq. ft./acre basal area), and clearcut sites will be generally preferred. Existing green vegetation shall be sprayed with glyphosate (or similarly acting herbicide) in a 1-meter circle around each planting spot in advance of planting. Directed applications of glyphosate (with seedlings shielded) shall be used after plantation establishment as needed to exclude serious competition from herbaceous and woody plants. The site shall be protected from deer if deer browsing is likely to be serious.

- All records of test plantation establishment, including a map of the design, detailed directions to the location, contact information for ownership, date of establishment, and contact information for the person responsible, shall be sent to a central office to be designated by TACF.

- Cooperators shall commit to making annual (initially) measurements of the following:
  - height,
  - diameter,
  - survival,
  - form (index to be developed),
  - severity of cankering (0 = none),
  - date of bud burst,
  - date of flowering,
  - date of fruit maturation,
  - date of fall coloration,
  - abundance of male and female flowers (0 = none), and

presence and nature of other serious insect or disease injury.

For reference, the dates of phenological events (bud burst, flowering, fruit maturation, and fall coloration) should also be recorded for nearby native trees. It is highly recommended that plantations be visited several times during the growing season, especially during the first few years.

Measurement protocols will be developed and distributed to cooperators. Cooperators may record additional information if they desire.

- In order to allow measurements of naturally occurring rates of disease progress, trees will not be artificially inoculated. Other plantings in orchard settings will be tested for blight resistance by artificial inoculation.

- Cooperators shall verbally commit to plantation care and measurement for a minimum five-year period. All data shall be sent annually to the central office designated by TACF. Cooperators shall be free to publish data from their test plantations. The central office will annually prepare a report on the progress and performance of all test plantations. It is impossible to specify a precise duration for the usefulness of these test plantations. A minimum of three to five years' evaluation will be required for preliminary conclusions about relative performance. Fairly definitive conclusions about some aspects of performance should be available within ten years. With time, the value of each additional year's duration will diminish, but never quite to zero. A key question to be answered is whether backcross hybrid chestnuts will have the ability to grow to dominant canopy height in competition with naturally occurring trees. A definitive answer to this question will require perhaps two or three decades of testing, but crown form and the pattern of early height growth can be useful predictors.

- Test plantations will be thinned at an appropriate time after crown closure in order to maintain reasonable access with measuring poles without modifying too much the natural progression of forest stand development. When fairly definitive conclusions are possible regarding the relative performance of backcrosses vs. Asian chestnuts, a decision will have to be reached on whether to remove all Asian chestnuts from the test plantation. The purpose of this removal would be to remove a source of major pollen contamination from the planting.

To the extent possible, test sites shall be scattered throughout the original distribution of Castanea dentata, or at least the region of its greatest abundance (Massachusetts to North Carolina and Tennessee).

BREEDING BLIGHT-RESISTANT AMERICAN CHESTNUT TREES

By Paul H. Sisco, Ph.D.

Editor's Note: Paul Sisco, TACF Regional Science Coordinator, presented this overview and history of TACF at Enhancing the Southern Appalachian Forest Resource Conference in Hendersonville, NC, in October, 2003.

The American Chestnut Foundation is nearing completion of the first stage of its program to develop blight-resistant American chestnut trees using the backcross breeding method to transfer genes for resistance from Chinese to American chestnut. The generation of trees with sufficient crosses to be 15/16th American in genotype will be ready for testing within five years.

History of American chestnut in Western North Carolina

In the mountains of western North Carolina at the beginning of the 20th century, American chestnut (Castanea dentata) was by far the most abundant and widely distributed tree, comprising 27% of the total stand by volume (Buttrick, 1913). On the dry ridge tops it was extremely abundant, while in the deep, moist soils of the north-facing slopes, it could reach gigantic size. The largest American chestnut tree ever reported in the United States was in Francis Cove in Haywood County, NC, a whopping 17 feet in diameter (Detwiler, 1915). J.S. Holmes, the NC State Forester, reported that chestnut was "used for a greater variety of commercial purposes than any other tree of the region." (Holmes, 1925). The wood — light in weight, rot resistant and easily split — was preferred for fence rails, siding, and utility poles. Even the fire-scarred, worm-eaten timber of the dry ridges was utilized for tannic acid extraction. An entire plant at Champion Fibre's Canton Division was devoted to the production of "chestnut extract" for worldwide distribution to tanneries. It was the company's most profitable enterprise, because after the tannin was boiled out the wood pulp could be used for paper making (Robertson, 1959).

The nut production of the trees was also prodigious, providing reliable fall mast crops for wildlife and free-range hogs, as well as food and cash income. (Rice et al., 1980). Many a mountain child bought schoolbooks and shoes with money from the sale of chestnuts.

The Devastating Effects of Two Diseases of Chestnut

A root-rot disease kills chestnut in the Piedmont in the 1800's

In the last 200 years two major diseases have heavily impacted American chestnut in North Carolina. The first, a root rot disease caused by Phytophthora cinnamomi, killed most chestnut trees in the Piedmont of North Carolina in the 1800's (Buttrick, 1913; Crandall et al., 1945). Phytophthora root rot, also called "Ink Disease" because of the black stain in the roots of affected trees, is lethal to American chestnut. The disease is more of a problem in heavy, poorly drained soils. Both Chinese (C. mollissima) and Japanese (C. crenata) chestnut trees have resistance to the root-rot disease.

Chestnut blight arrives in western NC in the 1920's and 1930's

Chestnut blight, a bark disease caused by Cryphonectria parasitica, was first discovered on American chestnut trees in the Bronx Zoo of New York City in 1904, although it was probably carried to this country on infected Japanese chestnut trees in the late 1800's. The disease spread quickly down the chain of the Appalachian mountains, where chestnut formed an almost continuous stand. Spores of the fungus were carried by air, insects, birds, and mammals, and by the 1930's, most of the chestnut trees in western North Carolina were affected. Although the dead trunks covered the mountainsides, making for ghost forests, there were two hopeful aspects. (1) The blight fungus girdled the trees but did not penetrate the root systems. Because chestnut has the ability to sprout from its stump, hundreds of thousands of chestnut trees are still alive in the western NC mountains, existing as small sprouts in the woods. (2) The tannic acid content of the dead chestnut boles did not decrease, so the wood was useful for acid extraction and paper-making until the early 1950's (Nelson and Gravatt, 1929; No author, The Log, Champion Paper and Fibre, Aug. 1951).

Efforts to Combat Chestnut Blight 1912–1960

Because chestnut was such a key component of the eastern forests, the public outcry to save the American chestnut trees was immediate.

Frank Meyer, famous plant explorer, made a trip to China and Japan, sending back bark samples infected with the blight fungus, proving that the blight had come from the Orient (Cunningham, 1984). It was soon clear that both Chinese and Japanese chestnut trees were carriers of the deadly fungus, although they themselves were not greatly affected by it. The American chestnut, however, seemed to have little or no resistance to the disease. Pennsylvania, the state with the most chestnut trees, made the biggest effort to stop the blight by cutting a wide swath of trees in advance of the blight in hopes of stopping its spread. This did not work. (Hepting, 1974). Breeding programs initiated by Walter van Fleet of New York, Arthur Graves of the Connecticut Agricultural Experiment Station, and Federal scientists at Glenn Dale, Maryland, sought to combine the timber qualities of the American chestnut tree with the blight resistance of the Oriental species by making hybrids. Although these hybrids grew quickly initially, they failed to reach the height of the native American chestnut trees and their blight resistance was not as strong as that of their Chinese or Japanese chestnut parents. By 1960, most state and federal breeding programs had been abandoned (Burnham et al., 1986).

The largest American chestnut tree ever reported in the United States was in Francis Cove in Haywood County, NC, a whopping 17 feet in diameter (Detwiler, 1915).

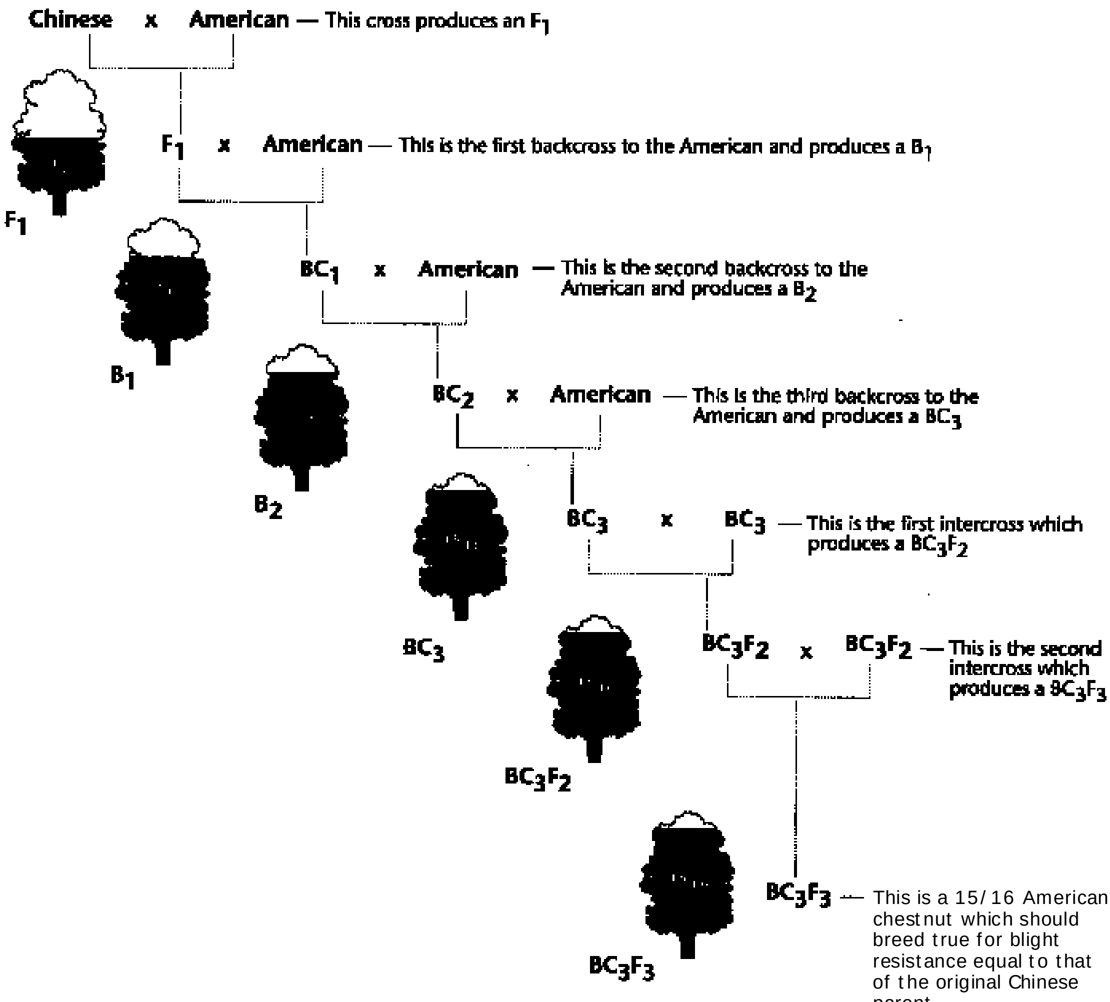
The American Chestnut Foundation's new Approach

Organization founded in 1983 to undertake backcross breeding

In June, 1983, a group of scientists and concerned citizens founded The American Chestnut Foundation (TACF) as a private, not-for-profit organization dedicated to restoring the American chestnut tree to the Appalachian forests. The group outlined a new approach to breeding for chestnut blight resistance called "The Backcross Method". Backcross breeding was first proposed in a 1922 paper by Harlan and Pope and had proved very useful in many crop plants such as wheat, barley, and corn. But it had not been used in tree breeding. Dr. Charles Burnham, plant geneticist at the University of Minnesota and a founder of TACF, thought that backcrossing would be successful in chestnut for three reasons: (1) blight resistance was partially dominant and thus selectable in each generation; (2) the resistance appeared to be controlled by only two or three genes coming from Chinese chestnut and (3) crossing to American chestnut at least four times should restore most of the American chestnut genome and result in a tree that looked like and

THE AMERICAN CHESTNUT FOUNDATION'S BACKCROSS BREEDING PROGRAM

With each backcross, additional American chestnut characteristics are regained. Only at the intercross, however, is blight resistance equal to that of the Chinese parent again restored.



Note: In each step, the backcross is selected for resistance. Trees indicate average fraction of American genes with no selection.

performed like the native American trees.

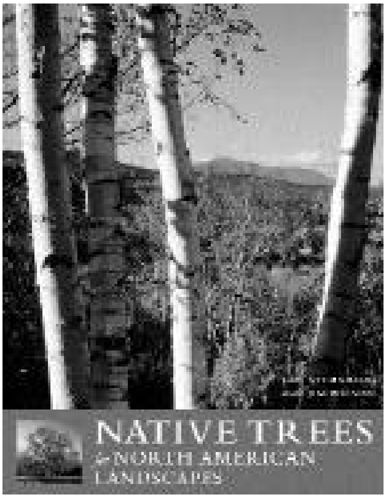
MEADOWVIEW, VA, RESEARCH FARMS ESTABLISHED IN 1989

For six years TACF President Phil Rutter and his colleagues made speeches and visited people all over the country to try to raise enough money to begin the breeding effort. At one such talk in Scientists Cliffs, Maryland, Anna Belle Wagner and her daughters Jennifer and Cheri offered a lease on 20 acres of good pastureland at their home in Meadowview in southwestern Virginia. Dr. Fred Hebard, a plant pathologist who had done his thesis work on the chestnut blight fungus at Virginia Tech, was hired as the Farm Superintendent, and the first trees were planted at the farm in 1990. Dr. Hebard started his breeding work with two trees named 'Graves' and 'Clapper' that were of the Backcross1 (BC_1) generation [(Chinese x American) x American]. Both these trees had shown good growth characteristics and a moderate level of blight-resistance. Through diligent care, fertilization, and irrigation, Dr. Hebard was able to turn around a generation of trees in only 6 years, so the breeding work has proceeded much faster than the founders of the organization anticipated. Dr. Hebard has now completed the BC_3 generation, which is on average 94% American, and has intercrossed members of that generation to produce a tree that is highly resistant to the blight. The highly-resistant, 94% American chestnut trees have been planted in a seed orchard to produce nuts for testing and reforestation. It is anticipated that the first test plots will be planted by 2008, and seed may be available for wider distribution by 2012. The work of TACF in the southern Appalachians has been greatly aided by matching grants from the National Forest Foundation and the National Fish and Wildlife Foundation.

LANDSCAPING WITH AMERICAN CHESTNUT

Native Trees for North American Landscapes

A new book by Guy Sternberg and James W. Wilson



Trees are natural focal points of any landscape—living structural elements. They inspire an appreciation of nature as well as providing food and shelter for wildlife. For all these reasons, the choice of a tree for your landscape should be carefully considered.

Many common native trees are just as beautiful as cultivated exotics. Since they have evolved with local conditions and are well adapted to their climate, they often require less maintenance and won't escape to invade a balanced ecosystem. The authors' extensive horticultural knowledge is distilled in this comprehensive cross section of trees native to North America, from the Atlantic to the Rockies and from northern Canada to the Gulf Coast, including the American chestnut.

The main section of the book is divided into tree profiles, each describing flowers and fruit, native and adaptive range, culture, and problems. The authors also list the best seasonal features—whether a tree has striking bark in winter, for example, or bright fruit in fall. In all, more than 650 species and varieties, and more than 500 cultivars, are discussed.

Following are excerpts from Native Trees for North American Landscapes, reprinted with permission, Timber Press Inc.

> Our…American chestnut exemplifies a critical concern about importing exotic species. In 1904 Hermann Merkel, a forester working at the Bronx Zoo, noticed some of the chestnut trees lining the zoo's walkways had a strange new disease. His concern could not have been more justified, as millions of chestnuts – virtually every one in existence – were to be killed or reduced to stump sprouts within the next few decades.
>
> Chestnut is among the most adaptable of trees, succeeding on almost any well-drained site. Research has shown that chestnut ranks higher than almost any other tree in competitive ability over a broad range of combinations of light and nutrient resource levels, but this

Native Trees for North American Landscapes
By Guy Sternberg and James W. Wilson

552 pp, Hardcover
ISBN: 0-88192-607-8
$59.95, plus shipping and handling
 133 S.W. Second Ave., Suite 450, Portland, Oregon 97204-3527. (503) 227-2878, (800) 327-5680.
www.timberpress.com
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species makes its best growth on rich, well-drained, slightly acidic soil in full sun. Nursery-grown trees are not difficult to transplant in the early spring, and the seeds are very easy to grow as long as they are not allowed to dehydrate.

Of course, the limiting factor with chestnut is the fungus, which can survive grudgingly on other trees, like oaks (Quercus spp.), until the next chestnut grows large enough to develop the furrowed bark that expedites infection. Until chestnut blight is overcome, no native chestnut tree is completely safe, even if planted a continent away from its infected native range. Chestnut plantings, for the present, should be located where the potential for their eventual loss to the blight can be tolerated.

[Combined] strategies are bringing us closer to the day when we can reintroduce the … American chestnut into its former range with confidence. Most of this fascinating work is being coordinated by … [T]he American Chestnut Foundation and its several regional chapters. I am a member and I support these efforts; I encourage other native tree enthusiasts to join us. The magnificent chestnut was the dominant tree of our eastern forests once, and it's coming back.

Guy Sternberg is a landscape architect, arborist, tree consultant, writer, lecturer, and photographer from Illinois. He has propagated and grown hundreds of species of trees, both native and nonnative, and maintains his own research arboretum, Starhill Forest, with his wife, Edie. He was the first president of the International Oak Society and is a life member of the International Dendrology Society, International Society of Arboriculture, and American Forests

Jim Wilson is a veteran horticulturist, familiar to most gardeners as the personable former co-host of the Victory Garden television series, on PBS. He is a widely published and respected garden writer and a lifelong student of native plants. A long-time resident of South Carolina, he now lives in Missouri.

Sternberg & Wilson are also the authors of Landscaping With Native Trees, 1995, Chapters Publishing, Ltd., Shelburne, VT memories

CHESTNUTS ROASTING MAIN STREET, BUFFALO, NEW YORK

By Herbert J. King, Watertown, Connecticut

My childhood memories of the American chestnut revolve primarily around the sale of roasted nuts by native Americans. Upstate New York is well known as the home of the five nations of American Indians, the Iroquois. I do remember them from early childhood, as each autumn they purveyed roasted chestnuts on downtown Main Street in Buffalo. The time slot was that of the early 1920s. They were a familiar sight as they sat in front of the Main Street department stores with their own home-fashioned roasting ovens as little columns of smoke rose from the roasting process.

This was not an occasional sight. The curbsides would be lined with them, often husbands and wives, several in a city block. It remains an arresting memory. Their dress was typical of that of native Americans of the day. It was an unforgettable mix of standard Americana and their own tribal dress codes. It seemed to be a fitting amalgam of efforts to bring their own colorful culture to a young boy.

Into the 1930's they continued, but gradually disappeared. We missed them, but in our ignorance accepted the thought that they had resorted to other activities more productive for them. Of course now we know that their source of product had disappeared. But that boyhood memory lingers on.

Send us your American chestnut memories:
e-mail to beth@acf.org, or mail to:
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Beth Daniels, Membership Director
PO Box 4044
Bennington, VT 05201

NITTANY LIONS IN A CHESTNUT WOODS: THE PAST AS PROLOGUE

PRESENTED AT THE AMERICAN CHESTNUT FOUNDATION'S 2003 ANNUAL MEETING IN STATE COLLEGE, PA

by Chris Bolgiano

I've been a TACF member for quite a few years now, but this is my first annual meeting, and I find it's a great comfort to be among so many other people who are all just as crazy as me. Crazy in the sense that we are creating our own reality by having a vision for the future. A vision that grows out of yearning so much for something lost in the past that we are willing to work toward a re-creation of it for the future. We know that it will take centuries to complete the process of re-creation, and that we ourselves will never see or even know about any return on our investment of work, money, and faith. By every modern definition of self –interest, this is pure craziness.

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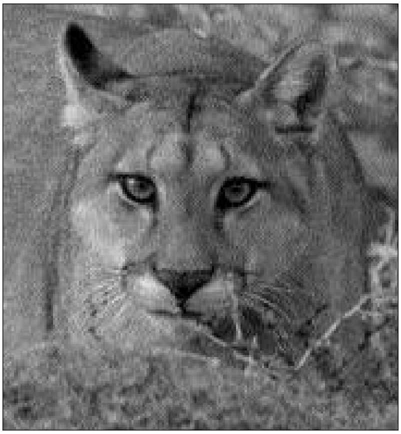

Our own insanity, my husband's and mine, began in West Virginia in 1971. We were young hippies then, as opposed to being aging hippies now. By now we've reached the point in life when our old motto, "Going back to the Land," is taking on a darker meaning.

But at that time, thirty odd, very odd, years ago, going back to the land meant, for us, buying an old farm on a high ridge overlooking the Tygart Valley River in east central WV. There were stumps in the woods there, stumps so big they could host the Mad Hatter's Tea Party, stumps so big that I could hardly believe they were real. Or rather, I could hardly believe the reality they hinted at — the reality of the "Great Forests of the East" — the chestnut-dominated, cougar-filled forests of eastern North America and most especially, the Appalachian mountain forests.

Now, perhaps some of you have never thought of cougars in the same breath, to make a broken metaphor, with the American chestnut tree. Cougars, also known as mountain lions, pumas, panthers, catamounts, and dozens of other names, are all the same species of large wild cat native throughout most of North and South America.

I hope tonight to show you that chestnuts and cougars are intimately related in our collective vision of the future, because together they ruled the past. Chestnut trees and cougars are unquestionably the charismatic megaflora and megafauna of the East. They each are the royalty of their respective kingdoms.

Chestnut trees and cougars serve as emblems of ecological health but also of our emotional attachment to the original, healthy native forests of the east.

I've studied both cougars and chestnut trees for many years now, and what better place to bring those two together than a TACF meeting at the Nittany Lion Inn. If any of you have not availed yourselves of the opportunity to see both Nittany lions on the Penn State campus, the elegant stone sculpture and the stuffed real, first Nittany lion, the original one, they are well worth a trip.

The story of the Nittany lion, which is now available in an interesting book published by Penn State, is a story of mistaken identity, of elusiveness, and of survival that in many ways reflects the entire history of this large cat. Cougars were the top predators throughout the eastern forests. We also had wolves in the woods, of course, red and grey wolves, but wolves are pack hunters that prefer open areas where they can chase their prey.

Cougars ambush from behind cover like trees or rocks and chase for only a very short distance. So cougars are better adapted for the deep woods, the chestnut woods, where abundant deer lived on the bounty of chestnuts. Cougars eat many varieties of small animals that ate chestnuts, but deer are the preferred prey of cougars everywhere; cougars and deer are believed to have evolved together in their own dance over the last two million years. Cougar colors mimic the fawn to red to grey colors of deer, and in fact, one of the many early names for cougar is deer tiger.

Obviously, the relationship between cougars and chestnut trees lies in the nuts that fed the deer. It's my own speculation that chestnuts provided food for deer in the deep woods, and without those nuts, deer today are more attracted to human-dominated landscapes where nearly continuous edges and tender ornamental plantings offer the most food. If we're going to allow cougars to recover, it would behoove us to have chestnut trees growing in the deep woods to keep everybody out of trouble.

The rule of thumb that biologists use to estimate the average cougar diet is to figure one deer per adult cougar per week. Unless the cougars are driven off their kill by coyotes or wolves or bears, they'll eat everything up. But where cougars do co-exist with bears and coyotes or wolves, they are often driven off their kill and so cougar kills provide for other predators as well.

Early attitudes toward cougars were quite negative, because cougars were not only a threat to livestock and even people, but also because they killed the deer the settlers wanted for themselves. By Novvember of 1856, when Samuel

Brush of Brushville shot the original Nittany lion, cougars had been harassed almost into extinction in the state of PA.

Sam was surprised to find the large cat tracks, but he had his dogs with him, and as soon as they treed the cougar Sam killed him. That was what any right thinking person at the time would have done. Sam had that cougar made into a mount, and the taxidermist gave him a threatening snarl that was meant to convey the ferocious beast's entire character. The Brush lion was 7 feet 9 inches long, 30 inches at the shoulder, weighed 147 pounds when shot.

For nearly 40 years, the Brush children rode and wrestled with the Brush lion and played many a prank upon their friends with him. Until in 1893 – which coincidentally is the same year that the last cougar was reported killed in PA – several natural historians persuaded the Brush family to give the stuffed cougar to the State College. He was cleaned up and remounted and immediately then sent off to Chicago to be exhibited in the World's Columbian Exposition, where he was a great attraction.

Upon his return, the Brush cougar was placed in the college's new wildlife museum. The class of 1908 named him the Old Nittany Mountain Lion and chose him for their mascot. But there arose some serious confusion. Over the years the Brush cougar was somehow transformed into the king of beasts, that is, the African lion. He was often portrayed with a mane and there were many references to his mighty roar. It was a confusion that reflected the state of mind of the earliest European explorers and settlers in North America. Having only an old world frame of reference, they thought at first that the cat they occasionally glimpsed in the woods was a lion like the African lion. For more than a century they kept looking for lions with a mane and couldn't understand why they never found one.

There was some serious disappointment over the caterwauling and screaming that cougars make, instead of the stately roaring of the lion, which cougars cannot do because of the structure of their throat. Then the general confusion shifted to the old world leopard, also known as panther, which in body form is very similar to the cougar.

The confusion at Penn State was compounded by the disappearance of the original Nittany lion, the Brush cougar, into a storage area for most of the 1930's. When he was brought out again in 1938 for use in zoology classes, the class of 1940 was inspired to give Penn State a truly unique gift for the campus: a limestone sculpture of a real, true to life mountain lion. The sculptor, Heinz Warneke, spent time in zoos observing cougar movements. The Nittany

Sightings are not evidence because they can be neither proven nor disproved. What's needed to confirm the animal as cougar is field evidence that can be examined by various experts.

Lion Shrine was dedicated in 1942. Instead of being the ferocious, slaughter hungry, despicable beast that settlers had feared, hated, and harassed into extinction, the cougar was seen as alert, resourceful, fearless, powerful, beautiful, and unconquerable – in short, the perfect mascot.

The Nittany Lion Shrine, a limestone sculpture by Heinz Warneke, was given to Penn State by the class of 1940

Not too many years later the original, real Nittany lion disappeared again, this time for 40 years, into the maws of the Carnegie Museum in Pittsburgh, which borrowed him in 1953 for a 1-year exhibit on exterminated animals. In 1993, the Brush cougar finally came back to Penn State. He was carefully restored, and to this day still has his entire skull, some of his original teeth, and much of his skin intact, making him one of the very few specimens of an eastern cougar still in existence.

Now, it used to be that the wildlife establishment – the state and federal wildlife managers and the academics — would always claim rather insistently that the eastern cougar was extinct. That all the cougars in the eastern woods had been killed off, and if anyone claimed to see one they were either delusional, deceived, or drunk. The thing is, a lot of people do see them. But sightings are not evidence because they can be neither proven nor disproved. What's needed to confirm the animal as cougar is field evidence that can be examined by various experts. Field evidence being things like scat (droppings), which can be scooped up in a plastic baggie and dried or frozen; plaster casts of tracks which are easily made if you just carry a few tools, or photos in which there's a background size reference that can be used for analysis.

That is exactly the kind of evidence that is now accumulating. There are now 2 to 3 dozen cases of confirmed field evidence of cougars living wild across the east. Several of these cases involve kittens and indicate that some cougars are reproducing in the wild. There's also quite a bit of evidence showing that western cougars are moving into the mid-west and perhaps, unlikely as it might seem, even managing to cross the Mississippi River.

So the wildlife officialdom can't keep saying there are no cougars out there because they'd lose all credibility. So the official policy now is to acknowledge that some cougars may be out there, but they are all escaped or released captives, not descendents of original native cats. Therefore they are not the eastern cougar subspecies.

Keep in mind that the 32 cougar subspecies were taxonified in the early 1900's. At that time, the thing to do in biology was to discover a new organism and get your name on it. The eastern cougar subspecies was defined by morphological measurements of seven specimens, which hardly seems like a valid scientific sample. Taxonomy is a human construct that doesn't necessarily reflect what's happening in the real world.

All 32 subspecies of cougars in North and South America can interbreed, for example, and all of them can adapt to many different kinds of habitats. But it's much easier for the state and federal wildlife agencies to stay in denial than acknowledge cougars, because they'd have to handle a lot of educational and safely kinds of issues.

Well, as you can see, genetics is one of many contentious issues that cougars and American chestnut trees have in common. In one case, scientists disapprove of mixing genes and in the other they do it on purpose.

There are other paradoxical similarities between cougars and chestnuts. Breeding specimens of both, for example, are quite elusive.

Both cougars and chestnuts were lost in the east before the scientific method and mindset had developed to the point that serious ecological studies could be made. American chestnut ecology is so little known there's not even an entry for chestnuts in The Sylvics of North America, that 2-volume tome of collected knowledge. Donald Culross Peatie has only a mournful page and a half on the American chestnut, but in it he describes their flowering in an image I've never forgotten: "From the upper slopes of Mount Mitchell, the great forest below waved with creamy white chestnut blossoms in the crowns of the ancient trees, so that it looked like a sea with white combers plowing across its surface."

To continue the parallels between chestnuts and cougars, the restoration campaigns of both will face significant public acceptance problems. Viable wild populations of both chestnut trees and cougars will require long-term preservation of large, connected patches of forest across regional landscapes. In this way, they are the umbrella species of the east, because if we can restore them, with their needs for large ranges, then we will surely retain most of our other native biodiversity that require smaller territories.

Both chestnut trees and cougars will also need complete protection, at least early on. Chestnuts may need periodic fires across the landscape, and cougars will need some good press concerning human and livestock safety issues.

And therein lies the biggest difference between chestnuts and cougars: one is benign and productive, the other is deadly and perceived as destructive. There's nothing threatening about chestnut trees; even the falling nuts have never been considered a mortal threat —unlike, for example, the coconuts that fall out of palm trees. Here's a little lesson in risk management vs. the power of perception: Sharks kill an average of 10 people a year, all around the world, every year. But every year, 150 people are killed by coconuts falling from the beach palm under which they were, until that moment, peacefully enjoying the ocean view. True fact. But who's afraid of palm trees?

The risk of cougar attack is very, very low. Around 25 known human deaths have been attributed to cougars in North America in the last 500 years. Dogs kill about that many people every year. It is possible to live with cougars; millions of people out west do it every day. There are effective methods of protecting yourself and livestock that can reduce potential conflicts.

Another difference between cougars and chestnut trees is that cougars are offering to recover themselves, if we would just allow them to, while chestnuts need help to heal themselves from the sickness we inflicted on them.

If the trees succeed, if the American chestnuts come back, if we are successful in our efforts, it will not be exactly the same kind of American chestnut tree that used to live here. The cougars that come back, if we allow them to, won't be exactly the same kind of cougars that used to live here.

We can't re-create the forest that was, because too much has been lost – too much of the gene pool, too much productivity from soil that's been burned, eroded, and toxified by acid rain. But we can begin the restoration process with some of the most important ecosystem parts, and we can, if we put our social and political will to it, protect the rest enough to allow natural processes of healing and recovery to become widespread. Chestnut trees and cougars are the ultimate measures of sustainability in the way we manage our landscapes.

If you look at nature – and that's one of the basic principles of sustainability, to mimic nature — life is a matter of communities. Envisioning a community in which chestnut trees and cougars co-exist, mutually sustaining, the chestnuts feeding the deer and the deer feeding the cougars at a rate that keeps browsing impacts below a threshold of damage to young trees – that's my vision of a new Great Forest of the East, and I thank you for letting me share it with you.

Chris Bolgiano is author of the multiple-award winning book Living in the Appalachian Forest: True Tales of Sustainable Forestry

science and natural history

1979 CHINESE CHESTNUT STUDY FASCINATES AND PUZZLES TACF FOUNDERS

By Philip A. Rutter, Badgersett Research Farm, Canton, MN

Phil Rutter, TACF Founding President and Honorary Board Member, is a commercial chestnut and hazelnut grower

One of the great joys of my life was the years Charles Burnham and I spent together, going through everything we could get our hands on that had to do with chestnuts. Typically, once every couple months, I would travel up to the Twin Cities and spend 4 or 5 days with him; sleeping on his roll-away, eating every meal together, burrowing into whatever scraps of original papers we'd been able to dig out since the last time. And over coffee, at lunch, we'd carefully NOT talk about chestnuts; just everything else in the world. It is one of the great pains of my life that he mostly forgot these times, as he got older. I never will.

When we managed to get a copy of this booklet on Chinese chestnut cultivation, it was simultaneously fascinating and frustrating; we could see we had something fabulous here, but couldn't read any details. Graphs and tables gave us hints, but only to tantalize.

I'm constantly intrigued by how events in the world "connect." We needed not only a native Chinese speaker to translate for us, but a trained forester. The reality of written Chinese is that many characters have different meanings, strictly depending on context, and there are some characters in each different walk of life that people from other disciplines may never see, and do not know the meaning of.

Technical translation is not a light task. We had no money. But we had an odd "connection." When I was in high school, I remember vividly the months when Alison Stilwell Cameron, General "Vinegar Joe" Stilwell's daughter was a guest in our house. She'd written a text book on Chinese brush stroke painting techniques, and my mother was her editor. Alison had learned Chinese painting in China; my mother was one of her best pupils, and so could be trusted not to edit out critical information. I learned a tremendous amount about China, just listening at the dinner table, and was captivated. Her book is still in print; still considered one of the best English texts on the subject.

As it turned out, my wife's best friend in her graduate school department was married to the head of the University of Minnesota's department of Oriental languages: Dr. David Wang. Because I knew a little about China, he became a friend of mine. In good Chinese "connections" style, I asked him for help. He found, and convinced, Dr. Chengguo Wang to do this partial translation for us, free of charge. I'm sure David Wang wound up paying something for it, but we'll never know what. I still owe him.

Charles and I picked out the sections we really wanted to see in full text, and Chengguo Wang (working on his doctorate at the time) provided us a manuscript, part translation, part transliteration, with a few missing places where even he couldn't find a way to translate the information. It was all priceless, providing insights into the population structure of a live, healthy, chestnut species.

There were also strong hints that the genetic diversity of Chinese chestnut was very much higher than previous workers in the US had realized, and that the samples of Chinese germplasm we had to work with in breeding for a new resistant American tree were tiny compared to what existed in China. In spite of huge importations of chestnut germplasm from China by the USDA during their years of work on chestnut breeding, we knew that most of what had been imported was from orchard populations, not the "wild" trees, which were far more likely to contain good and different genes for blight resistance. Charles had arranged for the original plant importation records to be loaned to the University of Minnesota. I had gone through them, every last one, and mapped them. Besides the fact that during most of their years of importing there was no safe access to wild areas (bandits), it was also evident that little of the imported material survived.

This set the stage for my collecting trip to China in 1989, just a couple months after the "turmoil" of Tiananmen Square. China was very unsettled, but I was afraid the problem might get worse. I had the chance to go, some financial help from Brad Stanback (of course), so I went. I was able to bring back quite a diversity of "wild " and seguin chestnuts, alive. Some of it survives at the TACF farm in Meadowview, some at 3 other professional germplasm collections. Chances are very low that these chestnuts have exactly the same genes for resistance that the USDA chestnuts have, giving us much better weapons against the blight.

Without this translation of the booklet Ban Li, written really only for internal Chinese use, we wouldn't have known what questions to ask, or what answers to look for.

Part of the game is checking the accuracy of information. We had some reasons to wonder, like this excerpt:

This disease is one of the most destructive world diseases. The distribution is vast and the damage is heavy. Almost all chestnut trees in Europe and

America were destroyed by the disease at the beginning of this century. Afterwards, Chinese chestnut was used for breeding resistant variety and chestnut trees were cultivated again. In China, Chinese chestnut trees were consistently considered to be resistant tree species. But in recent years, the disease spread in several provinces of southern China and damages were considerably serious in some places. It is a main disease in chestnut production at present.

There are several inaccuracies: destruction of European chestnut was not nearly so thorough as American; European breeders rarely used Chinese in their crosses, and it was fascinating to see them report that the USDA breeding program had been successful. And, when I was in China, I found that in Hubei province, at least, chestnut blight was far from a "main disease." Young chestnut scientists had barely heard of it, it was so trivial there.

There is still a great deal of understanding we could glean here, both from this text, and from the much more extensive writings now available. In a very Tolkienesque way, the road goes ever on.

— Philip A. Rutter, March 1, 2004

BAN LI (CHESTNUT)

A partial translation by Chengguo Wang, Northwestern College of Forestry, Yang-Ling, Shaanxi, People's Republic of China

From Anonymous, 1979, Science Publishing House
Beijing Institute of Botanical Research, Jiangsu, China
Commissioned in 1984 by Phillip Rutter and Charles Burnham, Ph.D.

Editor's Note: Space constraints prevent publication of the complete translation from Chinese of Ban Li. The following is a summary prepared for The Journal. Full copies of the paper are available from The American Chestnut Foundation, courtesy of Philip A. Rutter. Copies are available by e-mail in PDF format, or in hard copy by ground mail. Contact Dale Kolenberg, TACF Communications Director, to order a copy.

Chengguo Wang's translation of Ban Li tells us that recorded Chinese history and prehistoric cultural ruins clearly indicate that wild chestnut was an important human food source at least 6,000 years ago. Over 300 varieties of chestnut trees are said to be found in 21 of China's provinces. The northernmost cultivation is in Liaoning Province, the southernmost is in Hainan Island. Most of the chestnut trees, however, are distributed in the Huanghe River and the Changjiang River valleys.

The translation describes the characteristics of various Chinese chestnut species and their distribution. The species are divided into 6 variety groups, based upon ability to be grafted for reproduction, capacity to reproduce through seed distribution, nutrient content, yield, and the size of fruits produced. Tables included in the paper suggest the most suitable time of the year for grafting the various cultivars, and demonstrate different growth patterns between cultivars and trees growing in the wild. Another table compares "Survival Rate in Grafting Using Developmental Branches From Different Parts of the Tree." There is also a look at the progression of chestnut disease and gall wasp infestation in China.

Ban Li also explains various budding, grafting and crossing techniques: "Chestnut bud grafting is the same as apple tree bud grafting, that is T-shaped bud grafting. At present, successful experience in this method is small. It is not used in production very much. The main reason is low survival rate. So when bud grafting, you must pay attention to these problems: (1) Because there are ridges and grooves on the outward appearance of stock xylem, they influ-

Charles Burnham

1904-1995

Editor's Note: Please see "A Minnesota Story: Restoration of the American Chestnut" by Charles R. Burnham, in The Journal of The American Chestnut Foundation Vol. XVII No. 1, Fall 2003. It is Dr Burnham's 1991 memoir of establishing The American Chestnut Foundation.

ence the integration between grafting bud and stock. So the location of grafting must be chosen at smooth surface of the ridge back. According to observation, the smooth surface is just located under the leaf scar. So here is the right T-shaped bud grafting place. (2) Thick grafting bud is better than thin one, because the thin grafting bud is easy to get dry and inside the bud there are larger gaps which influence the integration between grafting bud and stock. Moreover, the thick grafting buds have stronger resistance to low temperature. (3) Bud grafting should be started when buds have grown well and healing ability is very strong."

Excerpts from Phil Rutter's commentary — September, 1984:

> "This is an important document. It updates our knowledge of the Chinese populations of Castanea, and fills in many blanks. It also makes some statements that pique our curiosity.
>
> The Chinese authors separate their cultivars into 6 distinct, sometimes overlapping, groups. This is something we have previously been completely unaware of. All the surviving material imported into this country came from groups 1 and 2. Regions, and more importantly, "groups" that might carry better hardiness and possibly better blight resistance were unsampled.
>
> The authors mention an increase in damage from blight in southern China in recent years. The translator, however, adds that in his province, Shaanxi (North Central), the large industry, which ships many nuts to Japan as a cash crop, is completely free of blight. This is a startling statement, and needs to be confirmed. If accurate, there are 2 alternatives; either trees in that region are immune (very interesting!) or the blight is a relatively recent development in China, and has not reached into the cold, continental areas of the population. Note that the spread of the blight in the US and Europe has slowed greatly as it reached cold continental regions.

Ban Li – the Mandarin Chinese word for chestnut. Created by Wilma Wei-Lin Hu, an artist and a scientist whose family emigrated to the US from Nanking, China after World War II.

THE ROAD GOES EVER ON…

By Dale Kolenberg, TACF Communications Director

Wilma Wei-Lin Hu's illustration of Ban Li was created in 1998 at the request of Dr. Paul Sisco, TACF Regional Science Coordinator. That Wilma created it, and we are using it here to illustrate Phil Rutter's commentary on the translation of Ban Li, commissioned by him and Dr. Burnham, is but another in his noted "connections" within the science of chestnuts.

Paul and Wilma have known each other since the early 1980's, when Paul was a postdoctoral student and faculty member, and Wilma was a senior technician, at North Carolina State University in Raleigh.

Wilma, like Dr. Burnham, was trained in cytogenetics, the study of chromosomes. During the 1960's, Wilma had worked with Dr. Barbara McClintock, who taught cytogenetics in the late 1920's to Dr. Burnham, when he was a postdoctoral student at Cornell University. Wilma's work as a senior technician at NC State was with Dr. David Timothy, who was Dr. Burnham's graduate teaching assistant at the University of Minnesota.

When Paul graduated from Cornell in 1982, it was the 75th anniversary of his department. Drs. Burnham and McClintock returned for the celebration, and it was Dr. Burnham who later signed Paul up as a member of TACF in the spring of 1986.

Cornell University, 1929

Charles Burnham, Ph.D., left, a postdoctoral student, was studying corn cytogenetics. Marcus Rhoades, second from left, and George Beadle, kneeling with the dog, were graduate students of Dr. R.A. Emerson (in the cap), head of the Cornell Dept. of Plant Breeding and Genetics. Barbara McClintock, right, pioneered the work of cytogenetics in corn and taught Burnham, Rhoades, and Beadle how to work with chromosomes.

McClintock and Beadle each won a Nobel Prize in Medicine – Beadle in 1958 and McClintock in 1982.

Cornell University, 1982

Marcus Rhoades, left, Charles Burnham and Barbara McClintock. Also pictured are Harriet Creighton, George Sprague, and Harry Hill. McClintock and Creighton wrote a famous paper together while they were still in graduate school. George Sprague, a corn geneticist, was head of the USDA cereal genetics program until 1972. Harry Hill was one of the first faculty members at Duke University.

CHESTNUTS: A HEALTHY FEAST

NUTRITION AND YOUR HEALTH: MISSOURI CHESTNUTS

by Melinda Hemmelgarn, M.S., R.D.

Editor's Note: The food values presented in this paper most closely resemble those of the Chinese chestnut.

Chestnuts are called the "UnNut" because nutritionally, they hardly resemble their tree-nut cousins. Unlike pecans and walnuts, chestnuts are relatively low in protein, high in carbohydrate, and contain just a trace of fat. They are also the only nut that contains a significant amount of vitamin C. Like all plant foods, chestnuts contain no cholesterol. For weight watchers, chestnuts are a low-calorie feast.

Nutrient composition of 1 ounce

(3 chestnuts/ounce) roasted Chestnuts:

(source: USDA; www.nal.usda.gov/fnic/foodcomp)

Protein	1.2 grams
Fat	0.3 grams
Carbohydrate	14.4 grams
Fiber	1.4 grams
Vitamin C	11 milligrams
Calories	68

Chestnuts are also the "UnNut' because they are perishable. They must be handled as though they were a fruit, such as an apple. Fresh chestnuts must be refrigerated, they can not be left out in a bowl with other nuts (or they will dry out, get moldy and rot). When purchasing chestnuts, select nuts that are heavy, glossy and firm, with smooth shells. One pound fresh chestnuts equals about 2 cups roasted and shelled.

Chestnuts can be incorporated into a wide range of dishes - in soups, along with fish, poultry and meat in a main course, in poultry stuffing, pancakes, muffins, and pastries. Chestnuts are frequently used in stuffing for fowl and traditionally combined with Brussels sprouts and red cabbage.

A puree made from cooked chestnuts is used as a filling for dessert crepes, and candied chestnuts or "marrons glace" are used in a variety of sweet desserts.

Here are some easy ways to enjoy the sweet, delicate flavor of Missouri chestnuts:

- Add roasted, chopped chestnuts to pasta, vegetable and grain dishes.
- Top baked winter squash with a tablespoon of brown sugar and roasted, chopped chestnuts.
- Spread crepes or thin pancakes with chestnut puree mixed with maple or vanilla syrup. Top with a sprinkle of cinnamon sugar.
- Puree boiled chestnuts in a food processor, and use to thicken soups.

Chestnuts are delicious and nutritious

Roasted Chestnuts

Preheat oven to 425 degrees F.

Using a sharp paring knife, cut a small cross on the flat side of each shell to allow steam to escape and to make nuts easier to peel. Place nuts in a single layer on a roasting or baking pan. Roast 15 to 20 minutes.

(Optional: Wrap hot chestnuts in a towel and squeeze to crush the shells. Keep nuts wrapped for 5 minutes before removing). Shell the chestnuts by removing both the hard outer shell and the thin brown skin (pellicle) inside. In preferred chestnut cultivars, the pellicle will come off with the shell. Roasted chestnuts are delicious plain, right out of the shell.

Boiled Chestnuts Cover chestnuts with water, and bring to a boil. Lower heat, and simmer for 15 to 25 minutes. Drain, and remove shells and skins. If the meat isn't tender, cover with boiling water and cook for a few minutes longer. Tender, boiled chestnut meats can be mashed or pureed.

Courtesy Michael A. Gold, Associate Director
University of Missouri Center for Agroforestry, Columbia, MO
www.centerforagroforestry.org

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NORTHERN NUT GROWERS ANNUAL REPORT 1999

NUTRIENTS IN CHESTNUTS

Sandra L. Anagnostakis and Peter Devin
The Connecticut Agricultural Experiment Station,
and Connecticut Chapter, The American Chestnut Foundation

For several years the chestnut breeding program at The Connecticut Agricultural Experiment Station has had a two fold mission: breeding blight-resistant trees for timber and for their nutritious nuts. The ideal timber tree is tall and straight, with a strong central leader, and flowering is delayed until the tree is quite tall. Thus, all the energy is put into vertical growth and not "wasted" on making flowers and nuts. An ideal nut tree is short and spreading, and starts flowering when it is only a few years old. Most of the tree's energy goes into nut production.

Chestnuts are a good food, as shown in Table 1. Chestnuts are high in fiber, have a good amount of protein, and the fats are more than 90% unsaturated fatty acids. Similar work is being done in Europe by Danielle

Table 1. Nutrients in chestnuts given as the % of dry weight

Species	Fiber	Protein	Fat	Carbohydrate
Chinese	14*	8	2	65
European	14	6	4	66
Japanese	14	8	0.4	90
American	19	10	10	40

*Note that since the fibers are carbohydrates, the numbers across will not necessarily add up to 100%.

Bassi and his colleagues in Milan, and by Liu Liu in China.

In 1994, Samuel Senter did chemical tests with chestnuts and found that the fats are unsaturated fatty acids that are known to be important to the flavor, nutritional quality, and storage quality of nuts. The individual fatty acids were quite different from species to species (Table 2). The sugar levels in the nuts of the species tested were all the same, but the American chestnuts tasted much sweeter. Senter believes that the fatty acids are the factor that make the American chestnuts taste sweet (notice that the American chestnuts had much more oleic acid than the others).

When a particular chestnut tree is determined to be especially good, it is often named as a cultivar and clonally propagated by grafting. Our Experiment Station released several cultivars to growers in the 1950's, and several of those are still being propagated and sold. The Experiment Station has recently released two new cultivars. One is 'Lockwood' which is a broadly spreading tree that has very large nuts, ranging from 13 to 30 grams per nut average weight in four different years (which is 16 to 35 nuts per pound). The other is 'Little Giant', which is an extremely small tree with nuts ranging from 4.5 to 10 grams average weight in four different years (which is 45 to 100 nuts per pound). As part of our study of old cultivars and our search for new ones, volunteers from The American Chestnut Foundation made crosses three years in a row, to see which combinations of four of our cultivars resulted in the most nuts. 'Eaton' was an exceptionally good pollen parent in both 1997 and 1998, and 'Eaton' and 'Sleeping Giant' crossed well in both directions. These are the two cultivars that I suggest for people who only want to plant a few chestnuts in Connecticut. Our two new cultivars, 'Lockwood' and 'Little Giant,' had an unusually high percentage of filled nuts in 1997, 1998, and 1999 when the pollen source was 'Eaton' (Table 3).

Table 2. Some of the Fatty Acids in chestnuts (from Senter, et al., 1994). The amounts are given as % of dry weight.

Species	Total Fat	Palmitic	Steric	Oleic	Linoleic
Chinese	2.10	0.22	n.d.*	0.91	0.77
European	2.95	0.43	0.04	0.88	1.26
American	9.50	1.05	0.08	5.70	1.91
American Chinquapin	4.01	0.53	n.d.	1.68	1.22

*n.d. not detected in these tests

Table 3. Percent of filled nuts in hand-pollinated crosses of cultivars at The Connecticut Agricultural Experiment Station in 1997, 1998, and 1999.

1997	**Pollen Parents**			
Nut Parent	**'Sleeping Giant'**	**'Lockwood'**	**'Little Giant'**	**'Eaton'**
'Sleeping Giant'	—	0	6	26
'Lockwood'	30	—	32	41
'Little Giant'	60	16	—	58
'Eaton'	24	20	10	—

1998	**Pollen Parents**			
Nut Parent	**'Sleeping Giant'**	**'Lockwood'**	**'Little Giant'**	**'Eaton'**
'Sleeping Giant'	—	2	18	10
'Lockwood'	32	—	39	48
'Little Giant'	40	23	—	46
'Eaton'	51	6	24	—

1999	**Pollen Parents**			
Nut Parent	**'Sleeping Giant'**	**'Lockwood'**	**'Little Giant'**	**'Eaton'**
'Sleeping Giant'	—	17	11	21
'Lockwood'	3	—	18	30
'Little Giant'	33	22	—	42
'Eaton'	33	33	18	—

In 1998 and 1999 we had nutritional analyses done by a commercial laboratory on the hybrid nuts produced by hand-pollinations. Tests were limited because of the expense. There was very little difference in fiber, protein, and carbohydrate between nuts from the same cultivar with different pollen parents. There were, however, big differences in the amount of fats in the results (Table 4). For example, the 1998 nuts from 'Sleeping Giant' with 'Little Giant' pollen had seven times as much fat as 'Sleeping Giant' with 'Eaton' pollen, and 'Lockwood' with 'Sleeping Giant' pollen had twice as much fat as 'Lockwood' with 'Little Giant' pollen. We did not get such clear results in 1999, but the extreme drought may have affected the results. If genes in the pollen parent affect the amounts of fatty acids that determine flavor, we need to know which work best so that better recommendations can be made to growers planning which chestnuts to plant in their orchards. Next we will be testing the nuts for sugar content and for specific fatty acids to see whether the "flavor components" are under simple genetic control. This would allow us to more easily design crosses to improve our nut-producing cultivars.

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Table 4. Nuts from hand-pollinated crosses of two cultivars at The Connecticut Agricultural Experiment Station in 1998 and 1999. Values are the % of dry weight which is fat (total) and the average weight of the nuts as grams per nut.

1998	**Pollen Parents**			
Nut Parent	**'Sleeping Giant'**	**'Lockwood'**	**'Little Giant'**	**'Eaton'**
'Sleeping Giant'	—	n.d.*	3.6% fat, 7.8 gms/nut	0.50% fat, 10.3 gms/nut
'Lockwood'	1.10% fat, 30 gms/nut	—	0.50% fat, 30 gms/nut	0.50% fat, 30 gms/nut

*not done in this year

1999	**Pollen Parents**			
Nut Parent	**'Sleeping Giant'**	**'Lockwood'**	**'Little Giant'**	**'Eaton'**
'Sleeping Giant'	—	0.84% fat, 11.8 gms/nut	7.8% fat, 11.8 gms/nut	0.89% fat, 10.2 gms/nut
'Lockwood'	0.68% fat, 16.8 gms/nut	—	0.56% fat, 17.6 gms/nut	0.86% fat, 16.7 gms/nut

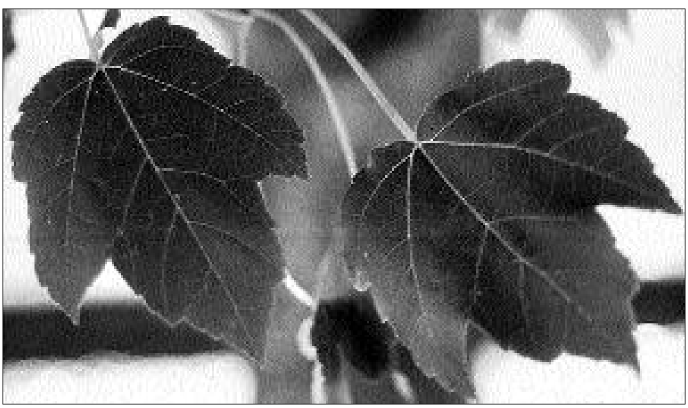
THE RED MAPLE, AN IMPORTANT RIVAL OF THE CHESTNUT

By Bill Lord

The red maple is an emerging phenom of the present and the foreseeable future. Within the past century it has become the most abundant tree throughout most of the central and eastern states.

In the early 1900's, when the blight removed the chestnut as a major component of the Appalachian forests, it was replaced, in general, by oaks and other hardwoods of high timber quality. If blight-resistant strains of chestnut had developed, it is probable that the chestnut would have made a prompt recovery and re-established its position of dominance.

Not too many years from now we plan to introduce a blight-resistant chestnut to the Appalachian forest. It is reasonable to assume that our tree would successfully establish itself among a pre-blight population. But now the neighborhood has changed and a thorough, updated knowledge of the red maple is imperative for a successful deployment.



In pre-blight time the red maple was more typical of moist lowlands where it was also known as the swamp or water maple. However, its marked genetic diversity enabled it to thrive in a variety of environments. Although probably in lesser numbers, it was found, then as now, at elevations of up to 4,000 feet in the Southern Highlands. In general, it was not a major component our eastern forests prior to European settlement. However, early land survey records show a sizeable population in the Allegheny Mountains of central Pennsylvania and the Ridge and Valley of eastern West Virginia [(1)]

The red maple has always had an extensive range, from the Atlantic seaboard west to Texas and Minnesota and north from southern Florida well into Ontario, Quebec and the Maritime Provinces. Within the past century it has increased primarily, not by expanding its outer boundary, but by adapting itself to an increasing variety of environments within its range.

Within its rich gene pool it has the resources to thrive in conditions that are either too wet or too dry for many of its competitors. "Roots of maple seedlings are capable of developing differently in response to various environments, so that the seedlings can survive in situations ranging from swamp to dry upland….. Red maples seem to tolerate drought through their readiness to stop growing under dry conditions and by producing a second growth flush when conditions improve again, even after growth has stopped for 2 weeks." [(2)]

Red maple, "can probably thrive on a wider range of soil types, textures, moisture, pH, and elevation that any other forest species in North America." [(2)] It associates with more than 70 different species of commercial tree species, including: in the north with spruce, fir and white cedar; at mid latitudes with sugar maple, beech, hemlock, white pine, oaks and hickories, and in the south with sweet gum and loblolly pine.

The red maple's composite of attributes make it the consummate opportunist to take advantage of any change in the environment. It flowers and produces seed in the spring and the seeds can germinate as they lie on the ground giving the seedlings an earlier start than the competition. The seedlings are shade tolerant and can hold out for several years awaiting a release into sunlight. Trees four years old can produce seed.

Obviously the red maple is a remarkable competitor. But it had the same potential centuries ago. Why has its numbers so increased during the past century? This enigma is characterized as "The Red Maple Paradox." There are proponents advocating several different explanations, but none are in general agreement.

Mark D. Abrams, a professor of forest ecology at Penn State says "Periodic burning of oak and pine forests before European settlement was arguably a key factor limiting red maple domination in the original forests. The increased use of prescribed under story burning may be the most effective ecosystem management approach for keeping red maple populations in check and restoring the health and vigor of the historically dominant oak and pine forests. [(1)] I have underlined "prescribed under story burning," because the phrase deserves special consideration. Controlled burning is being given increased attention and cautious application by both federal and state forest departments. The effort is necessarily exploratory because there is ample evidence to show that red maple can actually increase in response to burning. An interesting observation from the past

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is provided by a study on the replacement of blight-killed chestnut by Korstian and Stickel, 1927. [3] A sketch made in 1904 of the crown spread of trees on an approximately 65x65 foot plot showed blight-free chestnut among a group of hardwoods including oak and red maple. The red maple presence was far above average and called for an explanation. “Its preponderance is probably due to the fire which lightly burned over the area a few years after cutting. The fire favored the increase of red maple in the under story.” A sketch was made of the same plot in 1923. No chestnut remained, but red maple was prominent among scarlet and white oaks.

Further observations on the effect fire has on red maple are provided by Russell S. Walters and Harry W. Yawney of the USDA Forest Service. [2] “Presently, red maple is important in many stands where it was formerly a limited associate; it is enabled to increase by disturbances such as disease, wind throw, fire and harvesting.” The trees are very sensitive to fire but, “Red maple stumps sprout vigorously. Inhibited buds are always present at the base of red maple stems. Within 2 to 6 weeks after the stem is cut, these inhibited buds begin to extend….Fire can also stimulate these buds.”

However, burning is a tool that can be of benefit to oaks, and by extension to the chestnut. In one study, burning has been demonstrated to be selectively more harmful to red maple. “After an oak forest under story was burned, net photosynthesis for black cherry and oak seedlings was enhanced compared with the unburned control, but that of red maple was not, indicating that the physiology of red maple is more sensitive to fire than other hardwoods (Reich et al. 1990).” [1]

[Corey] Wentzel, Forester, Pennsylvania Department of Forestry, describes a current burn program to increase oak regeneration on Mt. Davis in southwest Pennsylvania as an exploratory learning process. The ground cover of a six acre plot within a 26 acre area protected by a deer fence was burned in the spring of 1999 and of 2001. One purpose of the burn was to reduce the number of sweet birch, striped maple and red maple in the mid and under story and thus encourage a seedling crop from the mature oak over story. Following each of these burns approximately 60% of the birch and maple produced sprouts. However, an increase was noted in the number of seedling red and chestnut oak. The oak seedlings develop a more extensive root system than their competitors. Subsequent burns are planned to see if the entire burn sequence will give the oaks a competitive advantage. Unburned controls are maintained for comparison of results.

The neighborhood has changed and a thorough, updated knowledge of the red maple is imperative

Bill Sharpe, a professor of forest hydrology at Penn State, has observed a decades old decline of red oak and replacement by red maple. The villain of the piece is acid rain. "The acid comes from sulfur dioxide in the emissions from coal-fired generating plants in Ohio, Indiana, Illinois, West Virginia and western Pennsylvania." Forest soils are much more acidic than 40 to 50 years ago. "The acid deposition leaches aluminum out of the soils, which is toxic to plants, and also lowers the availability of calcium and magnesium, both essential elements for plant growth. We have a forest regeneration problem and a forest health problem- our forests are sick. We know there is very little regeneration of red oak and large, mature red oaks are dying. That cannot be blamed on deer or lack of fire." [4]

As a result of several studies Sharpe has observed that soil acidification, "…may be responsible for the rising fortunes of red maple." It is much less sensitive to aluminum and low calcium than red oak. In deer studies conducted at Penn State it was shown that deer, "…actually preferred to browse on red maple over red oak," so Sharpe does not, "….subscribe to the deer hypothesis."

However even though red maple and the oaks in general are a preferred deer food, the red maple is obviously persevering and spreading whereas the oaks are in decline. Selective deer browse commonly results in a forest with a dense under story of ferns and a depletion of seedlings, particularly of oak. Once established, the ferns out compete the seedlings. Reducing the deer herd should aid in the return of oak species. It is also essential to a successful deployment of the chestnut.

[Corey] Wentzel adds the wasteful practice of harvesting timber by "high grading" as a cause for the increase in red maple. The motto of this method is, "Remove the best and leave the rest." The size and value of a tree may not correlate to its age. Many of the taller and more superior trees selected by high grading are younger, and a better source for regenerating the woodlot than smaller trees of the same species left uncut.

Appalachia, the native land of the chestnut, is of particular interest to us and much of the timber in this region is in privately owned woodlots. Many owners prefer "high grade" contracts that remove the best timber for short term gain, leaving inferior trees to restock their woodlots and provide an environment for that consummate opportunist, the red maple. As previously noted, the red maple takes advantage of disturbances such as logging. The poorly managed character of a high graded woodlot invites the red maple.

The red maple is a beautiful tree. More than any other it composes the tapestry of fall color. But we need to be fully aware of this exuberant phenom and its expanding ways. We must think and plan ahead for our time of deployment.

Many thanks to [Corey] Wentzel and Tom Fitzgerald, of the PA Department of Foresty, for their crtique of this article — Bill Lord

Dr. William G. Lord, a retired veterinarian from Pennsylvania, is a frequent contributor to The Journal.

As Dr. Lord notes, the red maple is among a variety of high timber quality trees benefiting from the chestnut's demise. In pre-blight time, the red maple was widely distributed, but evidence for the dominance of chestnuts and oaks throughout the Appalachians undoubtedly argues for a much lower abundance than is currently found. Red maple has always been a component of Appalachian forests. Chestnut, to be re-established, must replace much of the red maple currently growing in our forests.

The burn program Dr. Lord mentions to increase oak regeneration on Mt. Davis in southwest Pennsylvania is notable, because the frequency and intensity of such burns may play a key role in determining the advantage given to different tree species when others are destroyed.

—Hugh Irwin, Southern Appalachian Forest Coalition
Vice Chair, TACF Science Cabinet

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USE OF MICROINJECTION OF SYSTEMIC FUNGICIDES TO SUPPRESS CANKER DEVELOPMENT IN AMERICAN CHESTNUT TREES

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Introduction We have attempted to preserve a stand of planted American chestnut, Castanea dentata, trees from chestnut blight cankers, caused by Cryphonectria parasitica, in a research plot in Deerfield, MA through the use of mud-pack poultices since 1994 (Groome, et al, 2001, Tattar, et al, 1996). This stand of trees has been producing fertile nuts through natural cross-pollination since 1998, but canker suppression has become increasingly difficult as the trees increase in size. Therefore, trunk injection of systemic fungicides was added to the canker suppression treatments in 2002. The objective of this research project was to determine if the fungicide trunk injections could suppress canker development to help preserve American chestnut trees for pollination projects.

Methods In 2002 and in 2003, we selected blocks of 10 trees to be treated with either a systemic fungicide treatment via trunk microinjection or act as uninjected control trees. Two systemic fungicides were used in capsules provided by the J. J. Mauget Company of Arcadia, CA: Tebuject, an experimental formulation of 12% tebuconizole, a triazole fungicide, and Fungisol, a clinically used benzimadazole fungicide. Trunk injections were performed in 2002 and 2003 in late June and early July according to J. J. Mauget's dosage recommendations of # capsules/tree = trunk diameter (inches)/2. Injection capsules were placed into 11/64 inch (4.3mm) drill holes made 6 inches (15 cm) apart around the root flare of each treated tree. Linear canker development in existing and in newly formed cankers were measured horizontally and vertically at the end of September.

Fungicide capsules are being injected into an American chestnut tree in South Deerfield, Massachusetts research plots.

Results Measurement of cankers from both the Fungisol-injected and Tebuject-injected trees demonstrated suppression of canker enlargement of both established and newly formed cankers when compared with control trees. Results from 2002 and 2003 trials were comparable and data reported represented combined trials. Measurement means followed by 95% confidence intervals are reported. Existing cankers formed vertical oval-shapes that were limited to a mean of 7.5 cm+/-2 cm horizontal and 10 cm +/-2 cm vertical directions on trees averaging 20 cm in diameter. There were no differences between average canker dimensions in either the Fungisol or Tebuject-treated trees. Newly formed cankers tended to be circular and restricted in mean size 6 cm+/-1.5 cm in diameter. The level of suppression in newly formed cankers was also similar for both fungicide treatments. Cankers girdled 100% of the stems on the untreated control trees, with mean canker sizes of 45 cm +/-5 cm.

Discussion It is not surprising that trunk injection of a benzimidazole fungicide would suppress canker development. Jaynes and Van Aflen demonstrated such use in 1974. However, this is the first report of suppression of canker development by a triazole fungicide. This study suggests that systemic fungicides may be considered a management option to protect and preserve large American chestnut pollination trees.

Acknowledgements This study was supported by the donation of fungicide capsules from the J. J. Mauget Company and by a grant-in-aid from the Massachusetts Chapter of The American Chestnut Foundation to the University of Massachusetts.

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