

# SAVING AN AMERICAN ICON

HOW A PASSION FOR OUR COUNTRY'S HERITAGE, SOME CUTTING-EDGE SCIENCE,  
AND A LITTLE BIT OF LUCK MAY BRING BACK THE BELOVED CHESTNUT TREE

BY SUSAN FREINKEL



Crossbred Chinese-  
American chestnut,  
Meadowview, Virginia.

**E**ARLY IN THE TWENTIETH CENTURY, MARTIN HICKS PLANTED A HANDFUL OF AMERICAN CHESTNUT SEEDS ON THE RIDGE OVERLOOKING HIS FARM IN WEST SALEM, WISCONSIN. THE PLANTING WAS AN ACT OF FAITH: CHESTNUTS ARE NOT NATIVE TO THE MIDWEST. THE SEEDS, A GIFT FROM HICKS'S MOTHER, CAME FROM TREES IN PENNSYLVANIA, THE HEART OF A VAST CHAIN OF CHESTNUT FORESTS STRETCHING FROM GEORGIA TO MAINE. THOUGH NEW TO THE WISCONSIN TERRAIN, THE SEEDS

sprouted into saplings that flourished and multiplied into a stand of more than 5,000 soaring, straight-trunked trees.

But in the chestnut forests back East something was going terribly wrong. While Hicks's trees decorated the hillside with waving white blossoms in the summer and littered the ground with sweet mahogany-colored nuts in the fall, the eastern chestnut woods were falling victim to the most destructive plague ever to strike an American forest. The cause was a fungus that originated in Asia and first surfaced in New York State in 1904. Over the next 50 years, the blight rampaged through the chestnut's traditional range, eventually killing some four billion trees and devastating communities that had come to rely on the chestnut for food, lumber, and livelihoods. Today, all that remains are the memories of old folks and the dream of a younger generation that wants to bring the forests back. They see in the woods at West Salem—the largest existing stand of American chestnuts—a living embodiment of that dream.

It's a dream sustained by the tree's own tenacity. Even now, a century after the blight began its deadly campaign, chestnut saplings continue to sprout from the stumps of fallen trees. These saplings offer a glimpse of the forest that was and inspire hopes for its eventual return. But the blight has shown equal tenacity in this long-running duel and strikes down most sprouts before they reach maturity. It is not a duel the chestnut can win without human intervention. Is science up to the task?

Chestnut researchers are generally pursuing two complementary strategies: fixing the tree so it can fight the fungus and fixing the fungus so it can't hurt the tree. Fred Hebard of the American Chestnut Foundation has led the way in efforts to create blight-resistant trees. Sandra Anagnostakis of the Connecticut Agricultural Experiment Station has pioneered methods of rendering the fungus less lethal. Both once may have hoped their focus would be *the* salvation of the chestnut tree. However, they—like most chestnut researchers—now agree that beating the blight may require a combination of strategies. There are no rivals in this fight. "Everyone who works in chestnut is passionate," says Anagnostakis. "You have to be. The odds aren't in your favor."

But nature does not yield readily to the longings of the human heart, even when they're coupled with the best tools of science. Whether the quest to rescue the chestnut can succeed remains an open question, as Hebard is all too aware. When an admirer recently said to him, "Isn't it great to think you can die knowing that you were responsible for bringing back an entire species?" the laconic Hebard remained guarded. "Yeah, it'll be great," he said. "If it works."

**W**hen you ask people why they want to bring back the chestnut, you get a variety of answers that distill to one core conviction: It was a remarkable tree. Chestnuts grew quickly, with thick, arrow-straight trunks that topped the canopy at 80 feet or more. They were what ecologists call a keystone species, providing habitat and sustenance for nearly every living thing in their vicinity. The nutritious nuts that dropped each fall fed wild game, livestock, and people. The trees also yielded a wondrous, rot-resistant wood that had an unmatched variety of uses, ranging from fence posts and utility poles to pianos and coffins. Ground into a pulp, the tree gave up valuable tannins that were used to process leather. Such a combination of traits has created fans among both the ecologically and the commercially minded. The tree, they say, would be a wonderful addition to the beleaguered East Coast forests of today. Chestnut trees offer a boon for wildlife, a source of lumber that does not need to be chemically treated, and—because they grow so rapidly—an especially effective means of soaking up atmospheric carbon.

The goal of chestnut restoration is driven not only by visions of the future. It also rides on nostalgia for the past. In Appalachia as many as one in four trees was an American chestnut, and the forests are still filled with the remains of the grand old trees—massive silvery carcasses and yawning stumps that "evoke an eerie feeling of longing for what must have been," as one American Chestnut Foundation member put it.

Chestnuts played a central role in the economy and culture of the Appalachian Mountains. People built their homes of chestnut logs, brewed home remedies from chestnut leaves, and sold the nuts to pay taxes and buy

necessities like shoes and school supplies. As subsistence farming disappeared after World War I, the tree became a symbol of that vanished way of life. "If ever there was a place defined by a tree, it was Appalachia," folklorist Charlotte Ross of Appalachian State University in Boone, North Carolina, told members of the Chestnut Foundation at their 2004 annual meeting. "It was our icon. We loved that tree."

Love for the tree (some call it chestnut fever) has gone a long way in keeping its prospects alive. That fever has propelled enthusiastic amateurs to tenderly nurse ailing trees, to scour the woods for flowering sprouts, to climb high into trees to pollinate flowers or collect the precious nuts.

One way to outwit the blight is by breeding a tree that resists it. At first, experts considered that a straightforward task. The fungus, *Cryphonectria parasitica*, originated in Asia. Over millennia, the chestnut trees in China and Japan evolved genes that allow them to



PHOTOGRAPHS BY  
FORREST MACCORMACK

live with their parasite. They're not immune, but they don't succumb. By crossing American trees with their Asian cousins, breeders hoped to transfer the genes that would allow the American species to put up a winning fight.

Unfortunately, Chinese and Japanese chestnuts tend to be shorter. As scientists for the U.S. Department of Agriculture (USDA) discovered when they started breeding hybrids in the 1930s, many more genes than the few that govern resistance also cross over. Initially the hybrids grew like gangbusters and appeared to resist the blight. But when they stopped growing after a few decades, the USDA scientists realized they had a problem. The trees were only 50 to 60 feet tall.

Hopes for the tree seemed stymied by a Catch-22: Blight-resistant trees require Asian genes, yet Asian genes produce a tree with neither the height nor the hardiness to survive the fierce forest competition for sunlight. In 1960 the USDA shut down its chestnut-breeding program and the tree seemed consigned to oblivion.

A retired plant geneticist named Charles Burnham became interested in the chestnut's plight two decades after the USDA program ended. He concluded that the breeders had made a basic mistake in crossing Chinese-American hybrids with Chinese trees in order to boost resistance. Any geneticist could have told them the trees would end up looking Chinese.

Burnham proposed an alternative method called backcross breeding, which is used when breeders want to tinker with only a single trait, like susceptibility to disease. A backcross breeding program would start by mating Chinese and American trees. But then, instead of mating those hybrids with Chinese trees, they would be crossed with American chestnuts in order to beef up the quotient of American genes while diluting the concentration of Chinese traits. Ideally, after several generations, the only Chinese genes that remained would be those conferring blight resistance. The result, Burnham dared to hope, would be a tree that looks and grows like an American chestnut but fights blight like a Chinese.



Fred Hebard,  
chestnut savior.

ican Chestnut Foundation was looking for someone to manage its farm. He leaped at the chance, though the job then paid a meager \$12,000 and meant moving his wife and two small children to the hamlet of Meadowview. His first year on the job, he planted the open pasture behind the farmhouse with 250 young Chinese and hybrid trees. Since then it's been a long, slow slog: planning matches, planting nuts, collecting pollen, pollinating trees, harvesting nuts, testing young hybrids for resistance, culling inferior specimens.

It wasn't until the mid-1990s that Hebard got confirmation that the plan could even work. He inoculated a group of second-generation hybrids with the blight fungus and then methodically tracked how well each tree coped. Crawling along the ground between the

## ALL THAT REMAINS ARE THE MEMORIES OF OLD FOLKS AND THE DREAM

In 1983 Burnham, along with chestnut breeder Philip Rutter and several others, established the American Chestnut Foundation to carry out the new breeding program. The group has grown steadily over the years and now numbers some 5,600 members—most of them enthusiastic laypeople—with chapters in 13 states spanning the tree's historic range. But the foundation's center of gravity is the research farm in Meadowview, Virginia, where for the past 17 years Fred Hebard has overseen the day-to-day execution of what he calls "the Burnham hypothesis."

Hebard is tall and lean and has the taciturn, low-key manner of a farmer—a farmer whose "I reckon" are followed by terms like "phenotype" and "homozygote" and "pyramiding genes." At 57, he has spent most of his adult life thinking about chestnuts. He got hooked on the tree when he was 22, after dropping out of college to work on a dairy farm in Connecticut. He was helping round up stray heifers when he came across an old chestnut sprout. The farmer told him about the blight and all the trees that had died. Something about the story captivated Hebard. "I don't understand the psychology very well, but it gives me a mission."

In 1989, after getting a master's degree in botany and a Ph.D. in plant pathology, Hebard heard that the recently established Amer-

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long rows of trees, ruler in hand, he measured the cankers on each tree and compared them to those on the Chinese trees. Gradually he realized that some of the hybrids were showing a marked resistance to the blight. "It looked like the Burnham hypothesis had at least passed its first test," he says, adding with characteristic understatement, "I was pretty pleased about that."

The results also underscored the intimidatingly long odds of creating a fully blight-resistant tree. By tracking how many of those hybrids held up against the blight, Hebard was able to confirm that, as suspected, only two or three main genes control resistance. This means that after all the necessary crosses and backcrosses, only a fraction of the trees he produces will have the level of resistance needed to survive in forests riddled with blight.

When the foundation was started, Burnham, Rutter, and their colleagues thought it would be 2030 before they reached their goal of a truly blight-resistant tree. Hebard now hopes that by 2008 he'll be producing seeds for trees that could be set in the forests, fully equipped to tackle the blight. Even then, he says, "things could go FUBAR [f\*\*\*ed up beyond all recognition]." The resistance itself may not be sufficient. The fungus could mutate. New enemies could appear. The trees could be munched up by deer, crippled by gall



Chestnuts nestle in their spiny husk.

wasps, or done in by a deadly root rot that is endemic at lower elevations. Residual Chinese genes could yet prevent the trees from getting tall enough to shoot past their competitors.

As far as Hebard is concerned, the ultimate test of Burnham's hypothesis is decades down the line: "The trees look strongly American. Whether that translates into growing like an American, we'll see."

**N**ot all experts are so circumspect. "It is obvious to me that it will work," says Sandra Anagnostakis, who oversees a much smaller backcross breeding program. She is, in many ways, Hebard's opposite: a small, sturdy, cheerful woman of 67 who bubbles with excitement. Her office is filled with chestnutabilia; the license

plate on her car reads CHSNUT. An expert on plant fungi, Anagnostakis fell into chestnut work almost accidentally in 1968, when a colleague laid a blight-ridden chestnut branch on her desk, saying "Here—you're a mycologist, why don't you do something about this."

A few years later Anagnostakis learned about a discovery in Europe that had opened a whole new avenue for fighting the chestnut blight: deploying a naturally occurring virus to defang the fungus. The virus had first been identified in Italy in the 1950s, by which time the blight had long since reached Europe. But then a strange thing happened: Some of the trees spontaneously began to heal. French mycologist Jean Grente cultured samples from the cankers of recovering trees and found that these strains of the fungus grew more slowly than usual and were a pasty white rather than the typical vibrant orange. Later researchers established that the fungus was infected by a virus that dramatically slowed its growth. This gave the trees time to marshal their natural defenses. Grente termed the phenomenon "hypovirulence."

When Anagnostakis read about Grente's discovery she immediately fired off a letter asking for samples of his hypovirulent fungus. She and colleague Richard Jaynes then injected the strains into American chestnuts in the Connecticut Agricultural Station's green-

house: "Sure enough," she recalls, "the cultures that had the viruses kept the blight from killing the trees."  
In 1978 she and Jaynes followed up with tests on 70 young American chestnuts in one of the station's orchards. "We treated every canker we could reach for four years," she says. Then they left the trees alone. More than 20 years later, the trees are riddled with blight cankers, but they're all still alive and some continue to grow. "They're gorgeous," Anagnostakis says proudly. "Well, gorgeous in my eyes."

Truly, a mother's love is blind. These trees are a far cry from the "American classic." Many look more like bushes than trees; the best of the bunch are scraggly, limby specimens averaging no more than 35 feet tall. As another researcher joked, "They're apple trees." Could they really be signs of success?

"It depends on what you call successful," Anagnostakis says. "I'm talking about trees that survive and flower." The trees blossom abundantly each summer, and every fall produces bushels of nuts. To her the trees are proof that hypovirulence can keep the species going while she, Hebard, and others work on developing blight-resistant trees.

That's a more modest goal than the early hope that hypovirulence could be used to resuscitate entire forests. Researchers got one last chance to test that notion when some trees in West Salem, Wisconsin, started to show signs of infection. In the early 1990s, a group of scientists began inoculating the blight-stricken chestnuts with hypovirulent fungus in the hope that the virus would be transmitted to the blight strain that was already in the woods. That proved trickier than anyone expected, according to Dennis Fulbright, a plant pathologist at Michigan State University. It's believed that the first virus used was so debilitating to its fungal host that it didn't spread. After three years, the researchers tried a weaker strain. Though this spread more readily, it has not been able to keep pace with the virulent strain of fungus. By now, Fulbright concedes sadly, the epidemic is so far advanced in West Salem that the blight appears to be getting the upper hand.

Even so, hypovirulence does appear to be rescuing some individual trees. To his surprise, Fulbright, like Anagnostakis, has found

## OF A YOUNGER GENERATION THAT WANTS TO BRING THE FORESTS BACK

that some trees are better able to take advantage of hypovirulence than others. As he puts it, "Some of the trees out there seem to 'get it,' and some of them don't."

Walking through the stand, he stops and points to a pair of trees that were inoculated seven years ago and marked with red numbers on their trunks. Number 12 is little more than an upright mass of withered sticks. Number 13, however, is exuberantly alive, flush with shiny green leaves and bunches of nut-filled prickly burrs. Fulbright suspects the difference has to do with the tree's genes: Number 13 may have "a smidgen more resistance." If the hypovirus bought the tree some time, that whisper of genetic moxie gave it a chance to heal itself. And the evidence is visible in the healing cankers that pockmark its trunk and branches.

What does Fulbright's finding mean in practical terms? If nothing else, it suggests that the century-long quest to defeat the blight is not so quixotic after all. Most researchers would now say that in the long run it will take a combination of tougher trees and a weakened fungus. As Fulbright says, "That really might be the whammy the chestnut blight needs."

Then maybe, just maybe, as the tree's devotees like to say, the American chestnut can begin to save itself. 🌱