

A Man and His Tree

A century after one of America's most beloved trees was doomed to near-extinction by an Asian fungus,

Fred Hebard has dedicated his life to pulling the chestnut out of the fire By **STEVE NASH**



Photographs by Sara Hirakawa



Fred Hebard, left, of Meadowview, Va., is trying to revive the majestic American chestnut tree by genetically crossing it with the blight-resistant Chinese chestnut, above.

THIS SUMMER MARKS A CENTURY since the beginning of the end for the American chestnut tree. Or you could argue that the trouble really started about 50 million years ago. Neither possibility is much on the mind of Fred Hebard this morning as he patrols the hummocky roads of his three chestnut research farms. More of a concern just now: A derelict truck a couple of miles away needs the ministrations of a welding torch, and Annie has, once again, jumped ship.

We're near the hamlet of Meadowview, off Interstate 81, on the southwestern big toe of the ragged-foot profile of Virginia. This has become an evolutionary intersection, a place where prosaic small-scale tree farming meets global natural history.

That's because the landscape here—and wherever you live, too—used to be found at a different address. It was part of the supercontinent Laurasia, which combined the land masses of what are now North America and Eurasia. The remote ancestors of Hebard's chestnut trees grew all over Laurasia. Their fossil remains have been found along Yellowstone National Park's Specimen Ridge.

But then North America and Eurasia slid off in different directions, and the Atlantic widened between them. The last of the land connecting us with Europe vanished about 50 million years back. To the west, our link with Asia was gone by 15 million years ago. Since then, chestnut trees and thousands of other kinds of plants, though related, have developed along diverging paths on their separated continents.

This has ramifications, and here's one: Some Asian insects and diseases affect trees over there only mildly, because they have shared the same landscape for eons and adapted to one another. Set loose as strangers among distant-cousin trees here in North America, however, those same pests can be lethal.

So when people began to ship Chinese chestnut nursery stock and logs into the United States in the late 1800s,

silently killing trees along the broad avenues of what is now the Bronx Zoo. The vivid orange blight leapt like sparks through stands of chestnuts from Maine to Georgia, consuming an estimated 3.5 billion trees in only 50 years—perhaps a quarter of the entire Appalachian forest.

The same morose scenario—a carelessness akin to arson—has played out again and again since then. Other alien tree-killers continue to make landfall on a regular basis. Fraser firs and butternuts are nearing extinction in the wild; dogwoods and two species of hemlocks have been devastated; ash, oaks, maples and a lengthening list of other kinds of trees are under threat, as imported insects and diseases expand their territory. The scientific outlook: Unless Americans decide to take action, more such problems are on the way.

WE PULL IN FOR GAS at Brantley's-N-Dillow's crossroads laundry-grocery—also, biscuits-n-gravy, 99 cents, as a vinyl banner strapped to the cinder blocks announces.

Predictably, everyone in the chance meetings here and on the road seems to be first-names with everyone else. Fred Hebard is no exception. He's tooled along these roads since 1989. He pays up at a cash register flanked by a display stand with 22 kinds of chewing tobacco.

We need to keep an eye out for the venturesome Annie, a border collie mix with irrepressible energy. She is, Hebard has explained, a real farm dog: She can jump into the bed of the pickup truck with the tailgate up. That skill

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it was as if a bridge had been built, reuniting the two continents. A blight fungus, unanticipated in the evolutionary playbook of American chestnut trees, also crossed over.

The first scientific confirmation of the invading organism was made 100 summers ago, when it was discovered

works the other way, too, though, so she is frequently AWOL. Here she comes back again—"Wag your tail if you're stupid!" is Hebard's affectionate greeting—and we're on our way.

Hebard is a graying, wiry 56, strong enough to wrestle





One tree at a time. Above: a huge chestnut in the 1920s; a blighted chestnut today. Opposite: a crew "bagging" a tree to prevent pollination; seedlings at Meadowview Research Farms; a volunteer inoculating a tree against blight.

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the big, balky drive shaft of a mowing machine onto the back end of a tractor. It's one element of the campaign to contain the explosion of spring weeds across his fields.

And that, in turn, is a little part of Hebard's larger work on behalf of the chestnut tree. To push the continents back apart. Burn the bridge. Leverage the wit and sentiment of Homo sapiens against the blind reproductive rapacity of the blight. On 131 acres, he is trying to reinvent healthy, blight-resistant American chestnut trees and reintroduce them onto their original range.

Or you could look at it that way. Hebard, a PhD plant-disease specialist of modest bearing and entrenched wryness, would wave off any such exalted stuff. "One of my great revelations was when I got poked in the eye by a chestnut twig," he says. "It was that they didn't give a [expletive] that I was trying to help them."

He has, however, a bit of cross-grained fascination with the enemy species. "It just kills the hell out of the chestnut forest. I know it's kind of like admiring the Boston Strangler or something," Hebard says with a laugh, "but it's

more like a neutral admiration."

In any case, bringing American chestnut trees back isn't a project for a lone hero. Instead, it's a mix of scientists, volunteers, long patience and strong hopes.

Meadowview proper is a short drive from the gas station. Its business section is just a few blocks long, tidy but half-abandoned. There's a phalanx of pickup trucks at the town eatery where we stop to check in with a couple of other local chestnut experts, the kind whose knowledge of the species is becoming rare. Over grilled cheese and fried potato nuggets, Jack Wilkinson, 88, remembers that in his childhood "there was mountains of chestnuts. My granddaddy had, I guess, about 50 acres. We used to say that chestnut was all that was on them. My other granddaddy, he had some—all the big woods had chestnuts in them." When phone lines reached here, to the Holston Valley, chestnut trees supplied the poles. "They was as straight as could be," Wilkinson says, "the healthiest tree in the woods," and one of the most beautiful.

By then—the 1920s—the blight already was bearing down on Meadowview. News reports cited theories that "the real cause is the general wickedness of the people of the United States. It is a scourge for sinfulness and extravagant living . . . a grand religious revival might stay it."



But the flanks of the mountain valleys near Meadowview still had stands of chestnut trees so dense that their heavy load of blossoms was sometimes called "June snow."

"On my farm, that old hill used to be covered up with them," Lloyd Odum, 83, says. "Big old trees. Three, four or five men couldn't reach around them. Lord yes, we'd carry the chestnuts to the house and feed them to the hogs."

Chestnuts for roasting were harvested each autumn and shipped by the boxcar-load to Eastern cities, a popular street snack. But for rural folk, the tree was indispensable. It was a sturdy prop under a sometimes shaky economy. Chestnut wood—rot- and insect-resistant, hard, light, straight-grained and abundant—was often the lumber of choice for cabins, barns, shingles, fence rails, firewood, cribs, coffins, mine timbers and furniture. And "the farmers' hogs were fattened on chestnuts, and, to no small degree, his children were also," one historian has written.

Although a hundred different hardwood tree species were used for lumber in the southern Appalachians, chestnut made up more than a quarter of the cut. It also supplied much of the extract for tan-

twice as wide during their first eight years.

Turkeys, bears, squirrels, jays and many other animals fed on chestnuts—a much heavier and more reliable annual food crop than acorns. A small hint of that former richness surfaced when scientists attempted to reintroduce red wolves in the southern Appalachians a few years ago. One reason the project failed was that the wolves found too few small mammals to eat. That food chain may well have been depleted when the annual supply of countless billions of chestnuts vanished.

By the '30s, the blight had begun its destructive work around Meadowview. When Odum left the Marines after World War II, he got a job dynamiting the stumps of some of the last trees to succumb. "People didn't seem to talk about it much," he recalls. "They just took for granted, you know, that the trees would come back. But they never would."

You can still find chestnut trees scattered through the woods of Maryland and Virginia today, especially in the mountains. They sprout from the half-buried stumps of giants that died seven decades or more ago. A few survive until they're mature enough to bear the tough, spiny burs—about the size



CHESTNUT SEX is easy to master. There's some sweat, and it's a good time.

ning heavy leathers, a major industry.

Its virtual disappearance from 200 million acres of Eastern forest was a convulsive change for the ecosystem. That pre-blight chestnut forest was magnificently adapted to its environment, growing at elevations from 1,000 to 5,000 feet. The largest specimens were 120 feet tall, eight to 10 feet in diameter. The trees were hardy survivors of steep slopes, poor soil and drought. A few lived for as long as six centuries.

Though our knowledge is sparse, by any reckoning the chestnut was a keystone species. In the survival game of competing for sunlight in wild forests, chestnut "tends to just explode out of the ground," Purdue University researcher Douglass Jacobs says. His studies have found that chestnuts dominate black walnut and red oak, for example, growing more than half again as tall and more than

Meadowview volunteers
Timothy Lowe, Benji
Cornett, Jason Allen
Mann and Lionel Ruberg.

of billiard balls—that crack open in the fall to release three glossy chestnuts.

But they seldom grow even 10 feet tall before the blight invades, bursts open their bark and kills them.

"Fred and them's doing a pretty good job," Odum allows. "Get them trees so they can put them back into the mountains."

THE EFFORT TO REVIVE the American chestnut has determined much of Hebard's life, and his family's, since 1970. At 22, he found himself working as a farmhand in Connecticut.

"The farmer and I were trailing a heifer that had busted out and gone a long ways," Hebard recalls. "He showed me a chestnut sprout and just started telling me

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about it. I thought, well, it would be nice to go back to college and study biology and try to cure chestnut blight . . . I didn't realize it was a lifetime proposition, back then."

That was enough to keep him in school at Columbia University, the University of Michigan and Virginia Tech for years. In 1989 he was hired by the non-profit American Chestnut Foundation to start its breeding and restoration program, on a small leased farm. Now there are four staff members, thousands of chestnut trees of varying ages and pedigrees, and two more small farms in the same neighborhood.

On one of the farms is that decrepit truck, now being reconfigured with a welding torch. And next to that, several hundred four-foot-tall seedlings blanket a hillside. They are the latest mark of progress along Hebard's experimental path, whose destination is to capture the blight resistance that's found in the comparatively squat Chinese chestnut tree species and to incorporate it into the DNA of the American tree.

This is to be accomplished with a tree breeder's genetic sleight of hand. First, a Chinese and an American tree are crossed. A few of the progeny will inherit the two or three genes that confer blight resistance—a kind of genetic lottery. The winners still have much of the appearance of the Chinese parents, so they are mated with American trees, and that generation is also tested to see which trees carry the resistance genes. The breeding process continues until the Chinese resistance has been transferred to a tree whose genes and structure are almost completely American.

Chestnut trees mature slowly and have to be three or four years old before they can be tested for blight resistance. This means that the research can run to decades, over several generations of trees. Hebard's sets of genetic linkages have been assembled one day at a time for the past 15 years, and the work continues. In the meantime, it's all about hailstorms and drought, plowing and planting, spraying against the bugs and weeds, mending fences, irrigation systems and broken tractors.

The seedlings on the hillside are the latest, and greatest, generation. In three

or four years, the nuts from the ones that have inherited the blight-resistance genes will be planted—but not on the farms. For the first time in the project's history those nuts, 15/16ths American, will be planted out in the wild, perhaps in nearby Jefferson National Forest.

Then we'll see. The longer they survive, and the more they look like American chestnut trees as they mature, the better. Meanwhile, trees of even greater genetic refinement will continue to be bred back on the farms.

CHESTNUT SEX is pretty easy for humans to master. There's some sweat, and it's a good time—even if you do have to climb up a stepladder. That's lucky, because the success of the Meadowview project also depends on volunteers in a network of state chapters along the chestnut tree's former range, including a thriving chapter in Maryland.

"We have lots of fun doing it," says Barbara Knapp, a volunteer from Germantown. "The whole story of the chestnut is addictive. Getting this magnificent tree back into the Appalachians, even if I'll never see it . . . it's a very exciting prospect."

Knapp is one of several dozen Maryland volunteers who plant and pollinate trees among native chestnut groves—terminally blighted but, for now, reproducing—at the base of Sugarloaf Mountain and near Thurmont. They are trying to make sure the genetic variations that have allowed chestnuts to adapt to the soils and climate of Maryland, Maine or Georgia are not lost as the blight-resistance breeding project ramps up.

The first thing to know is that chestnuts trees are bisexual. In late spring, each bears the starbursts of long, fuzzy, cream-colored male catkins. Each tree also has dozens of small, green female flowers. But a tree cannot pollinate itself, and not just any pollen is welcome. Hebard exports pollen from his hybrid trees to volunteer matchmakers all over the East. Then the volunteers pollinate local, specially chosen "mother trees" that have escaped the blight long enough to reproduce. (The Massachusetts chapter calls its campaign "the American chestnut dating service.") At least some of the resulting crop of nuts will carry both the blight-resistance genes and the localized survival traits.

To get all this done, these far-flung

volunteers emulate the human-assisted mating dance that occurs at the Meadowview Research Farms. There, Hebard, his staff and groups of volunteers all put in hundreds of hours atop ladders or cherry-picker cranes.

Each chestnut tree that has reached reproductive age is spreading pollen in the breezes and also presenting receptive female flowers to all comers. If you're trying to control that unruly, indiscriminate mating process to narrow the genetics of the offspring, you have to take extraordinary measures.

About mid-June, "we put special bags very tightly over the female flowers, so that any wandering pollen can't get in, and pull off the male catkins that are near these particular flowers," Knapp says. "And then, about 10 days later, we get pollen from the nursery down in Virginia, and we open up the bags and brush the pollen onto the female flowers." Then the bags are put back in place, and the resulting chestnuts are of known parentage.

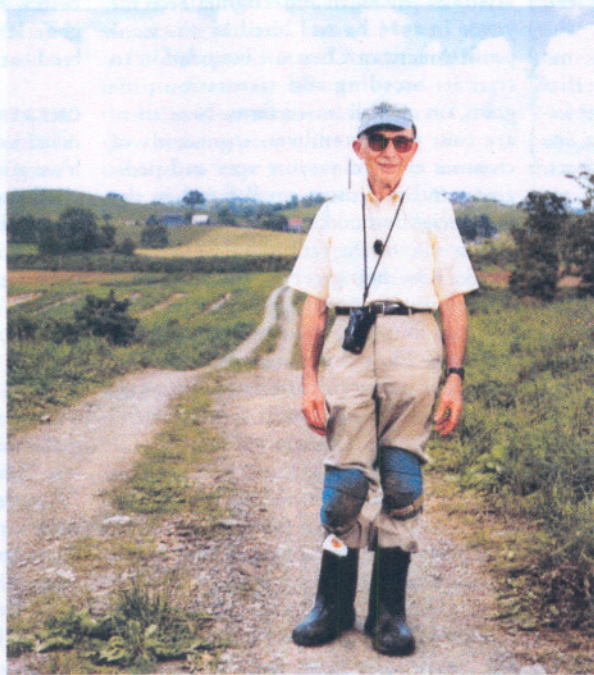
But perhaps the most demanding work, especially for

JUST THE SAME, failure is a possibility. With time, the blight might adapt to the "new" trees' defenses and overcome them. The Chinese genetic component, though proportionally small, might still be enough to strongly affect the trees' structure and appearance as they mature. The resistance could start strong and then break down. Some unknown

Just a few have proved worthy of further tinkering.

Naturally, Hebard gives the Meadowview project very good odds of success, but he has plenty of company. Indeed, Meadowview's breeding program was first worked out and proposed by an eminent plant geneticist, the late Charles Burnham. The soundness of the approach has since been reviewed and confirmed by two independent science panels.

Votes of confidence have also been registered recently by the feds. Jim Sherald, regional chief of natural resources and science for the National Park Service, calls Meadowview "not doubtful, but hopeful . . . It's certainly the avenue that holds the most promise for now." Plans for reintroducing the hoped-for, blight-free chestnut tree to Southeastern national parks in the future are already under discussion. Even more significantly, funding from the U.S. Forest Service spiked to \$250,000 this year, boosting the American Chestnut Foundation's budget by about 25 percent.



The thought of **RECLAIMING** that immense, vanished forest is deeply agreeable.

retirees who come to Meadowview to help, is testing young trees to see whether they are blight resistant. This is stoop labor, performed by pushing your way through a faceful of stiff branches to the base of the tree, auguring a hole in the trunk, then administering dollops of two strains of chestnut blight. The survival rate is one measure of the success of the whole project.

Sandra Anagnostakis is a longtime chestnut research scientist in Connecticut who collaborates with Hebard on some of the tree-breeding work. She breaks into laughter when asked if there are any nonbelievers. "Most people just think it's too much work. It all depends on whether you put in the time and effort. The problem is, does anyone have the faith and the money and the time to do it? Of course it'll work. These are just simple breeding principles."

Leon Porter, above, volunteers at Meadowview, helping to restore the American chestnut to its pre-blight grandeur, right.

factor might prevent the newly invented trees' ability to survive in the woods.

Hebard is not reluctant to point out these pitfalls. And a pessimist might call to mind the daunting history of attempts to resuscitate the chestnut forest.

There have been earlier breeding experiments, searches for resistant trees, acid sprays, poisons, quarantines, grafts, treatments with sulfur fumes and rusty nails, nuclear irradiation and a genetically modified organism dubbed "Frankenfungus" that was supposed to kill the chestnut blight but not the tree.



Elsewhere, biotechnicians also are attempting to revive the chestnut, with gene-sequencing machines and microscopic tweezers. They hope to splice blight-resistance genes into chestnut trees someday and make a high-tech end run around most of the tedious tree breeding. They salute the Meadowview

BOTTOM PHOTOGRAPH COURTESY AMERICAN CHESTNUT FOUNDATION

project as important work, however.

Even if some laboratory breakthrough were on the far horizon, it would still have to be proved out in the field, patiently, sometimes beyond the life spans of the researchers. "Ninety-five percent of all tree-breeding efforts are still like what our ancestors did thousands of years ago, only more refined," says Rob Mangold, a geneticist who directs the federal forest health protection program.

Hebard, too, has done time over a microscope. But he decided early on that he works best out on the land.

A half-hour drive south from Meadowview takes you along a steepening, overgrown old logging track, up into the Jefferson National Forest along Chestnut Ridge, which is part of Iron Mountain. At perhaps the 3,000-foot elevation, Hebard has negotiated his truck to where the road is impassable—acquiescing, finally, to the incline and the dense tangle of forest.

That journey links the carefully groomed, rank-and-file hybrid trees down on the Meadowview Research Farms to their wild, native cousins. We're looking at a desolate grove of shrubby American chestnuts—all terminal cases, their trunks already burst open by the blight. They have resprouted from the stumps of the huge trees that used to shade this part of the mountain long ago.

The thought of reclaiming that immense, vanished forest is deeply agreeable. To consign it to biological oblivion was mindlessly simple, ruthlessly quick. To restore it will take far longer—patient labor, distant goals, to suit the slower rhythms of the lives of trees. "If there's any genius in what I'm doing here, it's just growing these trees out to an age where they can be tested and survive," Hebard says. "Biting the bullet and planting out the acreages."

And, of course, the real success of the Meadowview project will be guaranteed only after he's in the ground himself—when those experimental American chestnuts to be planted out in the wild are 50 or 100 years old and look like, and thrive as certainly as, their lost ancestors.



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