A retired Seneca doctor is making great strides in the long battle to restore the American chestnut tree to its once-dominant role in the forests of eastern North America. by Pete Laurie
On a long ago summer morning in a remote corner of Pennsylvania, my grandfather stopped the Oldsmobile and pointed to a spindly sapling in a hedge row.

"That’s a chestnut," he said solemnly. "You’ll probably never see another."

As we proceeded along the dusty road to the cabin, he told me the sad story of how chestnut blight had wiped out the towering American chestnut, once the dominant tree of eastern deciduous forests. Born in 1885, he recalled majestic stands of chestnut, its strong, durable wood, and harvesting bushels of sweet nuts every fall — nuts relished by humans and all manner of wildlife.

*Chesnut trees protect their nutritious nuts in tough, bristly husks, which split open when the nuts ripen.*
Seventy years later, "the perfect tree," as many called it, lived on only as a few scattered sprouts from the roots of the fallen giants. My grandfather had witnessed the chestnut's sad demise, but he could not have guessed at its brighter future. For even back then, researchers had begun efforts to restore the American chestnut.

Chestnut blight, first discovered in New York City in 1904, arrived on this continent with Japanese and Chinese chestnut trees imported as ornamentals and for nut production. Having evolved for eons along with the fungus that causes the blight, these chestnut varieties native to the Far East had developed a genetic resistance to the disease. American chestnuts, however, never before exposed to the blight, had no resistance.

Cross breeding Chinese and American trees produces individuals with some American chestnut characteristics and at least some of the Chinese chestnut's blight resistance. Repeatedly back crossing these hybrids with pure American chestnuts for several more generations yields a tree genetically similar to the American chestnut, but with the Chinese genes for resistance to the blight. For decades, researchers in eastern states have pursued hybridization with enough success to establish small experimental reforestation projects in many areas.

But for much of the South, breeding chestnut hybrids with resistance to blight solves only part of the problem. Even as scientists sought a solution to the blight, the disease continued to race south and west across the chestnut's range, the deadly spores spread by wind, birds and insects. However, in South Carolina, most of the state's chestnuts had succumbed decades earlier to another imported disease — root rot — only nobody knew it. That passing had gone undocumented.

Most likely brought into Charleston in the late 1700s in the soil of ornamental plants imported from the Far East, root rot, a type of algae related to slime molds and red and brown algae, enters a plant's root tips, destroying tissue, preventing the uptake of water and finally encircling the plant's base, killing it. Not identified until 1926, root rot attacks more than eight hundred species of trees and herbaceous plants, including some pines and firs. A close relative, potato blight, caused the Irish potato famine of the mid-1800s. Before its discovery, root rot may have wiped out other North American plants unknown to modern botanists.

Root rot spreads more slowly than chestnut blight, usually through water and displaced soil. In early days it no doubt hitched rides on wagon wheels and horses' hoofs. But whereas chestnut blight kills the tree only above ground, leaving the roots alive to sprout new saplings, root rot destroys the root system, killing the entire tree. And, unlike blight, which produces obvious cankers, root rot lurks below ground, unseen until the tree withers and dies.

Fortunately, freezing kills root rot and its spores. In areas where the ground freezes down to two or three feet during winter, root rot cannot exist. From Pennsylvania north, about one third of the American chestnut's original range, root rot presents little problem. Nor does it affect
In 2001, he planted eighty blight-resistant hybrid chestnut trees on his 250-acre farm in Seneca. They immediately began to die; none lasted more than three years. James contacted Dr. Patricia Layton, Forestry Department Chair at Clemson University, who immediately suspected root rot, by then a well-known pathogen of many plants but at the time not known as a killer of chestnuts. Layton placed James in touch with Dr. Steve Jeffers, a Clemson root rot expert. In 2003, with Jeffers’ assistance, James began a unique program to develop a chestnut hybrid resistant to both blight and root rot.

James starts with hybrid chestnut seed from the American Chestnut Foundation’s experimental farm in Meadowview, Virginia. This 150-acre seed orchard, established in 1989, has produced thousands of back-cross hybrid chestnut trees in many variations, carefully selecting those individuals with American chestnut characteristics that show the most resistance to blight. Since both root rot and blight have their origins in the Far East, James theorized that Chinese-American hybrids selected for blight resistance might also have some resistance to root rot, although through quite different genes.

Initially, researchers expressed skepticism about James’ approach, and he had to beg for seed. Today though, thanks to his successes, he gets all the seed he needs and even some funding for his mostly privately financed research.

Each spring since 2011, James has planted blight-resistant nuts he gets from Meadowview — half in carefully marked pots and half directly into the ground. When the seedlings reach about twelve weeks of age, he inoculates the soil with root rot spores he has cultured from dead and dying roots. The soil on his farm contains some level of root rot, but he wants to make sure the seedlings get a good dose of the pathogen so he can select those with the most resistance. Once exposed to the disease, most of the young trees die within three months, others hang on longer. When the seedlings become dormant in December, James, Jeffers and a volunteer crew from Clemson pull them up and plant the most promising specimens in his seed orchard.

James considers any of his seedlings that survive to the age of three years (about 3 to 5 percent) to have at least some resistance to root rot. He now has ninety-five trees in neat rows across the rolling hills of his seed orchard and hopes to expand that number to 150. When mature, these trees should produce nuts with substantial resistance to both diseases.

Why all this time and effort spent on bringing back a single tree species? The estimated four billion chestnuts that once thrived throughout eastern North America no
doubt played a key role in the ecology of the entire region. Abundant and fast growing, chestnuts could adapt to many soil types and a variety of climates. The huge and dependable production of nuts fed bears, white-tailed deer, turkeys, squirrels and many other small animals, such as wood rats. Plus, the American chestnut, growing to a height of a hundred feet with a wide canopy, offered shade and cover to many other forest plants. The almost total disappearance of such a key species in just a few decades must have greatly altered eastern forests. But the environmental impact of the chestnut’s loss went all but undocumented, since the science of forestry barely existed at the time.

The human impact of the chestnut’s disappearance, we know much better. Throughout the tree’s range, early settlers depended on chestnuts for food and as trade items, as did native Easterners before them. Whole families, especially in the Appalachians, derived part of their livelihood each year from the chestnut harvest. Even into the late 1800s, mountain residents harvested chestnuts each fall by the wagon load and sold them to buyers who shipped them to major cities. Urban and rural residents alike relished the sweet meat of the nuts and worked chestnuts into a great variety of recipes.

The straight-grained chestnut wood, lightweight yet strong and insect resistant, helped build the young country, finding uses from rough construction to furniture, fence posts and telephone poles. The wood’s stability and light weight made it excellent for the core of furniture and caskets, often veneered with showier cherry, walnut or mahogany. The bark and wood proved ideal for tanning hides. Paper companies turned chestnut pulp, a byproduct of tannic acid production, into newsprint and other types of paper. Indeed, the American chestnut came as close as possible to the “perfect tree.” And then, very quickly, it all but vanished.

Whenever humans introduce new species into any natural environment, whether by design or by accident, trouble invariably follows, often in unexpected ways. The deadly introductions of blight and root rot into North America would have doomed the American chestnut to extinction decades ago except for two factors: Blight does not kill the tree’s roots, which allows saplings to sprout over and over, with some sprouts living long enough to produce nuts. And, climate limits the more deadly root rot to just the southern portion of the tree’s range, sparing those trees to the north. Thus, surviving trees and their offspring remain available for hybridization through selective breeding with related, disease-resistant chestnut species.

American chestnut has many advantages for selective
breeding. Chestnuts mature early, producing nuts at year six or seven, whereas some species of oaks do not produce their first acorns until age twenty-five. Also, the prolific American chestnut produces many times more nuts than oaks or hickories of similar size. Nor do chestnuts go through annual cycles of nut production, reliably churning out their bountiful crop year after year. And, chestnuts have a high rate of germination — 85 to 90 percent — ensuring that most planted nuts will sprout.

Despite these attributes, breeding chestnuts for disease resistance remains a slow process involving many years, although researchers throughout the American chestnut's historic range have made considerable progress. The pioneering efforts of Joe James continue to make a unique contribution to this effort by concentrating on developing resistance not just to blight but to root rot as well.

"For successful reforestation, American chestnuts must possess all the genetic disease resistance they need for vigorous growth," says James. "They cannot acquire these genes on their own, at least not for millions of years."

Based on his success to date, James believes that in ten or perhaps twenty years, stands of American chestnut hybrids, virtually identical to pure American chestnuts but carrying the genes for resistance to both blight and root rot, will dot Southern forests in experimental plots with great chance of success. Moreover, James firmly believes chestnuts once grew throughout South Carolina's piedmont and even into the coastal plain, not just in the mountains. Reforestation on a large scale will take many decades, and just as one knows the environmental impact of the sudden removal of chestnuts from the forest, we cannot predict how present day plant and animal communities will react to a large scale re-introduction of the tree. But most foresters, naturalists and traditionalists see it as a positive step, a righting of a long ago wrong.

And my grandfather? He no doubt would smile at the thought of the forest monarch of his youth soaring again above the hills and valleys it once dominated, and perhaps, sometime in the distant future, reclaiming its title as the perfect tree.

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