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The President's Message

There is a great deal of news in this issue of the Journal, almost all of it very good; the wonderful possibilities for a first class, cutting-edge Research Center in New York; the increased success with publicity, and what I consider the very wise authorization for State Chapters of the Foundation. All of these are covered in detail elsewhere here, and I hope they give you the good feelings about the future of the Foundation and the chestnut that I have. We are making progress; real progress.

However. One need we have not yet addressed is the one for our own office. At the moment, although we have several people hired on part-time arrangements, they all work in their own offices, at various locations, and only on very specific jobs. General housekeeping chores are still done by volunteers, or myself (one of the part-timers), and with all the new developments there really are just not enough hands to always get the work done as quickly as we want. What I am working up to here is an apology - if you read one of my previous messages, I confessed to having a small pile of unanswered mail on my desk. The pile, alas, is no longer small.
Please, if you have written to me and have not received a reply yet, forgive me. It is certainly not because your letters, questions, information, and offers are not important. They certainly are. It is just that I am daily faced with the choices of following up some new need for the effort to get the Research Center going, or mailing off another request for urgently needed funding, or actually pollinating chestnut tress that have to be attended to today, or mailing out information to a journalist who is working on a story. Etc. I am guessing, and hoping, that you will understand, and agree with me, that these things are urgent, and that I need to do them first, to widen the Foundation's horizons, and make its future more secure. I do try to answer some letters each week, but progress is woefully slow. Usually for every two letters I get answered, three arrive. Please, bear with us. With any luck, we will get an office with secretarial help in the coming year.

It may comfort you with unanswered letters to know that you are not on the bottom of my list, at all. When trying to decide what is the next urgent thing to do, many things can wait a few days, and filing always comes out last. I am about to drown in unfiled papers. At the moment, I know where everything is, but my wife is making serious threats to begin unauthorized rearrangements. Clearly, things have to change!

On a happier note, I want to share with you another significant, tangible, advance for the chestnut: planting more trees for our breeding program.

For the past two years, the Foundation has not made any new plantings, following the initial ones at Oberlin, West Virginia U, Virginia Polytechnic, and the Great Smokies Park. This was for two reasons. One was a shortage of trees, in some years. Another was to allow us to watch the first plantings, and see how they developed, and see if changes were necessary in our policies.

We have inquiries all the time for trees; everybody would like to grow a few of our developing blight resistant hybrid trees in their back lot, but so far we have had to turn all such requests down. The number of controlled hybrid trees we have been able to grow simply does not allow us to put them in a place where there is a chance of losing them. Realistically, we have to insure that the trees will be safe, and that we will have access to them for at least 30 years. It is sad but true that individuals, planting trees on their own land, simply cannot make any such guarantees. Life is full of both expected and unexpected turns. Private land may suddenly change ownership, and under such circumstances we would stand a very good chance of losing valuable trees. Therefore, it has been our policy to plant trees only on land belonging to a permanent institution.

If we had enough trees to work with, that policy might change. So far, luck has not been on our side, however. The pollination weather last year was just plain lousy. Many of the female trees that we have been using for our hybrids are in Iowa and Minnesota, where large, unblighted trees tempt us with the possibility of making many hybrid nuts in one place. Last year, like this year, the spring was very warm, and these trees accordingly developed their flowers quite early. At the same time, in New York and New England, where much of our hybrid pollen is gathered, the spring was cool and cloudy, causing the pollen to develop later than usual. The end result was that the female trees were at the very end of their receptive period when the first pollen was available, resulting in many fewer nuts than we had hoped for ..

In spite of that, this year it was decided that it was time to start another plantation. Enough trees were in the greenhouses so that some of them could be and should be planted out in a good site in the east, both so they could be field tested against the blight, and so they could grow big enough to start producing blight resistant pollen. A shortage of appropriate pollen is one of the chief bottlenecks in the breeding effort.

In choosing the site for the next planting, two major factors were con¬sidered. One was that we did not wish to plant a region where a planting already existed, and the other was that the institution involved should be both permanent and enthusiastic about participating in the breeding work. The Natural Lands Trust, in Pennsylvania, met both those criteria.

Their Director of Land Management, Richard Studenmund, and his Chief Forester and Assistant Director David Steckel, heard me talk last fall at the Morris Arboretum, and on learning that the American chestnut is indeed not a lost cause, approached me right after the meeting and expressed their serious interest in having the Natural Lands Trust take part in the breeding program. Such expressions of interest are fairly common, and always welcome, but what made the Trust stand out was that they didn't stop with just one statement of interest. They really were interested, and they made it clear by writing follow up letters and making phone calls to be sure I understood the seriousness of their intentions.

Consequently, we arranged to plant trees August 12th, after my family and I attended the conveniently nearby Annual Meeting of the Northern Nut Growers Association. On that morning I drove to the Reineman Wildlife Sanctuary, which is administered by the Natural Lands Trust. This private sanctuary is located just north of Carlise, PA, on the western slope of Blue Mountain, the first ridge of the Appalachians.

Everyone will remember this last August. It was Hot. And on August 12th it was going to be Hot, too. My family and I arrived there at about 9 o'clock, and were met by the caretaker, Lawrence Trout, who took me out to look at the planting site. It is beautiful. There is a large clearing in the forest there, from pre-wildlife preserve days, and they had moved a piece of it in preparation for the planting. Off to the west, the next ridges of the Appalachians were visible through the morning haze, their color a clear explanation of the mountain's name. Many old trees surround the opening; tall old trees that will shelter our chestnut planting from the north and east, so winter winds won't strike them too hard.

We went back to await the arrival of the rest of the planting crew, and they quickly appeared: Rick Harrison, our Foundation funded U. of Minnesota graduate student, who had driven the trees to Pennsylvania through the heat in an air-conditioned U. of Minnesota van. The back of the van looked like a jungle, packed with 52 of our hybrid trees, all growing in pots and ready to be transplanted.

The trees were in good shape, though some of the older trees were obviously getting tired of being kept in greenhouses; it looked like they were aching for the chance to sink their roots into real dirt. Many of the trees were young seedlings of this year, obviously had been growing vigorously in the greenhouse, and were ready for bigger and better things. Rick, who had charge of the trees this summer, gave them one last drink before the transplant.

Shortly thereafter, Rick Studenmund and Dave Steckel arrived, and I got my first shock of the day. In the back of their pickup were the digging tools. Now on my farm in Minnesota, when we want to plant a tree, all we need is a light shovel. There are no stones at all in most of my soils. In Pennsylvania, I found that the standard equipment includes reinforced shovels with fiberglass handles, and heavy iron digging bars. I dug a couple of holes, but the great majority were dug by the other members of the planting crew, using a technique that was novel to me. One man churns the stones with the digging bar, and the other lifts the loosened stones and soil out of the hole with the shovel. My father was born in Pennsylvania, but somehow neglected this part of my education. Don't get the idea that the soil there is not good; quite the contrary. Although it is so full of small stones that it would be hard to sink a shovel more than two inches into it without hitting something, between the stones the soil is wonderful, rich loam; just what the young chestnut trees should like. But making good holes in it is heavy work.

My wife Mary joined in, and as the others dug holes, she and I set the young trees into their new ground. As the day wore on, the sun rose higher, and it got Genuinely Hot. It almost seemed that the careful weeks spent acclimating the seedlings to the outside world would be wasted: we were planting them in what was apparently a duplicate of the climate in a tropical orchid greenhouse. The temperature was certainly in the high 90's, and the humidity the same. And there wasn't much wind, since we were down between the mountains, and sheltered by the trees. Exactly the kind of weather that makes plants grow like weeds, and makes people wilt.

Eventually my wife had to leave to see that our children didn't starve to death, but the rest of us elected to continue without any lunch, to get the job done. My two boys had spent a fair amount of time running to carry water to us; Larry Trout thoughtfully provided us with ice water to keep us from getting completely dehydrated. Now as we continued to plant, we eventually hit a point where we were exhausted from the heat and heavy work. We sensibly decided to quit for a few minutes rather than faint from heat prostration, and went into the shade of the trees. Within moments, a savior appeared in the form of one of the Natural Lands Trust foresters, come to report progress on a nearby logging operation. He brought with him a bag of tree-ripe peaches and nectarines. He very generously offered them to us, and we were not terribly slow in accepting. Those peaches put a lot of strength back in us. After a few more minutes of rest, we went back to finish digging and planting the last 5 holes.

Now in the middle of the afternoon, the heat and humidity continuing to build, we Suddenly heard a rumble of thunder. Looking up, we could see looming very large over the mountain a huge thunderhead, brilliant white above, a promising black below, and growing fast. We wondered whether it would reach us; aching for a break from the heat, and hoping for a little water for the trees. For the next ten minutes or so we would look up from our holes, watch the progress of the thunderhead, and hope a little more.

And then, literally when the last tree was put in the last hole, within 5 seconds the rain began to fall. It came gently for a couple of minutes, until the tree was planted and most of the tools collected, and then it started to pour. Since we were completely soaked with our own sweat anyway, none of us saw any point in running for shelter. The rain was warm, but cooler than the hothouse we had been dealing with, and everyone of us broke out in grins.

Good omens. We had just finished planting 52 small trees, with great hopes, and as soon as our work was done, nature took over. We had planned to water the trees well; Larry was getting ready to haul water to them, but now it would not be necessary.

We gathered up the remaining tools, moved to the edge of the forest to be less of an invitation to the lightning that was still striking occasionally, broke out a few cool beverages, and ate another peach or so, standing out in the rain, thoroughly enjoying ourselves. Amazing how much pleasure it is possible to get out of watching rain fall on young trees.

It was quite an experience for me. I confess there is something about a tree in a pot that rubs me the wrong way, like seeing a bird in a small cage. I can feel the roots straining at the sides of the pot. Most of the chestnuts I have seen in greenhouses have not looked very happy. And we do need trees growing where they can be unrestricted, in order to get the flowers and seed for the next generations. Putting these little trees into the ground with my own hands, many of them grown from nuts that I also made with my own hands, came pretty close to being a religious experience. I know I'm not supposed to anthropomorphize, but you could almost feel their sighs of relief as they came out of their pots. In a curious way, I could imagine the stimulus to the root tips, as they discovered that there was new, fresh soil surrounding them, and no longer any walls. We set the little trees free, to grow up and become whatever they can.

It was sad in a way, too, because I know that these particular trees will probably not live long, healthy lives. At the best these trees can have only half the disease resistance they truly need. But growing there, where they will be carefully cared for and protected, they will grow up, even though they will also blight at the same time. They can live and flower, though blighted, for many years. And in that time, we will take the pollen and the seed and use them to make the next generation of trees, closer to the resistant American chestnut tree we seek.

Standing with the others in the summer thunderstorm, with all the grime under my fingernails and covering my arms, with the sweat and rain running together down my face, there was a tangible sense of accomplish¬ment. Here were trees with known genetics, going into good chestnut land, being cared for on a permanent basis, by people who really understand. This is progress. And I hope you understand that you are a part of it, because you are making it happen.

Mr. Philip A. Rutter
President

The Ecology and Genetics of American Chestnut Sprouts on the Mount Holyoke Range

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ABSTRACT

Zone electrophoresis and root association analysis were utilized to clarify the developmental origin of Castanea dentata (American chestnut) sprouts on the Mount Holyoke Range in Joseph Allen Skinner State Park. Circular advancement from pre-blight root crowns, induced seed production from sprouts, vegetative propagation from the very small root crowns of post-blight seedlings, or a combination of the three processes may be the explanation for the existence of these sprouts.

INTRODUCTION

The American chestnut (Castanea dentata) was once a dominant tree in the eastern North American forest (Gleason and Croquist, 1964). Because of its abundance, beauty, strength, and rot resistance, C. dentata was widely used in early American carpentry. In Hadley, Massachusetts, tobacco sheds made from *C. dentata* are still standing today.

But the American chestnut, well loved and thriving, was attacked by a devastating fungal infection (chestnut blight). The first recorded infection of American chestnut trees by the fungus, *Endothia parasitica*, occurred in 1904 at the Bronx Zoological Park in New York (MacDonald et al., 1987). The fungus invaded the bark through small cracks and wounds, ultimately causing cankers in the outer bark which girdle the tree. The trunks and branches died during the process of girdling, but the root crowns often remained alive for some time on stored food materials. Chestnut blight destroyed most of the mature American chestnut tree population by the 1930's. However, *C. dentata* sprouts exist today throughout the northeast, and there are still uninfected trees in the midwest and pacific northwest.

In the summer of 1985, I worked on the genetics of *C. dentata* in Dr. Robert B. Merritt's population genetics laboratory at Smith College. It was there that I first became interested in the existence of sprouts on the Mount Holyoke Range and acquired a working knowledge of zone electrophoresis. I added some new gel stain schedules to the list prepared in the previous summers and deleted some which did not give me consistent results. Obviously, this list does not include stains for a majority of the loci in C. dentata and, therefore, the genetic data in this study can not be used as definitive evidence that two sprouts are genetically dissimilar.

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The frequencies of heterozygosity of three populations tested earlier seemed rather low and the frequency of heterozygosity in this study is very low. This low frequency of heterozygosity implies that one allele was predominant at a number of loci within isolated populations of sexually reproductive American chestnut trees before chestnut blight. This predominance of only one allele or lack of genetic flexibility may explain why the American chestnut was more susceptible than European chestnut, Castanea sativa. In areas where no mature trees exist today, such as the Mount Holyoke Range, American chestnut population genetics has been frozen in time at the point where sexually mature trees dropped their last seeds and died.

Paillet studied American chestnut sprouts in Andover, Massachusetts (1984). He found that a few sprouts were growing out of knobs from the ctimbium of decaying root crowns of original, pre-blight, canopy trees. He concluded that about 95% of the sprouts arose from pre-blight, suppressed seedlings. He also found rare instances of vegetative propagation due to layering and division of root crowns. I have combined a modified version of Paillet's root analysis method with my own electrophoretic method in an attempt to elucidate the issue of sprout origin. Root analysis in conjunction with mapping of sprouts will help determine whether or not sprouts are arising from root crowns. Electrophoresis will support the root analysis data by showing identical genetics between any sprouts which may arise from the same root crown or by showing dissimilar genetics between independent sprouts.

METHODS

Work sites were choosen by perusal of the vegetation for American chestnut sprouts. Two sites were chosen: one site on the lower slope contained fourteen sprouts in a concentrated area and two sprouts at a distance from the others; and another site on the upper slope consisted of sixteen sprouts. The sprouts in the lower area were labeled "LA#," and those in the upper area were labeled "UA#." Wood samples were taken by sawing small sections from any stumps which occurred near sprouts. The wood samples were placed in plastic bags and kept at room temperature for future identification.

Root association data were obtained by digging around the sprouts. An area of the forest floor corresponding roughly to the circumference of the sprouts' branches was cleared of leaves and fallen twigs. Digging was then begun with a large shovel to a depth of approximately 42 cm on the outer portion of the cleared circle. Fine digging with a hand trowel was done around the base of the sprout and contained outward to meet the circumference of large scale digging. In this way the root system was carefully and completely uncovered near the base of the sprout where one would expect to find connections to old root crowns. The surrounding area was churned up with the larger shovel to investigate the possibility of separation between sprout and old root crown or some lateral root connection between sprout and old root crown. Samples of underground wood and root material were placed in plastic bags and kept with the stump samples for later identification. After digging was finished, the dirt was filled in and carefully tamped down especially in the area around the base of the sprout. The forest floor liter, which had been piled near the digging site, was replaced and flattened down to restore the original appearance of the area and to minimize cold shock to the sprouts.

Twigs with dormant buds were snipped from sprouts and placed in marked bags. These twigs were later wrapped in wet paper towels, put back in the bags, and stored at 7 QC. After field work was completed, the twigs were used for zone electrophoresis analysis. In zone electrophoresis, proteins isolated from the plant are run through an electric current in a starch gel. The proteins move to certain points in the gel according to their molecular weight and charge. Staining the gel marks the location of a specific protein (enzyme), and assuming that one gene codes for one polypeptide chain, one can determine the genotype of the individual at the loci coding for the protein. Heterozygotes would show two bands corresponding to the two different alleles. Homozygotes would show one band corresponding to the two identical alleles. When heterozygotes and homozygotes are placed on the same gel, one can identify the homozygotes as "fast" or "slow" by comparing their bands with the two bands of the heterozygotes. A fast homozygote has a protein band which appears at the same distance from the origin as the farthest band of the heterozygote. If the enzyme consists of more than one polypeptide, the analysis becomes more complicated.

Dormant buds were excised with razor blades from twigs of a specific sprouts and placed in a small ceramic mortar. Liquid nitrogen was added to the mortar, and the buds were ground with a pestle until all the liquid nitrogen had boiled away. The chestnut bud flour was then ground with approximately 1 ml of Soltis' Tris-maleate grinding buffer-PVP solution at pH 7.5 (Soltis et al, 1983). The ground sample was placed in a tube and stored on ice until the rest of the samples were prepared. It was found that samples which were prepared in advance and frozen until they were assayed gave poor results.

Paper wicks were dipped into the sample-containing tubes and placed in the gel. Thus a loaded gel contained sixteen wicks each imbued with sample from one sprout. Each gel was run for a specific amount of time at a specific voltage or amperage and then treated with specific stains that react with specific proteins.

The wood and root samples were identified by shaving a smooth edge with a razor blade and examining the sample under a dissecting microscope.

Wood identification was based on the book, *Wood Structure and Identification*, by HA Core, W.A. Cote, and A.C. Day.

RESULTS

Lower area description and root analysis

- LA 1 was short and bushy and was approximately 0.6 m tall. No vestigial seed case was found.
- LA2 had a slightly crescent-curved major stem and was approximately 2 m tall.
- LA3 and LA4 were about 15 cm apart and were bushy. They were approximately 1 m tall. The two sprouts were connected underground and there was decayed red-brown wood or root material in the soil. The fine, younger roots from the sprouts seemed to be connected to some of the decayed material, but on laboratory examination, the roots were found to be growing through the decayed wood/root.
- LA5 was approximately 4 m tall. There was evidence of blight infection on some branches and some were killed. The growth was bushy at the bottom but normal at the top.
- LA6, LA7 and LA8 were all approximately 1 m tall and arranged in a crescent. LA7 had one blight-killed branch. The sprouts were all connected underground .
- LA9 and LA 10 emerged together from the soil. They exhibited normal growth form but grew parallel to the ground rather than upward. The sprouts were growing out of the same root.
- LA 11 was approximately 3 m tall and associated with a blight-killed sprout. Its growth was normal. LA11 was growing atop a large underground rock.
- LA 12 was bushy and approximately 1 .5 m tall. There was one larger main stem.
- LA13 was approximately 5 m tall with a canker half way up the main stem. Growth form was normal.
- LA 14 and LA21 were members of a crescent of three sprouts. One of the sprouts was blight-killed. Both LA 14 and LA21 were approximately 0.7 m high and very bushy. LA21 had what appeared to be a healed canker. An underground branch near the roots was identified as pine.
- LA15 was approximately 2 m tall and growing normally. It was located 10 cm from a large decaying stump. I dug under the sprout so that I could clasp my hands under it but there was no obvious connection with the stump. The stump was chestnut.
- LA 16 was bent to the ground by a fallen log and growing parallel to the ground in normal growth form. The sprout was about 2 m long.
- LA 17 and LA 18 were approximately 3 m tall and associated in a cresent

with two blight-killed sprouts of the same height. LA 17 grew at a 450 angle to the ground while LA 18 grew upright. The sprouts were associated with an abundance of underground, decayed wood/root some of which was identified as pine. There was no apparent connection between the sprouts and the decayed material. The sprouts themselves were connected at the root.

- LA 19 was about 2.2 m tall. Some of the branches were blight-killed. A blight-killed sprout of the same height and broken off at the top stood near LA 19.
- LA20 was approximately 1.2 m tall and showed evidence of three die-backs. The sprout grew straight from the ground for about 0.7 M. until a large knob on the stem was apparent with three dead shoots arising upward from the knob. The sprout continued to grow upward from the knob.

There were no apparent root crowns associated with any of the lower slope sprouts. LA 15 was the only genetically distinct sprout found in the lower slope study area. It was heteroxygous for one locus while the other 20 sprouts were homozygous for the same locus.

Upper area description and root analysis

- UA1 was approximately 1.2 m tall with two small suckers arising from the base of the sprout. An older blight-killed sprout arose from the same spot. UA 1 was probably connected to an old, decaying root crown of approximately 0.5 m diameter. The wood near the probable connection point was soft and crumbling. No growth knob, as described by Paillet (1984), was present. The sprout had its own root system which grew to the opposite side of the old root crown.
- UA2 was branching and approximately 3 m tall with one blight-killed branch. Possible healed cankers were apparent near the bottom of the stem. Dead wood lay near the sprout. The sprout was connected to the circle of a root crown. The root crown had no roots of its own.
- UA3 was approximately 4 m tall and very healthy. It was located approximately 0.5 m from UA4. Between the two sprouts was a large decaying root crown with no roots of its own. The root crown was excavated, and there was no apparent connection between any of the three. The root crown was identified as oak.
- UA4 was similar to LA20 in that a knob on the stem at the soil surface gave rise to two shoots. One shoot was healthy, and the other was blight-killed. See above for root analysis details.
- UA5 was fairly healthy and approximately 2 m tall. There was some underground wood, but no apparent root crown and no connection between the root system and the underground wood, which might have been chestnut.

• UA6 was approximately 3 m tall and associated with suckers. There was some underground wood and many rocks. A root crown was not apparent. The underground wood could be chestnut, but it was hard to identify.

• UA7 was bushy although light seemed to be available for normal growth. It was located near a stump, but there was no apparent connection between the two. There was no apparent root crown other than that of the stump. The stump was identified as chestnut.

• UA8, UA9, and UA 10 were all approximately 3 m tall and arising from the same blight-killed stump. The stump was approximately 10 cm in diameter-at-breast-height (dbh). There was no apparent root crown or any indication of decayed wood/root underground.

• UA 11 was associated with both an old dead sprout and a newly killed sprout. The newly killed sprout did not show any signs of blight but had withered leaves and buds. These sprouts were on the edge of the trail to the summit and could have been damaged by hikers. All sprouts arose from the base of a blight-killed tree. There was no apparent root crown, although there was some loose, decayed wood/root material in the soil.

• UA 12 was approximately 1.2 m tall and located near two stumps. There was no apparent connection with the two stumps and no apparent root crown other than those of the stumps. The root system of the sprout was on top of rocks. Both stumps were identified as chestnut.

• UA 13 was a healthy sprout of approximately 4 m. The root system spread out and down over the larger roots of nearby hemlocks. There was no apparent root crown.

• UA 14 was approximately 2 m tall with some dead branches. Suckers arose from its base and it was blighted. There was no apparent root crown.

• UA 15 and UA 16 were associated with a fairly large, topped snag. UA 15 and a blight-killed sprout arose directly from the base of the topped snag, which was approximately 15 cm dbh. UA 16 arose from the blight-killed sprout which was approximately 1.5 cm dbh. Thus the sprouts and the snag used the same root system. There was no root crown near this root system.

Upper slope trees were found to be genetically dissimilar to lower slope trees. • UA4, UA5 and UA 14 were distinct from other upper slope trees at one or two loci. They were also genetically distinct from each other.

DISCUSSION

One possible explanation for the existence of sprouts in areas where no mature trees are apparent is circular advancement. It is possible that the trunks of pre-blight canopy trees died leaving root crowns and root systems. Sprouts may have arose in a circle from the cambium of the root crowns and began to develop their own roots. The root crown may have begun to decay as the sprouts grew. As decay continued, a circle of sprouts with independent root systems may have been formed. These sprouts could then have contracted blight and died back to their small root crowns, which were probably no more than 2 cm in diameter. New sprouts would have arisen from the cambium of these small root crowns. As the cycle continued, sprouts would be scattered in circular increments across the forest floor.

This explanation can be supported by the high genetic similarity within each of the two sites and by the fact that there seem to be clusters of American chestnut in a wood otherwise filled with hickory, oak, hemlock, and beech. UA2 and probably UA 1 arose through vegetative propagation from root crowns of 0.5 m diameter. The Mount Holyoke Range is known for its high frequency of vegetative propagation in other species of trees. Suckers arising from the base of blighted UA 14 support the idea that new sprouts on the periphery of a dying tree take over as the tree succumbs to blight. Beyond these few pieces of evidence, however, there is little to support the idea of circular advancement.

Although the sprouts are highly similar within the upper and lower areas, they are not completely similar. There are three genetically unique sprouts on the upper slope (UA4, UA5, UA 14), and one unique sprout on the lower slope (LA 15). If the sprouts in either area were clones arising from circular advancement of a single pre-blight canopy tree, the genetics of all sprouts would have to be exactly the same. It is important to keep in mind that high similarity was found between American chestnut tree populations in different states in a previous study.

A map of the sprouts does not support circular advancement. One would expect to find older sprouts or no sprouts at all at the center of a cluster and very young sprouts at the periphery. This arrangement of size was not found. Some sprouts such as LA 11 are found atop rocks. This position would rule out the possibility of vegetative propagation from a root crown cambium. LA 15 is not arising from the large stump just a few centimeters away. UA 15 and UA 16 are isolated from the other sprouts of the upper area by a large steep cliff of rock.

Although the sprouts, UA 1 and UA2, support the idea of vegetative propagation from root crowns, 5% of the sprouts surveyed were not connected with the root crowns found near them and the remaining 88% had no root crowns near them although 23 % were associated with rotted wood fragments that could have been root crowns at one time. There is not one case of association with root crowns in the lower area. It would seem that if circular advancement were occuring, the youngest sprouts in both areas would still be connected to the root crown from which they were sprouting.

If sprouts did not arise from circular advancement, another option is that they came from seeds. Seed origin seems implausible since there are not mature trees in the two areas. However, Gleason and Cronquist write the following about American chestnut: "Sprouts still come up from some of the old roots which had not yet decayed and, since they are already old plants, sometimes bear a few nuts." In light of this idea, the 15 cm and 1 0 cm diameter snags at UA 15/16 and UA8/9/10 respectively, might have been able to produce several nuts. There may have been other such snags on the lower slope beyond the study area which could have produced a few nuts.

The electrophoretic data on the upper slope area shows that there are four distinct genotypes. One contains ten individuals. The other three contain one individual each. A cross between the genotypes of UA 15/16 and UA8/9/10 would give all the other genotypes observed except that of UA 14. The electrophoretic data on trees in the lower slope study area shows two distinct geneotypes. One contains fifteen individuals while the other contains one individual. Mendelian ratios would not be expected because the number of individuals in the study is too small. All lower area genotypes could be obtained from a cross of UA 15/16 and UA8/9/10 except LA 15. Since there are no heterozygous malate dehydrogenase loci in the lower area while there are many in the upper, it is probable that lower area seeds were produced by parents on the lower area.

UA2 and possibly UA 1 are connected to rotting root crowns of approxmately 0.3 m diameter. These root crowns might be remains of the last seedlings (post-blight seedlings) from those trees which were mature when the blight first hit Mount Holyoke (pre-blight trees). These seedlings probably started growing in the late 1920's and grew until the late 1940's when they contracted blight. They might have finally died in the fifties leaving thirty years for the seedlings to topple and the root crown to decay to its present state.

Where did UA8/9/10 and UA 15116 and the proposed parents of the lower area come from? They may be the sprouts of pre-blight trees whose root crowns have decayed before the root crowns of the post-blight seedlings at UA2 and UA 1 decayed. The pre-blight tree root crowns probably began the proposed decaying process 20 to 30 years earlier than the post-blight seedling root crowns.

Neither circular advancement nor seed production from induced seedlings explains all the data. If one assumes that the sprouts seen today have been living in a suppressed sprout stage for some time, sprouts on the Mount Holyoke Range are probably the result of vegetative propagation from blight-killed, post-blight seedlings whose root crowns were so small that they rotted away quickly leaving the sprout with an independent root system. This explanation would account for a low genetic diversity seen as well as the lack well as the lack of root crowns. A few sprouts might be the result of induced seed production as described by Gleason and Cronquist.

Some other points of interest which were not relevant to this study were uncovered. UA2 and UA21 seem to have healed blight scars and UA4 may be exhibiting soil inhibited blight. It would be interesting to look for hypovirulent E. parasitica in these sprouts.

ACKNOWLEDG EM ENT

Special thanks to Dr. John C. Burk for advising and directing; Dr. Robert B. Merritt for the kind use of his electrophoresis laboratory and numerous discussions; Abigail Zoger for field work hints; Tracy Kope, Robin Howell, and Karen Cuchel for transportation; and Alice Christian for expert teaching of XIWRITE.

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Genetic Diversity in Post .. Blight Populations of American Chestnut: Past, Present, and Future

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ABSTRACT

Recent investigations demonstrate that American chestnut root sprouts are an important component of deciduous woodlands in southern New England more than 50 years after the first appearance of chestnut blight. Observations on the growth form and ecology of chestnut sprouts in modern forests indicate that these sprouts exhibit specific adaptations for survival of the subcanopy over extended periods. Various lines of evidence are used to conclude that the surviving population of sprouts represents a large percentage of the seedlings established in the years before loss of the chestnut seed source. Most of the original diversity of pre-blight chestnut populations probably still exists within the remaining populations of sprouts. Analysis of the interaction between sprouts and blight appears to indicate that there has been little selection for blight reisistance, and at most moderate selection for sprouting traits favorable for competition with shrubs. Estimates of recent rates of chestnut sprout mortality indicate that a genetically diverse population of sprouts with low blight resistance is likely to exist for at least another century, and possibly much longer.

INTRODUCTION

Most introductory textbooks on forest ecology describe the American chestnut (Castanea dentata (Marsh.) Borkh.) as a nearly extinct species because of the introduction of chestnut blight at the beginning of this century Hepting, 1974). One major text on plant geography (Gleason, 1964) even uses the case of chestnut destruction by blight as a prominent example of ongoing extinction. The expectation that chestnut will never be important in North American forests appears to be based upon sound ecological principles. According to the classical theory of competition, the nearly complete lack of sexual reproduction and the inability to attain a canopy position put the American chestnut at an extreme disadvantage. Even if these disadvantages could be surmounted, the regular destruction of a significant part of chestnut biomass by blight girdling still would be nearly impossible to overcome. For these reasons, the remaining chestnut sprouts still alive in eastern forests have been viewed as the last remains of preblight chestnut, representing the limited number of trees originally disposed towards more prolific sprouting. In the future, even this limited population would disappear through the combined effects of repeated blight infection and occasional attack by other pathogens, and the inability to compete with other subcanopy vegetation.

In spite of these predictions of American chestnut extinction, chestnut sprout populations appear to be increasing as a percentage of total stand basal area rather then decreasing. Chestnut is an important part of the modern forest today (1987), with densities approaching several hundred individual sprout clones per hectare in many oak-dominated woodlands (Paillet, 1984; McCormick and Platt, 1980). Quantitative data on this supposedly unimportant species are hard to find, but some detailed studies show that chestnut populations are increasing in both number of stems and percentage of total stand biomass (Stephens and Waggonner, 1980; Adams and Stephenson, 1983). These unexpected results indicate that the interaction between living sprouts and blight is much more complicated than originally envisioned. They also indicate that chestnut is likely to be an important part of the ecosystem for a long time into the future.

This paper considers the implications of the latest studies of chestnut ecology on the efforts either to breed blight-resistant strains of American chestnut, or develop an effective means for ameliorating blight in natural chestnut populations. How much of the original chestnut gene pool is likely to exist in the future, and how long can that level of diversity persist in the presence of blight? These are relevant questions for scientists attempting to develop blight-resistant chestnut strains. These questions also relate to current efforts to reestablish chestnut once the blight problem has been surmounted, or blight-resistant chestnut strains have been developed.

CHARACTERISTICS OF CHESTNUT-SPROUT POPULATIONS

The abundance of healthy chestnut sprouts in eastern forests after more than 50 years of blight indicates that chestnut root sprouts are effective competitors with shrub and subcanopy tree species (Stephens and Waggoner, 1980). This observation is remarkable, because chestnut is considered a relatively intolerant tree species adapted for competition with canopy dominants (Paillert 1982, 1984). Examples of typical chestnut sprouts observed in 1983 are given in Fig. 1. Observations indicate that the subcanopy chestnut stems are destroyed periodically by blight, so that successful competition with shrub species that are unaffected by such a disease seem unlikely. Since chestnut sprouts now are abundant,· and chestnut biomass appears to be increasing, what factors account for the increasing amount of chestnut in the forest? Are there forms of vegetative reproduction that allow sprout clones to expand, such as those described for Corylus (Tappeiner, 1971). If vegetative reproduction is important, the asexual reproduction of sprout clones could mean that the surviving chestnut gene pool is limited, in spite of the large population of living sprouts.

In a study of chestnut populations in northeastern Massachusetts, Paillet (1984) concluded that any apparent increase in chestnut-sprout biomass was being produced by increasing numbers and size of existing sprout root crowns. This conclusion was based on a number of independent observations. No signs of root sprouting away from the root crown were observed, and early literature indicated that chestnut was not known to root-sprout in a manner similar to beech and aspen (Zon, 1904). Examination of the relation between old chestnut stumps and living sprouts showed no clustering of sprouts around the old stumps, except for a few sprouts clearly associated with the root crown of the stump. Many living sprouts were found on sites that were recently abandoned fields at the time of chestnut blight appearance, far removed from any large chestnut trees, but where chestnut seedlings probably were established.

Results given by Paillet (1984) and Zon (1904) lead to two major conclusions about modern chestnut sprouts: (1) Almost all living sprouts originated as sprouts from seedlings rather than from former canopy trees; and (2) each of these sprouts is a genetically distinct entity, because little or no asexual reproduction beyond root crown expansion has occurred. These results are significant because the great abundance of living sprouts would indicate that a major portion of the original chestnut gene pool still is alive in the forest. These results do not mean that living sprouts are not still attached to the root crowns of former canopy dominants. Such sprouts from mature trees can be found, but they are a very small percentage of the existing population. These stump sprouts generally appear less vigorous than seedling sprouts in accordance with the documented decrease in vigor of chestnut sprouting with age (Zon, 1904).

An example of high density of chestnut sprouts in New England, and the small proportion of those sprouts that are associated with pre-blight canopy trees is given in Fig. 2. However, other locations can be found where there are abundant remains of pre-blight chestnut trees, and yet very few living sprouts. (Fig. 3). In some cases, the history of land use clearly rules out the possibility that chestnut arose from the root system of canopy trees. The relatively high population of chestnut sprouts living today, and the observed low incidence of recent mortality, indicate that the high densities of living sprouts are produced by the survival of a seedling population established in the years before blight introduction. If this hypothesis is correct, many places exist in which the pre-blight gene pool remains nearly intact, which is good news for chestnut breeders.

INTERACTION OF CHESTNUT SPROUTS AND BLIGHT IN MODERN WOODLANDS

One objective of current research on chestnut ecology is understanding those factors accounting for chestnut sprout survival in competition with shrubs in spite of periodic blight infection. Has the interaction of blight and sprouts begun a natural selection of blight-resistant chestnut strains? All those chestnut sprout clones that might have been especially susceptible to blight could have been eliminated in the first years after the appearance of chestnut blight, when the density of spore-producing fungus infecting the large number of pre-blight chestnut trees would have been high. However, results described by Paillet (1984) indicate that natural adaptations of sprout growth form and root-crown structure combine to minimize the destruction of chestnut biomass where competition is most severe. Paillet (1984) proposed that natural controls on the expenditure of resources accumulated over long periods prevented extensive growth under unfavorable light conditions. For example, a large percentage of the chestnut clones plotted in Fig. 2 were less than 1.5 meter tall in 1983, and exhibited only a few cm of growth per year over the previous growing seasons. These small, slowly-growing stems appear to present little opportunity for blight infection.

The growth-control mechanism described by Paillet (1984) appears to be the primary cause for the minimal effects of blight on populations of chestnut sprouts. Blight infection is rare under those conditions when sprout root systems are under the most stress. When chestnut sprout stems are released, stored resources are transformed into above-ground biomass, and rapid stem growth occurs; blight infection follows in a few years. However, these events take place under favorable conditions. Chestnut root systems resprout rapidly after stem girdling, and new sprouts usually survive under prevailing light conditions. The implication of these observations is that sprout clones survive blight because of preadaptations related to subcanopy competition, and not blight resistance. This process is not likely to select for blight-resistant strains of chestnut, but may have produced a selection for vigorous sprouting in the decade after the first appearance of blight in New England.

CHESTNUT SPROUT POPULATIONS IN NEW ENGLAND - DISTRIBUTION AND RELATIONSHIP TO SITE CONDITIONS

Many previous studies have shown that chestnut sprout clones are consistently present in the understory of southern New England forests. However, there are some locations where logs and stumps indicate chestnut was a major component of the pre-blight stand, but that chestnut sprouts now are rare or entirely absent (Paillet, 1987). Living sprouts may have died out on these sites in the years since original blight infection. On the other hand, several factors indicate that the absence of chestnut sprouts in certain areas may mean that conditions were unfavorable for chestnut seedling establishment on these sites in the years before the loss of the chestnut seed source. Early studies of chestnut seedling distribution also refer to chestnut stands where seedlings were rare or absent (Zon, 1904). The survival of dense populations of sprouts in many locations indicates that large populations of sprouts could have survived in similar woodlands elsewhere in New England. In those places where chestnut sprout distributions have been mapped, sprouts appear concentrated along old roads, woodland edges, fence rows, and the edges of marshy areas (Paillet, 1987). These sprout locations generally represent areas offering cover for rodents and corvids responsible for the dispersal of chestnuts, and protection from livestock foraging and trampling. Jaynes (1967) noted a similar concentration of Chinese chestnut seedlings along a stone wall adjacent to a modern orchard of these introduced trees. A typical example of the irregular distribution of chestnut seedlings in the years before the introduction of blight is given by Thoreau's observation that chestnut seedlings were more common under the cover of pines in abandoned fields than under mature oak and chestnut stands (Thoreau, 1906).

The one condition that does appear to have affected chestnut sprout survival is the dense shade produced by hemlock-dominated woodlands. Shade-tolerant hemlock is slow to invade deciduous woodlands when hemlock is originally absent, but it can dominate stands free of disturbance for extensive periods if hemlock stands mark many of the small woodlots that existed in the early nineteenth century before the downward trend in agricultural activities produced large-scale land abandonment (Spurr and Barnes, 1983; Cronon, 1983; Whitney and David, 1986). These same woodlots also contained many chestnut trees. The remains of those trees still can be found, either as fallen logs or sawed stumps. Some of these old woodland remnants now contain a very large percentage of hemlock. The understory of such hemlock-dominated stands appears barren, with no shrubs and only a few of the most shade-tolerant ferns and herbs. Chestnut sprouts may have been eliminated from the understory of these stands. However, a few living sprouts have been found under dense hemlocks on the Prospect Hill Tract, Harvard Forest, Petersham, Massachusetts. Very few remains of previously-killed chestnut seedling sprouts can be found in these stands. Therefore, the lack of living sprouts in the understory of hemlock-dominated stands may be related to the original unsuitability of such sites for seedling establishment, in accordance with the low density of chestnut seedlings found in mature woodlands by Thoreau (1906).

POST-BLIGHT SELECTION FOR SPROUTING CHARACTERISTICS

The importance of root-crown sprouting in the survival of chestnut sprouts may indicate that the ability to resprout after blight infection is an important genetic trait. Perhaps the continued presence of blight has resulted in selection for sprouting ability instead of blight resistance. If this is the case, weakly sprouting chestnut clones have probably been eliminated from the population, because all modern sprout clones appear to resprout vigorously after destruction of the main stem. The possible selection for sprouting ability could have produced an associated elimination of characteristics related to rapid growth into the canopy, a highly desirable silvicultural characteristic.

The ability of chestnut seedlings to resprout is apparently a critical factor in the reproductive strategy of chestnut. Hibbs (1983) showed that seedling sprouts play an important part in natural forest regeneration in New England following disturbance such as windstorm and fire. Paillet (1984) described the appearance of chestnut root crowns, showing that most sprouts originate from preformed buds established on the periphery of the root-crown (Fig. 4a). Paillet (1984) hypothesized that the natural growth form of suppressed chestnut sprouts relies on hormonal control of bud release. As long as the main stem remains healthy, root crown buds either do not activate, or fail to continue vigorous growth after the first season. Slow deterioration of the dominant stem eventually allows release of one or two of the suppressed buds, and they in turn assume control of the clone. Under favorable conditions, this cycle of bud control and release provides a single healthy stem with a minimum of resource expenditure.

In contrast to natural suppression and understory competition, blight destruction of the main stem results in sudden release of all basal buds, producing the shrub-like growth form associated with many blight-infected chestnut clones (Fig, 1 d). After chestnut root-crowns resprout, new root-crowns form around the base of the surviving sprouts. This process is probably the only significant mode of asexual reproduction of chestnut occuring today; an extreme example is illustrated in Fig. 4b.

Early observations of chestnut root-crown sprouting appear to indicate that all chestnut seedlings are capable of resprouting vigorously. Early chestnut literature indicates that sprouting ability decreases with age, and that old coppice sprouts lose their ability to resprout earlier than stems originating from seedlings (Zon, 1904). However, Paillet (1984) indicates that the chestnut sprouts form new root-crowns shortly after resprouting, and these new root-crowns appear to resprout as vigorously as the original root-crown. The continued vigorous resprouting of multiple generations of root-crowns is demonstrated by the repeated resprouting of chestnut clones in New England nearly 70 years after the first incidence of blight. Variations in size of root-crowns and number of suppressed buds have been noted; these variations may be related to the genetic character of the sprouts. Such differences are more likely related to the history and types of injury experienced by the individual sprout clone. These observations indicate that the characteristics related to sprouting may have influenced the selection of chestnut sprouts that survived after the first appearance of blight. However, the large surviving populations of chestnut sprouts and the apparent lack of diversity in the ability of individual clones to resprout indicate that such selection has not been significant.

CHESTNUT SPROUT MORTALITY AND PROJECTIONS FOR THE FUTURE

Various lines of evidence have been used to hypothesize that a large percentage of the chestnut seedlings established in the year before the first appearance of chestnut blight have survived in the understory of postblight forests. This survival rate has not been an accident; it has been the direct result of adaptations for subcanopy competition underless-thanideal light conditions. The continued presence of blight does not seem to have had a direct effect in the selection of clones with ability to resprout. Local absence or scarcity of modern sprouts appears to be explained best as the result of poor conditions for seedling establishment in the years before the loss of the chestnut seed source, rather than a high mortality of sprouts since then. All these observations appear to indicate that chestnut sprouts will continue to be an important part of eastern forests for many years to come in spite of the lack of sexual reproduction.

Estimates of the potential life expectancy of the surviving population of chestnut sprouts can be made from observations on the extent of sprout mortality in post-blight woodlands. Several completely dead sprout clones are indicated in Fig. 2. All but one of these clones had been dead for many years in 1983. The one recently killed chestnut clone appeared to have died under the combined effects of rapid release, blight infection, and canopy reclosure. This clone hadresprouted after the main stem was killed, but the new sprouts had been reinfected, and light conditions had deteriorated because of competition from adjacent maples. The combination of resource loss through destruction of the main stem by blight and the stress of heavy shade produced by canopy reclosure appears to have caused the death of this clone.

Stresses related to the combination of the effects of blight destruction of stems, of canopy closure, and of increased subcanopy competition apparently can combine to destroy blight clones. Mobilization of stored resources triggered by sudden improvements in growth conditions appears to be part of the chestnut reproductive strategy (Paillet, 1982). The expenditure of resources in rapid stem growth can make blight girdling a more destructive occurrence. At the same time, improved conditions stimulate intensive shrub competition and canopy reclosure. The changes in growth form associated with chestnut-stem release and blight infection are illustrated in Fig. 5. This example represents chestnut response to oak destruction in mature forests of Connecticut, described by Paillet (1982) and Dunbar and Stephens (1975).

Observations on the evolution of chestnut stems in gaps produced by oak mortality indicate that all released stems are destroyed by blight 3 to 6 years after release, and that from less than 5 to more than 10 percent of the clones are completely killed by the combined effects of blight reinfection and resuppression. The clones most likely to be killed are intermediate in size: the smallest and slowest growing clones are not subject to strong release, and the largest clones appear to have enough resources to deal with increased environmental stress. Major release events associated with canopy replacement may have a more severe impact on chestnut sprout populations than many decades of suppression. Several such events might produce a significant reduction in the chestnut sprout population. However, almost all forests in New England have experienced at most one of two such canopy replacements since the first incidence of chestnut blight.

These preliminary results indicate that chestnut sprout populations experience less than 3 percent mortality per decade in the understory of undisturbed woodlands, and approximately 10 percent mortality per decade of major canopy disturbance. These losses of individual chestnut clones are completely offset by the increase in size and number of stems of the remaining clones in the long-term records given by Stephens and Waggoner (1980). Most modern woodlands in southern New England originated after clearcuts or land abandonment. Conditions have remained relatively stable in these woodlands until the maturity of the current stand of oak-dominated trees provided major disturbances. The major episodes of oak mortality experienced in Connecticut may be just the first of many future episodes as the present forest matures (Stephens and Waggoner, 1980). Chestnut-sprout mortality may increase as more of the original old-field oaks succumb to disease, and as chestnut sprouts are subjected to the combined effects of resource mobilization during release blight infection, and increased competition with other understory species. Data given by Stephens and Waggoner (1980) indicate that this increased mortality will apply to the intermediate, medium moist sites where oaks grow the fastest, and canopy trees already have approached maturity. Frequency and severity of canopy disturbances will be much less on drier sites where oaks area less mature, and site conditions do not encourage rapid release of chestnut sprouts.

Even in the most severe instances of chestnut-sprout mortality related to release and resuppression, the observed rate of chestnut loss is not large enough to preclude chestnut-sprout survival for at least another century. Probably the single largest loss of chestnut-sprout clones in suburban New England today (1987) is the destruction of woodland for housing and other development. The nearly complete lack of sexual or asexual reproductions other than root crown sprouting indicates that no source of new chestnut clones will be available in the future unless blight is brought under control. However, the observed increases in the average size of surviving clones, and the records of clone survival over more than 70 years since blight introduction in New England, indicate that significant populations of genetically distinct chestnut clones probably will be present for at least another century, and perhaps far longer.

CONCLUSIONS

Recent observations on the growth form, distribution, and life cycle of American chestnut sprouts result in two important conclusions for the plant geneticist attempting to reestablish that species: (1) A large percentage of the pre-blight genetic diversity in chestnut probably still exists; and (2) significant natural selection for blight-resistant sprout clones probably has not been occurring. These conclusions are encouraging to plant breeders, in that a large amount of genetic material is available for experimentation. However, it is possible that the significance of resprouting in the perpetuation of sprout clones may have begun to select for clones with the ability to resprout vigorously. If this is the case, the otherwise low mortality of surviving sprouts may have begun to eliminate chestnut clones with the desirable capability of rapid growth into the canopy.

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FIGURE 1

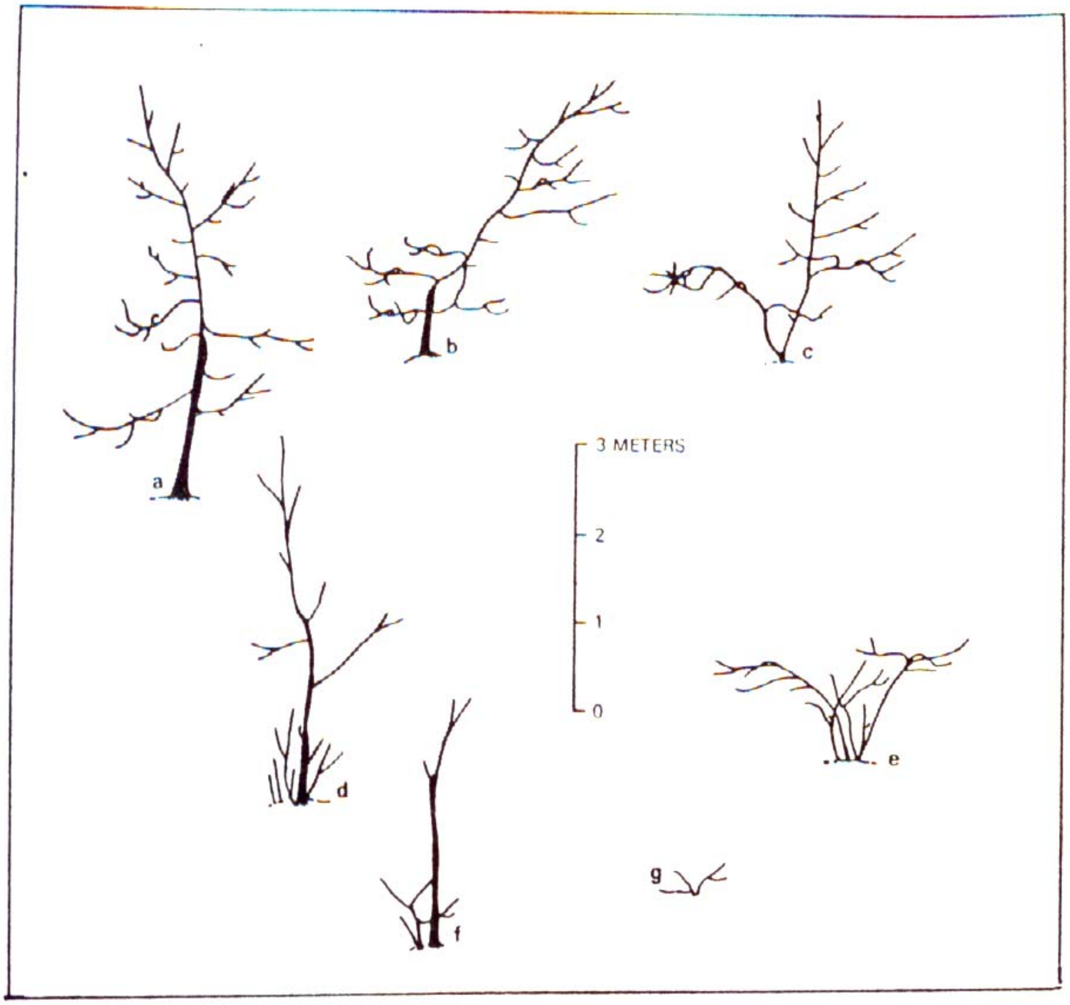


FIGURE 1 : Typical appearance of suppressed chestnut sprouts in New England : sprouts a-b have been free of blight for decades, d-f have suffered recent infection, and g has produced little new growth since severe blight infection many years ago: reproduced from Paillet (1987)

FIGURE 2

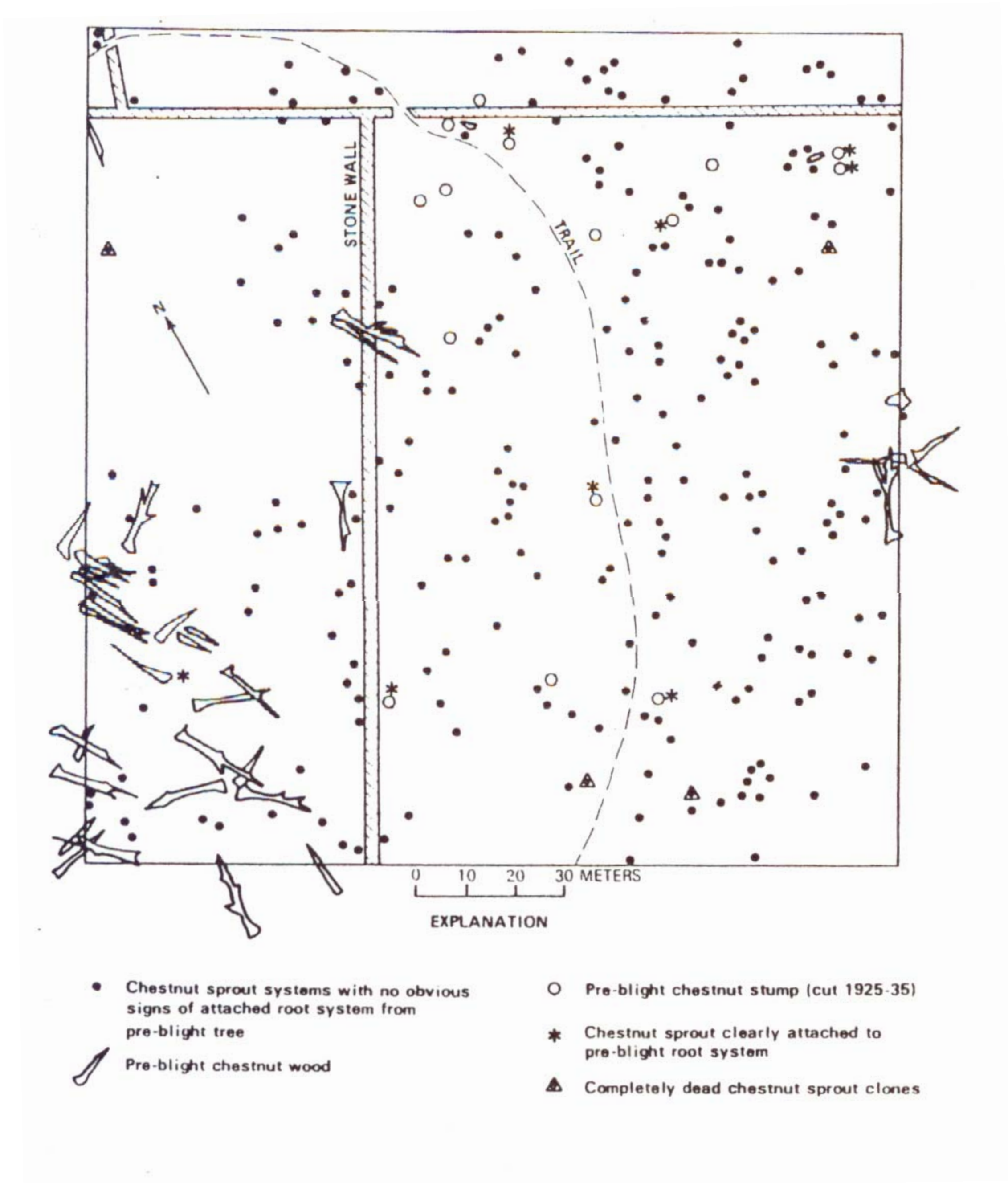


FIGURE 2 : Example of high chestnut sprout densities in oak-dominated deciduous woodland: Andowver, Massachussetts: from Paillet (1984).

FIGURE 3

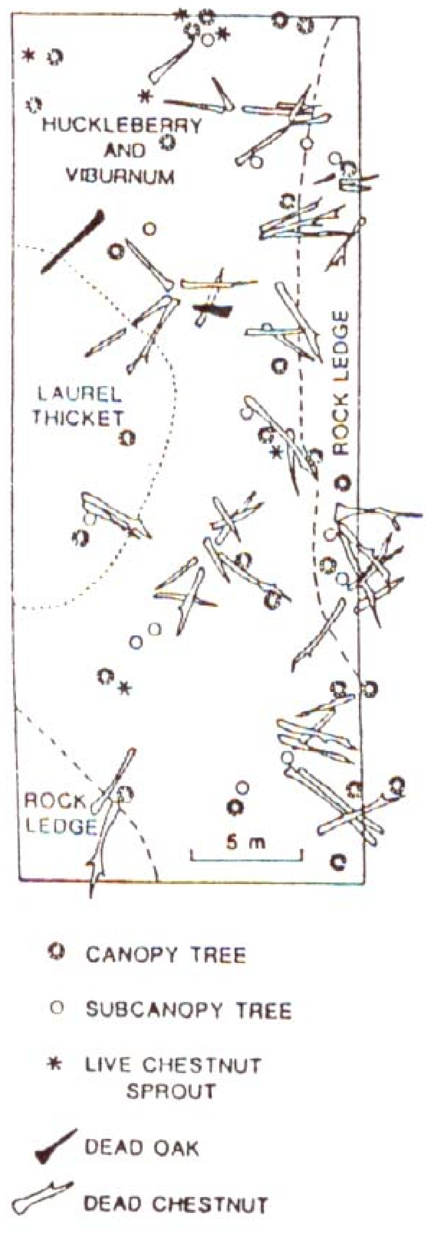
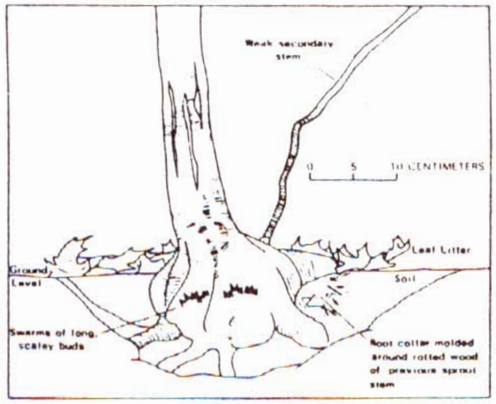
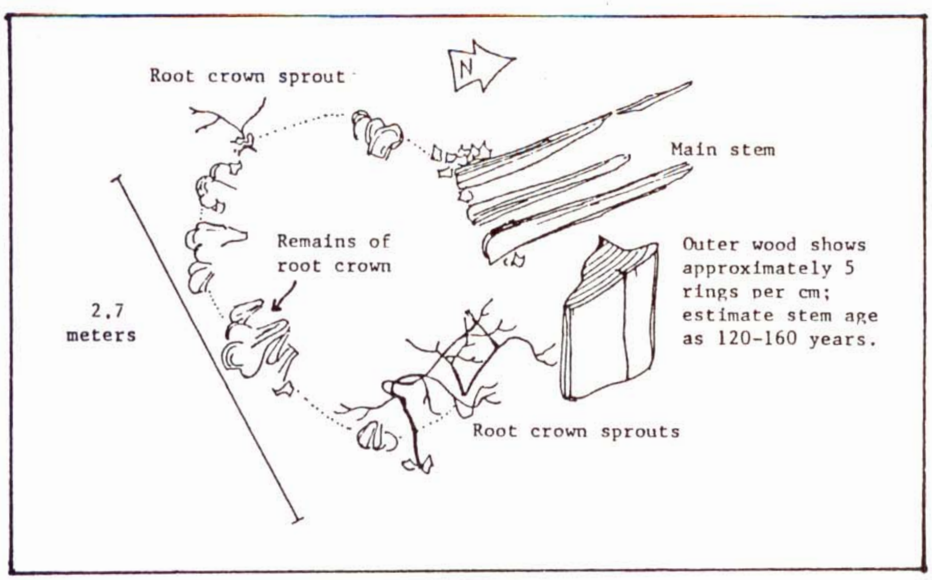


Figure 3 : Distribution of large chestnut trees killed by blight and surviving chestnut sprouts on a rocky ledge: Cockaponset State Forest, central Connecticut (Paillet 1987).

FIGURE 4



a) Typical appearance of root crown of suppressed chestnut seedling sprout (Paillet, 1984).



b) Living root crown sprouts associated with remains of massive root crown of former pasture chestnut.

FIGURE 5

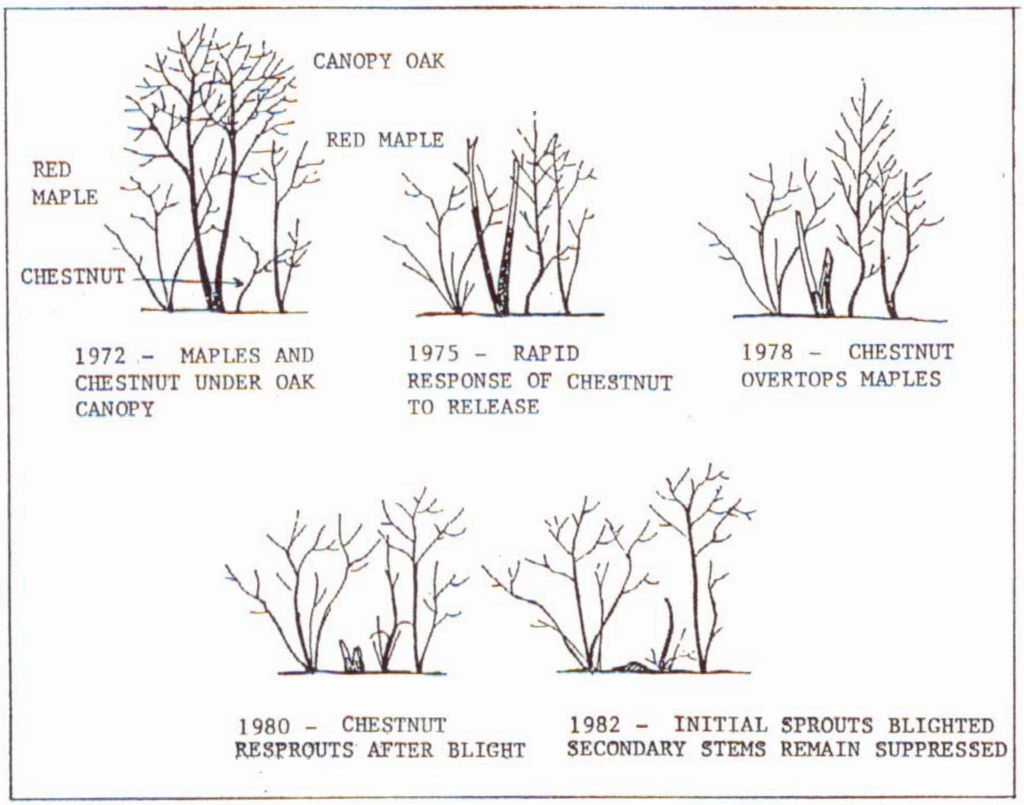


FIGURE 5 : Chestnut sprout form during typical cycloe of release, blight infection, and resuppression

FOUNDATION NEWS

Formation of State Chapters Authorized

After more than two years of discussion by the Board of Directors, the Foundation has now authorized the formation of state chapters, modeled after those of the Audubon Society. We believe state chapters will contribute to the restoration of the American chestnut in many important ways. There is no substitute for local expertise, both when it comes to knowing where interesting trees are and in understanding state politics. Other conservation organizations have shown the way. The Nature Conservancy has state chapters that find special lands, and the local support necessary to preserve them; Ducks Unlimited has raised millions of dollars for the protection of wetland and waterfowl, and for research. These organizations are notably successful. There is no reason why we cannot learn from their success, and apply that knowledge to our own needs. The American chestnut, once vital to many different wildlife species, and to the economies of many states, deserves and can generate similar support.

The basic plan authorized by the board is for state chapters with as much, or as little, autonomy as they desire. State groups may wish to incorporate separately and raise funds to stimulate research within their own state universities, or fund their own research programs. Or alternatively, they may wish to participate in the national effort. There is room for both paths.

One problem with progress in tree research is that the goal is apt to take more time than a single human individual has. If an interested person makes a serious planting on his own land, it is difficult to be sure it will survive the next ten years, let alone the 20-30 that may be needed, since divorce, illness, and unexpected death are not occasional but unfortunately certain occurrences. An organization is necessary. And while the Foundation is here to stay, the scope of the project is very large. There is a real need for help from the different regions where chestnuts grew .

Some specific suggestions:

- If a state group decides they would like to solicit donations of land, and own land themselves, this is quite permissible, although they would need to incorporate and receive federal tax-exemption independently of the Foundation. Sometimes this may acutally be eaiser than for the national organization to accept donations of land, as state laws regarding such ownership are quite variable. There is a safeguard provision, so that if through ill chance a state organization should dissolve, perhaps through loss of a crucial leader, then assets such as land holdings would revert to the national organization: this will assure that trees and breeding projects underway on such lands will not be lost.

•Political action is possible. If enough citizens are organized and persistent, it may be possible to move state agencies to take more interest in chestnut research. Such action must come from within a state, however; advice from a national organization may be perceived as slightly improper "outside pressure." Here is a field where only state chapters can be effective.

•Short of actually running their own independent breeding and research programs, state groups could organize to help out with the national research and fundraising efforts. Trees will need to be tested in many localities, and help will always be needed to care for and monitor such plantings. When we do get our Research Center, we will have to do serious fundraising to see it properly endowed. We will need your help.

•Collections of historical stories and facts about chestnut is also best done on a regional basis - documentation of the special nature and worth of the tree is invaluable in garnering support.

•Education programs for local schools - a whole generation is growing up not knowing what we have lost, or that we can regain it. State chapters could provide written material and talks by those who remember the tree. The lessons on conservation to be learned should be welcome, and the effect on young minds vital.

•A special, specific type of planting that could be undertaken immediately is the transplanting of surviving pure American chestnut sprout systems into useful, accessible, breeding orchards. This is described in detail below.

•And more - probably by now the reader has thought of several additional projects that would make sense for a state chapter. Chestnut festivals could be very effective ways to integrate fun, fundraising, education, food, and support for the chestnut orchardists now starting to grow more nut crops. Once people are involved in projects right within their own state, support and ideas will grow.

If you are interested in organizing a chapter for your state, please write or call President Rutter, Badgersett Research Farm, RR1, Box 118, Canton, MN 55922; phone (507) 743-8570. He will provide you with a list of Foundation members in your state, a copy of our Guidelines for forming and running state chapters, and as much help as possible. There is already considerable interest in New York and Tennessee. We hope to be able to report the actual formation of the first chapter soon.

TRANSPLANTING CHESTNUT SPROUTS FOR BREEDING STOCK

Currently, to find good American chestnuts to use in crosses, breeders have to travel about 50 miles between trees. This eats up money and valuable time during the breeding season, and makes it hard to know when a particular tree should be visited.

The root systems of chestnut sprouts surviving from pre-blight days are transplantable; folks have done it successfully many times. Such sprouts, found in the wild, are definitely pure American chestnut, which may not be true of trees found near cities, or even seed from the occasional American sprout which gets large enough to bear - the majority of chestnut pollen in the air today is Chinese. It is best to be sure.

When surviving sprouts are transplanted and grown in full sun with no competition from other trees, they produce plenty of pollen and nuts, even though blighted. Maintaining them as multi-stemmed "bushes" rather than single-trunk trees enables them to survive blight infections quite well; while two stems may be dying, perhaps three more will still be healthy, and several new replacement sprouts will be growing up. The reason this seldom happens in the wild is that other trees eventually shade them out. It appears that such multi-stemmed plants can tolerate either blight, or shade, but not both. They won't be very pretty, but they will be extremely useful.

This strategy will give us collections of certifiably pure American chestnut, from known regions (to preserve genetic diversity), all in one place, where it can be worked with. When they start to flower, several years after transplanting, they can be used as the American parents for the breeding program: pollen from them can be shipped to other breeders, or pollen from strains carrying the genes for blight resistance can be put on these trees. Being able to go to one or two sites and make crosses on 50 or 100 trees, instead of 2 trees, would be a very significant advance. We would like to have state chapters make such plantings in protected places, and individuals could make them on their own land, too. There are literally millions of sprouts, and no danger of damaging remnant populations by transplanting a few.

Such plantings may also be of value for testing new developments in hypovirulence. Any new, hopeful, hypovirulent strains will need testing under controlled conditions in different regions, as well as in the forests.

The best strategy for finding appropriate sprouts to transplant would be to do it as "plant rescue" - find land scheduled for development, where the sprouts would soon be destroyed anyway, and get permission to move them. Never dig up sprouts without ful/legal permission! Done properly, such efforts can make good publicity, for the chestnut and the developer too. Perhaps then the developers could lend you a backhoe for a few hours. Sprouts are often found in very stony soils, and the digging can be hard. Small root systems are much easier to move, and have a better chance of survival. Once put in full sun, even small sprouts should grow strongly.

To be of any real use plantings must be made with meticulous record-keeping. Haphazard moving of trees is useless, and possibly destructive. Each tree should have its history and origin written down, and its location in the orchard carefully mapped. These records should then be copied and filed with the Foundation and the state chapter, so they are not lost in the event of an accident. Then, the transplanted trees can be of real value to the restoration work.

Creating such plantings will also give many people experience in planting and growing chestnut trees, so when we start putting resistant trees out in the forest, we'll have trained folks ready to do it. There are some tricks to getting chestnut seeds to grow into trees, past all the hazards. The more people there are who have good hands-on experience in growing them, the faster blight resistant trees could be established, when the time comes.

STATE COORDINATORS

The formation of state chapters does not end our need for State Coordinators for the Foundation by any means. The Coordinators will still be the representatives of the national organization within each state, and will serve as the liaison between the Foundation and the state organization, if any.

Our coordinators have been very important to the progress of the Foundation: they have helped locate trees and volunteers, contributing substantially to the breeding program, and are accumulating an impressive amount of information about surviving chestnut trees in their states. In addition, they have helped line up seminars and talks for President Rutter, which have resulted in invaluable contacts. We still need Coordinators for many key states. If you are interested, please contact President Rutter for more information (address and phone above).

We are pleased to welcome several additions to our Coordinators since the last time we published their names and addresses.

We are particularly proud to announce that Stronghold, Inc., of Maryland, has agreed to become our Coordinator for that state. For many years, Stronghold distributed chestnut seed to its members, and made plantings on their Sugarloaf Mountain preserve. Our members may wish to make an effort to see those plantings, which flower regularly in spite of the blight. It is possible that there is hypovirulence at work in the groves, something we hope to investigate further. We are delighted to be allied with Stronghold in the fight to bring the chestnut back.

We have also had two resignations among our coordinators. Mr. Larry Geno, previously Coordinator for the Pacific Northwest, has emigrated to Australia, where he will be planting chestnut orchards. Mr. Geno was a Washington state nurseryman, and for the past 3 years has donated 5% of the value of his chestnut sales to the Foundation, which were considerable, for research. Mr. Carl Wiedemann, a forester for New York state, and one-time co-Coordinator, had to resign when he was promoted to a new district with little chestnut. Before that change he was most helpful and active, and shares the responsibility for growing interest in chestnut in New York. We will miss them, and want them to know that their work is appreciated, and continues to bear fruit.

If you live in a state that already has a State Coordinator and want to participate in chestnut projects, please get in touch with them; they can use your help.

ACF STATE COORDINATORS ADDRESSES

Illinois
Mr. Melvin Gerardo
Nursery Supervisor
R.R. #1, Box 182
Jonesboro, I L
62952 618-833-6125

Mr. John A. Sester
Staff Forester
Division of Forest Resources
600 N. Grand Avenue West
Springfield, IL 62706
217-782-2361

Maryland
Stronghold, Inc.
7901 Comus Road
Dickerson, MD 20842
attention: Superintendent
301-874-2024

Minnesota
Mr. Daniel Stubbs
16320-154th Street North
Marine on St. Croix, MN 55047
612-433-3708

New York
Dr. John W. Kelley
Cornell University
Department of Natural Resources
Fernow Hall
Ithaca, NY 14853-0188
607 -255-2110

Ohio
Dr. Greg Miller
Empire Chestnut Company
3276 Empire Road SW
Carrollton, OH 44615 216-627-3181

Pennsylvania

Mr. Dominic Demangone
RD 2, Box 84
Latrobe, PA 15650
412-539-8605

Wisconsin
Mr. Bruce Gabel
RR. 1, Box 25 Holly Road
Bloomington, WI 53804
608-994-2247

RECENT PUBLICITY - GETTING THE WORD OUT

We are beginning to be heard! After a few years of being ignored by the press, the American chestnut is becoming a hot topic, and journalists are perking up their ears. In recent months several fine periodicals have run articles covering both the history of the blight and the new research efforts aimed at restoring the tree. These articles are worth looking for in your local library.

Forest World, Spring 1988, published by the World Forestry Center, 4033 SW Canyon Road, Portland, OR 97221. ("Restoring the Chestnut Tree" by Loyal D. Rue, pp 15-17)

National Parks, July/August 1988, the magazine of the National Parks and Conservation Assoc., 1015 Thirty-First Street, NW, Washington, DC 20007 ("The Blighted Chestnut" by Stephen Nash, pp 14-19)

The Morris Arboretum in Philadelphia printed a very striking old etching of American chestnut trees in Fairmont Park, in 1878, on the cover of their MarchlApril '88 *Newsletter*. Inside there are several pages devoted to discussions of chestnut history and hopes, with short articles by three different authors. Back issues of this journal may be hard to come by, but you might try writing to the Morris Arboretum *Newsletter*, 9414 Meadowbrook Avenue, Philadelphia, PA 19118.

If you do try to find any of these articles by writing to the addresses here, please do be sure to include a check to cover the cost of the magazine, postage and handling.

COPIES DONATED

We owe all these magazines and their parent organizations a great debt of gratitude. Not only have the stories themselves helped many people to understand that the American chestnut is still alive and worth working to save, but each of these organizations generously contributed copies of the magazines to the Foundation, for us to use in our fundraising efforts. Forest World and the Morris Arboretum Newsletter each contributed 100 copies to us, and the NPCA has donated 200 copies of National Parks. These gifts are worth far more to us than their face value, and are deeply appreciated.

PLEASE HELP US FIND HISTORICAL IllUSTRATIONS

The etching on the Morris Arboretum Newsletter cover is a beautiful one, and is fast becoming a new standard illustration of what magnificent trees we used to have. It was found in an old issue of The Art Journal for 1878 by Mr. Paul Miterko, a Foundation member from the Twin Cities. Paul recognized its value, made several high quality negatives and slides from the print, and passed them on to President Rutter. Copies of those slides are now impressing audiences all over the country, and often being printed.

An illustration like this one is priceless for its power to move people to action, and Paul Miterko's recognition of that value has been a real contribution to the chestnut cause. We could still use more historical illustrations. They must exist, in old out-of-the-way publications or in attics, or even on old postcards.

THE NATIONAL GEOGRAPHIC

Finding good illustrations is even more important right now, since *The National Geographic Magazine* is preparing an article on chestnuts, both in this country and abroad. This article is a direct result of the work of the Foundation, and will provide the best kind of visibility for our cause. The *Geographic* staff has been working on the story more than a year already, and in the tradition of the Geographic, they are being thorough. The article is now being photographed and refined, and is tentatively scheduled for publication in December of 1989. They would like our members' help in digging out more old historical prints and photographs.

The *Geographic's* hallmark, of course, is the high quality of their photography and illustrations. If you have good or unusual old illustrations you would like to share, or any aspect of the chestnut's history, please send them to President Rutter, Badgersett Research Farm, RR1 , Box 118, Canton, MN 55922. He is working with the *Geographic* staff, and will pass potentially usable material on to them. Even if you think your pictures may not be good enough for the *Geographic*, please do send them to President Rutter, so we can add them to our own historical collections. They will be much more valuable if you will include everything you know about the pictures, including place, date, and names of people.

ELLlSTON RESIGNS FROM BOARD

We regret to report that Dr. Jack Elliston, one of our Directors and a researcher at the Connecticut Agricultural Research Station, has had to resign from our Board, for health reasons. Jack had been increasingly active in the Foundation's behalf, and was one of those who traveled to Albany to testify, very effectively, to the New York legislature. We will sorely miss him, want him to know how much his many contributions to the chestnut cause have been appreciated, and extend our best wishes for his recovery.

HONORS

Director Donald C. Willeke was recently elected a Director of The American Forestry Association, the oldest citizen conservation organization in the world. In May of 1988, Mr. Willeke was given the Joyce Kilmer award from the National Arbor Day Foundation, and in August he delivered the Keynote Address at the International Society of Arboriculture's Convention in Vancouver, British Columbia.

At the August Annual Meeting of the Northern Nut Growers Association, in Annville, Pennsylvania, our Coordinator for Ohio was elected President of that organization, and our President Rutter was elected their Vice President.

NEW ZEALAND, AUSTRALIA, AND FRANCE NEED YOU

We have recently had several requests for help in locating sources of chestnut and chinkapin seed from researchers in other countries. Both Australia and New Zealand have growing chestnut orchard industries, and considerable interest in breeding the trees. They also have no blight, and want to take no chances on importing any.

It is not difficult for us to procure pure American chestnut seed from unblighted trees that grow outside the original range of the tree, and also beyond the present reach of the blight. Amercian chestnuts have been planted all over the world, and in all 50 states.

Chinkapins, however, are more difficult. They have seldom been planted beyond their range, and we do not currently know of any that could be certified to be growing in blight free areas. France, of course, has blight, but does not wish to take a chance on importing additional strains. It has been shown that blight spores can sometimes be found even inside the seed coat of apparently healthy nuts.

If you have, or know of, any chinkapins; Allegheny, Ozark, or other variety; growing someplace where we could gather unquestionably blightfree seed, please notify President Rutter. We would like to help our overseas friends.

THE DUNSTAN HYBRID CHESTNUTS

We have received many requests for information and opinions about the "Dunstan Hybrid Chestnuts", particularly after several nursery catalogs printed ads for them this spring which proclaimed "the return of the American chestnut", or words to that effect. Not surprisingly, some of our members were startled.

In an effort to clarify the situation, we contacted Chestnut Hill Nursery.

In their letter of reply, they state that their trees are hybrids, not Americans, and that they have been selected for orchard qualities, rather than forest growth. We thank them for their help in straightening this out, and print here their entire letter:

CHESTNUT HILL NURSERY, INC.

April 12, 1988

Dear Mr. Rutter;

In response to questions you have received about the parentage and characteristics of the Dunstan Hybrid Chestnuts, we would like to provide additional information beyond what has been presented in some nursery catalogs that are offering these trees for sale. Several ads, such as those that appeared in Gurney and Henry Fields, misrepresented the Dunstan Hybrid's characteristics, and these companies will correct the ads in their next catalogs.

The Dunstan Hybrid Chestnuts are hybrid American x Chinese chestnuts that were bred by the late Or. R. T. Dunstan. The Dunstan Hybrid Chestnuts were produced by *crosssing an American chestnut that was found unblighted in a grove of dead chestnuts in Ohio and Kuling - Meiling - Naking Chinese chestnuts. One of the FI progeny was then allowed to cross with both parent trees. The resulting 2nd generation is now 27 years old and growing at our farm near Alachua, FL. As expected, these trees show a range of American to Chinese characteristics. For a more detailed history and cultivar characteristics, please contact Chestnut Hill Nursery at the address below.*

Named cultivars were selected on the basis of nut quality, production, and tree form. The cultivars 'Revival', 'Carolina' and 'Willamette' - were chosen for their large, sweet and easily peeled nuts, upright-spreading form, and good orchard production. The cultivar 'Heritage' has been selected for its American-like timber form, leaves, and smaller, flavorful nuts. Heritage has been tried by the American Chestnut Foun¬dation in its breeding program. Additional laboratory testing of the blight resistance of these trees will be undertaken in the near future, beyond the 20 + years of field growth of these hybrids around the nation.

Our goal is to produce a chestnut with the very best nut quality for establishing a chestnut industry in the United States. The efforts to establish a chestnut industry and to produce a blight resistant American chestnut are complimentary and interdepen¬dent parts of the work of re-establishing the chestnut in America. Scientific research and breeding are important to the evolution of the industry, and increased funding of basic research will result from the widespread consumption of chestnuts in the marketplace. We fully support the important work of the American Chestnut Foundation in its efforts to breed a blight resistant American chestnut, and offer our help for continued cooperation and collaborative efforts to help make chestnuts part of our agricultural and forest ecosystems again.

Sincerely,
R.D. Wallace, President

New York and The National Chestnut Research Center

When the Foundation adopted as a long-range goal the creation of a National Chestnut Research Center, no one expected such serious attention to develop so rapidly. The current interest in New York began when an alert legislative staffer brought an enthusiastic newspaper article written by Dr. Mike Zimmerman of Oberlin College to the attention of his Assemblyman, Francis Pordum. The article recounted the chestnut story and the new interest in restoring the species being promoted by the Foundation and followed one of President Rutter's seminars. The economic and environmental reasons for pursuing the goal of restoration seemed clear to Pordum and his staff, and they contacted President Rutter with a simple question: "What could New York be doing to help this work?"

Pordum took the suggestion of a National Chestnut Research Center very seriously, and asked for a formal proposal from the Foundation. Accordingly, an ad hoc committee was formed to quickly come up with plans for a Center. The committee consists of Or. Dennis Fulbright, Professor of Plant Pathology, Michigan State University; Dr. John W. Kelley, Director, Arnot Forest, Cornell University; Dr. Charles Maynard, Assistant Professor of Froest Genetics, SUNY College of Environmental Science and Forestry (CESF), Syracuse; Dr. Paul E. Read, Head, Department of Horticulture, University of Nebraska; Dr. David B. Wagner, Assistant Professor of Forest

Genetics, Univ. of Kentucky and Mr. Philip A. Rutter, President, The American Chestnut Foundation. In addition to these scientists, 14 others have agreed to advise the planning committee and help in refining plans as they develop.

An initial proposal was developed within a month, and submitted to New York. The proposal includes some detailed plans for administration, site selection, personnel, and yearly operating budgets, but is not entirely comprehensive pending further input from New York. The following paragraphs are taken directly from the proposal, and explain as briefly as possible just what is contemplated.

THE CONCEPT OF THE CENTER

"The Center as currently conceived would consist of a laboratory located within the old chestnut range, with facilities for several researchers and their support staff, and additional lab space for visiting researchers. It would house a small library of chestnut literature, archives, and computerized breeding records. It would be located on 200-500 acres of firstrate chestnut land, suitable for intensive management.

Research would be pursued by a multi-disciplinary team, and would include a breeding effort, research on hypovirulence, molecular genetics, and ecology. Researchers from other institutions would be encouraged to use the Center's facilities, and to run long-term experiments there. It is anticipated that researchers will be attracted from most eastern states, and probably from other countries as well (eg. China, Japan, Korea, France, Italy).

Adjunct test plantings in other states and parts of the chestnut range can be added when possible, consisting of land, plantings, and a resident caretaker. The American Chestnut Foundation will be the instrument used to locate, acquire, and fund these additions.

An interpretive center, with historical displays, a small museum, demonstrations of research currently underway at the Center, and facilities for the public, could be a part of the Center, and would serve several functions.

- Education: the lesson of the chestnut blight is a very important one for any study of conservation, ecology, or American history. Programs could be developed for grade school children, and internships might be made available for high school students.
- Historical preservation and research
- A public attraction: the interpretive center could realistically draw attention and visitors from many states.
- Public relations: the interpretive center could play a role in assuring continuing support for the research programs at the Center.

The Center should also serve as the physical home base for The American

Chestnut Foundation, with office space for an Executive Secretary and secretarial support for Foundation membership functions. While the Center will be an independent corporation, The American Chestnut Foundation is the parent institution, and will maintain a close and continuing relationship with the Center. In a real sense, the Foundation will serve as the public relations and fundraising arm of the Center, which is the Foundation's most important project.

THE ARRANGEMENT CURRENTLY BEING CONSIDERED IS AS FOLLOWS:

The State of New York will provide all basic funding, including land, capital expenses, and operating expenses, for a period of ten years. Land and facilities should become the property of the Center. By that time, The American Chestnut Foundation promises to have raised an endowment for the Center, sufficient for current operating expenses, and will undertake to provide all further costs of the Center.

The Center will be formally related to a New York University, and Center research staff will have academic appointments at that University. Arrangements will be made to ensure the adjunct University will at all times be satisfied with the quality of staff and research."

MEETING WITH THE LEGISLATURE

Following the submission of the proposal, Assemblyman Pordum called a meeting in Albany for May 17th, for preliminary discussions with some of the state agencies. President Rutter flew to Albany for this meeting, and met with Pordum and representatives of the Commission of Environmental Conservation, Cornell University, and SUNY CESF. He also spent another day visiting legislators and their staff, letting them know about the project.

The May 17th meeting was a success, and gave all concerned the strong impression that the project was worthwhile and that there was a good chance of support from the legislature. Consequently, a formal presentation to the legislature was scheduled for June 7th, and scientists were invited to attend and testify.

And come they did, mostly at their own expense, with the hope of convincing the New York legislature of the importance and feasibility of the Center. President Rutter gave an initial historical oversight of the blight and introduced the proposal for the Center. Following that, Dr. Fred Hubbard (University of Kentucky), Dr. Paul Read (University of Nebraska), Dr. John Elliston (Connecticut Agricultural Experiment Station), Dr. David Wagner (University of Kentucky), Dr. Charles Maynard (SUNY CESF), and Mr. Philip Gordon (Research Fellow, Yale University) all spoke of their own research areas and strongly endorsed the Center.

Dr. John Kelley (Cornell University), expressed his own support, and read very strong letters of support from the Cornell Dean of the College of Agriculture and Life Sciences, and the Director of the Cornell Plantations. Mr. Willard Ives, of the New York State Forest Practices Board then read a resolution from his board which established a task force to investigate current chestnut research and advise the NY Dept. of Environmental Conservation. President Rutter ended the testimony by reading into the record a statement of support from a visiting Chinese scientist, Professor Huang Hong-Wen, and making a summary statement.

A complete transcript of the presentation is available to those interested. It runs to 77 pages, a hefty document, but a very informative one. Please send requests for copies to Assemblyman Francis J. Pordum, Room 652, Legislative Office Bldg., Albany, NY 12248.

At this June 7th meeting, Assemblyman Pordum first introduced his 2 cosponsors, Assemblyman Maurice Hinchey, Chairman of the Environmental Conservation Committee, and Assemblyman Michael Bragman, Chairman of the Agriculture Committee, powerful allies indeed.

The deep interest aroused by the presentation was made evident by the fact that the New York Commissioner of Agriculture, Mr. Donald Butcher, and the Chief Forester of New York Mr. Robert Bathrick, both attended in person, and expressed a desire to pursue the project further.

WHERE ARE WE NOW?

As explained in the Chestnut Bark, the time immediately following the June 7 meeting was not a propitious one for starting new projects in the New York Legislature. All their time was being consumed by a difficult budget struggle.

The response to the presentation was clear, however - everyone involved wants to proceed with the effort to get a Research Center established, as soon as possible. Pordum and his co-sponsors will be introducing an initial "study" bill this fall, and passage is highly probable. Beyond that, no time is being lost. Officials from Cornell and Syracuse CESF will be traveling in August to a possible site for the Center, located in south western New York, near the Pennsylvania border. It is impossible to predict, of course, how long it will take to get the Center underway, but the most optimistic predictions are that a groundbreaking in the Fall of 1989 is a genuine possibility. If we can make it happen.

THE CALL FOR LETTERS CONTINUES

The last Chestnut Bark contained a copy of a letter from Pordum, Hinchey, and Bragman, pledging their best efforts to make the Center a reality. They asked us to write letters of support, and many of you have. It truly makes a difference, since it will be our task to keep the Center running after the initial ten year start up period. We must show that the necessary support exists. If you have not yet written, please take a few moments to do so now. Re-printed below is a portion of our Assemblymen's letter, asking your help:

"The research center as proposed would be self-supporting within ten years, and would be able to continue uninterrupted until the blight is cured.

"In bringing a proposal before the state legislature, it is always helpful to have evidence of wide public support. Any interested members of the Chestnut Foundation should show their support by sending letters to the following offices:

Assemblyman Francis J. Pordum, Room 652, Legislative Office Building, Albany, NY 12248;

Assemblyman Maurice D. Hinchey, Room 625, Legislative Office Building, Albany, NY 12248;

Assemblyman Michael J. Bragman, Room 828, Legislative Office Building, Albany, NY 12248;

Commissioner Thomas Jorling, NYS Dept. of Environmental Conservation, 50 Wolf Road, Albany, NY 12233;

Commissioner Donald Butcher, NYS Dept. of Agriculture and Markets, Campus Building No. 8, Albany, NY 12235.

Commissioner Orin Lehman, NYS Dept. of Parks and Recreation, Executive Offices, Empire State Plaza, Agency Bldg. 1, Albany, NY 12238.;

Honorable Mario Cumo, New York State Governor, Executive Chamber, The Capitol, Albany, NY 12224.

As mentioned before, letters from states other than New York are particularly important, to demonstrate the presence of national support. Letters from some of our members in other countries would also carry considerable weight.

If you have already written a letter or two, and would like to do more, consider bringing this project to the attention of other conservation groups you may belong to, and ask for the support of their members, too.

Write a letter to your newspaper, and get them interested. We need to make every effort possible, as opportunities and momentum like this do not develop every day.

Below, by way of further description of the project, is the complete text of Preisdent Rutter's testimony to the New York Legislature.

TESTIMONY FROM MA. PHILlP A. RUTTER PRESIDENT, THE AMERICAN CHESTNUT FOUNDATION TO THE NEW YORK LEGISLATURE, JUNE 7, 1988

The people who are going to testify here today have gathered from across New York and across the United States, at their own expense, to seek legislative support for the establishment in the Empire State of a National Chestnut Research Center, and to convince the Assembly and Senate that this

Senate that this project is extremely worth while, extremely timely, and would represent one of the best investments New York could make in the future of the forest industry, the agricultural community, and the environmental health of the State of New York and the Nation.

The Research Center is conceived as a one-of-a-kind national center, and would benefit the entire country, although many benefits would accrue to New York first. New York is to be congratulated for attracting such intelligent and far-seeing individuals as Assemblymen Pordum, Hinchey, and Bragman to its public service; persons who are able to look into the future and see the solid benefits that will return to New York from projects designed to enhance the economic well-being not only of New York, but also of its neighbors.

These days, when discussing American chestnut it is necesary to begin with some history. For while the chestnut blight was one of the greatest environmental disasters ever to hit this country, it has now been 70 years since the great epidemic, and many people no longer remember what the chestnut tree was, and what it meant, both to the environment and to the economy of this country.

The American chestnut tree belongs to the same family of trees that the oaks and beeches do, and there are chestnuts to be found in Europe and throughout Asia, as well as in North America. The American chestnut was by far the most successful of all the world chestnut species, and was also by far the largest. It is fair to call it the redwood of the Eastern United States. It got to be a huge tree, as much as 9 and 10 feet in diameter, and while they never grew as tall as the redwoods, the chestnuts were massive trees that dominated the Eastern forests. What made chestnut trees important to the early settlers and our forefathers was not their size, but that the trees, were extremely useful, fast growing, and abundant. There were not thousands of chestnut trees, there were not millions of chestnut trees, there were billions, throughout the Appalachian forests and out into the midwest, into Ohio, parts of Indiana and Illinois, and south to Alabama. We estimate that the time the blight struck there was a population in excess of 4 billion American chestnut trees in the Eastern United States. In general, in the Appalachians, where the ridges were often pure chestnut stands, as much as one fourth of all the trees in those forests were this one species.

Chestnut was important because the tree produces high quality wood. Like the redwood it is extremely rot resistant, and so stands weather very well. Chestnut also grows fast, and grows back fast after cutting - if stands are managed correctly, the stumps from one cutting will sprout vigorously and grow new poles and timber in a relatively short time. Some of the most important uses of the wood were for such items as railroad ties, shingles, telephone poles, fences, and bridge timbers. Chestnut wood is also beautiful, and was used for furniture, and was also used for pulp and plywood. Besides the timber and lumber, chestnut was very important for firewood, the fuel value of second-growth chestnut being compared by the USDA to that of red oak. While figures are a little hard to come by, we have a few - for example, in 1912 chestnut lumber added $85 million to the economies of Pennsylvania and Virginia (Roane et. ai, 1986). In 1909, 77.6 million board feet of lumber, worth $1.5 million (1909 dollars), was cut in Connecticut. More than half of Connecticut's firewood was supplied by chestnut at that time, and another $1 million (1909) worth of chestnut firewood, some 250,000 cords, was cut that same year. (Second Growth Hardwoods in Connecticut, E.H. Frothingham; 1909, Forest Service Bulletin 96).

And the nuts were extremely important. Environmentally, they were certainly one of the most important factors for the tree. Unlike all the other nut producing trees in the forest, chestnuts produce their crops every year. Oaks, hickorys, walnuts tend to produce every third, or fourth, fifth, or sixth year, with minor crops in between, and then having huge crops at erratic intervals. This, of course, is hard on wildlife populations. Chestnuts, on the contrary, bear good crops almost every year. Wildlife depended on that, and when the chestnuts died, a quarter of the forest, remember, many wildlife populations were severely hurt. Although figures are hard to pin down, it is generally agreed that the wild turkey populations crashed partly in response to the loss of the chestnut; deer and bear populations were hurt, not to mention all of the smaller animals, the raccoons, squirrels, possums, woodpeckers; chestnuts were eaten by virtually everything that walked, hopped, or flew. They were in a very real sense the lifeblood of the Appalachian forest ecology.

In 1904, chestnuts in the New York Bronx Zoo started to die. When the cause was investigated, it was found to be an unknown disease, quickly named the chestnut bark disease, and later when the full scope of the disaster became apparent, the chestnut blight. It is almost certain that the chestnut blight got to this country on orchard chestnuts that were imported from China and Japan in the preceding years in an attempt to increase the size of the American nut. The trees died quickly. Nothing that was tried was very effective. Massive efforts were mounted in New York and Pennsylvania. They sprayed fungicides, which were ineffective because the fungus grows under the bark, and on other species besides the chestnut, and thus can hardly be eradicated, particulary when a quarter of the forest will harbor the fungus. And they tired cutting "firebreaks" in front of the blight. There were actual efforts made in New York and Pennsylvania to clear mountainsides of their chestnuts. I have heard one person say that the intention was to clear a strip 10 miles wide of all chestnut trees, in front of the infection, to deny the fungus a place to grow so that it could not spread into the trees beyond the firebreak.

so that it could not spread into the trees beyond the firebreak. This was ineffective entirely, because the fungus spreads through the air, both through airborne spores and through sticky spores that can hitchhike on birds and insects.

By about 1950, the blight had wiped out the American chestnut almost completely. Of the billions of trees once growing in the forests, providing food and shelter for animals and man, only a few hundred of any size survive, and all of the survivors are crippled by severe infections. However, by a quirk of fate the fungus cannot kill the roots of the trees, and the chestnut is extremely good at growing back from stump sprouts. The current status of the tree is a sort of biological limbo - while there are millions of surviving root systems, they seldom grow to any size before the blight finds them again, and new trees, from the rare seed produced, are very rare indeed. The species is holding on, but is probably doomed if we cannot help it.

After early attempts to eradicate the blight failed, programs were started to crossbreed American chestnuts with disease resistant Asian chestnuts. The fungus came from Asia, and the Asian chestnuts, both Chinese and Japanese, are resistant to it. The hybridization programs, however, were abandoned entirely in the late 1950's, when after prodigious numbers of crosses, the lack of progress had so discouraged the researchers and administrators that it was simply decided that the program was never going to succeed. After so many years of working so hard on a species that was so important, the discouragement ran deep, the chestnut was officially declared dead, and further research was abandoned.

Things have changed drastically in the years since the previous attempts to rescue the chestnut as an important natural resource, however, and it is time now to use all the new techniques and new understandings gleaned from work with trees and crops to mount a new effort to restore this unique, irreplaceable, tree.

In the 1970's, a new hope arrived on the scene, in the form of the phenomenon known as hypovirulence. Don't let that word frighten you, it simply refers to a disease of the fungus. Curiously enough, there is a virus which infects the chestnut blight fungus, and renders it less harmful to the tree. This was discovered in Europe, where they likewise went through a chestnut blight episode. The European chestnut species is also susceptible to the fungus and at one time the chestnut orchards of France were nearly completely destroyed by it, but right now the virus is being used as an effective means of controlling the blight in the re-established and expanding commercial nut orchards of France and Italy.

Attempts to control the blight with this method in the US, however, have so far met with only extremely limited success - but the examples of France and Italy, where thousands of orchards each year produce millions of pounds of nuts, and millions of dollars, are a reproach to those who would say it cannot be done here. It has incontrovertibly been done, in Europe. Plantings once destroyed by the blight have been restored. In a world of uncertainties, that is a fact, which we cannot ignore. The fact that implementation of this biological control method in this country has been difficult, and complicated, is one of the best arguments for the creation of a National Chestnut Research Center, with a continuing focused, and interdisciplinary attack on all facets of the problem.

The American Chestnut Foundation, in addition to encouraging the ongoing research into hypovirulence, has started a new breeding program, aimed at transferring the blight resistance of the Asian species to the American. This is another instance where blight has been economically controlled, by means of genetic resistance, in other countries. Japan, China, and Korea, all have thriving and expanding chestnut orchard industries; in Korea, in fact, it is estimated that as much as 7 % of the cropland is devoted to chestnut orchard, most of the production being shipped as a lucrative cash crop to Japan. And they have blight in every orchard. But their trees are resistant to it.

The Asian chestnuts hybridize fairly easily with the American, and using our improved understanding of plant breeding, there is an excellent chance that we could succeed now in moving the Asian genes for resistance into the American species. This slide is a simplified breeding diagram, which I hope will not look too complicated to you, and which should help to explain why we think previous breeding efforts were not successful, and why a new one could be.

This is what happened to the breeding work in the past. When researchers crossed the two species, Chinese and American, they came up with a tree that was intermediate between the two species; more blight resistant than the American, and larger than the apple-tree sized Chinese. But when these trees were planted out for testing, they uniformly died, apparently of the blight. Quite reasonably, workers at the time saw this as a situation where their trees needed better disease resistance, and so they crossed their first hybrids back to the Chinese. This does result in some pretty blight resistant trees, but unfortunately it also brings back the Chinese-type tree; small, not good for timber, and unable to compete in our wild forests. This was a logical loop that previous workers got stuck in, and after some years of going around in this loop and not coming up with a tree that was really useful, they abandoned the breeding approach altogether.

The past 30 years of additional experience in plant breeding has been phenomenal, yielding such things as the "Green Revolution". The Nobel Prize winning author of the Green Revolution, Dr. Norman Borlaug, is in fact a member of The American Chestnut Foundation's Board of Directors, is familiar with, and endorses our revised breeding plan. What we understand now is that the breeding plan has to go almost opposite to the previous, unsuccessful one. The problem is not so much one of recovering good blight resistance in the hybrids, as of recovering the more genetically complex American forest and timber growth type. So the hybrids must be crossed back to the surviving American trees. In the early generations, trees from such crosses will be only partly resistant to the blight, but genetic theory strongly indicates that in later generations, when partly resistant but fully American trees are created, by crossing those with each other some individuals will be found that are as disease resistant as their distant Asian ancestor, but which are otherwise completely American. This is a plant breeding technique used with regular success in many species, but one which has never been applied to chestnuts. The Foundation has made a small start on this new breeding program. And I would point out here that breeding trees does not have to take forever. I have personally made hybrids that have flowered and produced useful pollen 3 months out of the nut.

Here is another approach to restoring the American chestnut where what we are attempting to do has in fact already been done, eleswhere. Asian chestnuts are genetically resistant to this disease. Not, to be sure, as a result of artificial breeding, but as the result of natural selection; but the orchards of Asia are living proof that genetic resistance is possible and an effective means of controlling the blight. Transfer of disease resistance from one group of plants to another, while not always simple, is done routinely today; ollr food supply depends upon it. But to be done for American chestnut, a Research Center, with its own scientists, research facilities, and lands, would be by far the most efficient and cost effective way to go.

While no one can promise success in any research undertaking, so far we have two demonstrably feasible possibilities for restoring the American chestnut; control of the fungus by a "virus", or breeding trees that are resistant to it. There are in addition several other approaches which may be extremely promising. There are "biotechnology" techniques which you will hear about from some of our later speakers, and there may be ways to select increasingly resistant trees from among the surviving American chestnut sprouts. The point to be made here is that times have changed from the last time anyone seriously tried to bring this tree back. The science of the 1980's has advanced immensely over the sciene of the 1950's, and it is time now to work again to bring this tree back to our wild forests, orchards, and timber production lands. This is an absolutely reasonable goal, as is demonstrated by the fact that the US alone, among countries with native chestnut species, does not have a thriving chestnut industry. The restoration to the wild is a realistic expectation also, since one of the things we know is that the American chestnut, when not fighting the blight, is a very competitive species; and if blight can be controlled by any of the possible methods, the tree is capable of out-growing and out-reproducing the trees that replaced the old chestnut forests, and turning them into chestnut forests once more.

While we have several good approaches to the chestnut blight problem now, what we do not have is one, coordinated, place, where they can all be investigated thoroughly to find the one technique or the combination that is actually going to be the most effective. Chestnut research has suffered in recent years from a lack of adequate funding, and a lack of continuity. There has been a lack of understanding that it is time to tackle the problem again and that there are excellent new opportunities for success.

There are several reasons why we need a National Chestnut Research Center. Today, chestnut research is splintered among some 10 institutions, where more of the time, because of universities' many commitments and priorities, chestnut research is forced to take a back seat. While the individual scientists doing the research are very dedicated, the fact is that time and again, when chestnut researchers have had to retire, particularly breeders, all too often their plantings, and years of work, have been lost.

We need an independent research Center, where researchers from all disciplines can work together on a daily basis; compare notes, pick each other's brains, kick each other's behinds, and stimulate each other to think and work as hard a possible. A place where they know that no one is going to pull the rug out from under their work, and where the plantings that they make today will still be there in 30 years for their successors to look at and evaluate, and work with. This is vitally important if we are ever to succeed in this work.

This species is so important, economically and environmentally, that it will merit research for many years to come. Even if by great good fortune we should solve the blight problem in the coming 15 or 20 years, there will be more research needed into insect problems, into the best kinds of management techniques for timber, pole production, and orchards, and into the natural ecology of the tree. While progress is possible on the 10 and 15 year scale, the great value of the Center will be its long life span, the years in which projects began 30 years ago can continue to be evaluated. This is critical for working with a forest species. We have to realize that trees do not live on the time scale of a human career. A human scientist's productive career may run for 30 years. At 30 years, the trees are infants. The American chestnut is a particularly long lived species. In Maryland, the figures we have indicate that the virgin trees ranged between 400 and 600 years old. Serious research into the ecology of forests and forest management must be able to look at time spans on the 100 year scale, at least. And for that kind of time scale it is critical that an autonomous research Center be established, one that does not depend on the political process for funding every year. It is a fact of life, something we have to deal with in our American democracy, that our governments will change, often at each election. As the governments change, so do their priorities. It is crucial that a research Center be established which once it is functioning is no longer dependent on the political process for its funding or land.

This is what we are proposing to New York, through the farsightedness and clear thinking of your Assemblyman Pordum. The current proposal suggests that in order to get the National Chestnut Research Center established in New York, and in order to get it fully functional now, instead of 10 years from now, which is what it might take if we have to put it together piece by piece, the State of New York will provide the start-up funding, at an approximate average cost of $900,000 per year, for no more than 10 years. During that time The American Chestnut Foundation will commit all its resources to raising an endowment, for the entire country, to provide for all further operating expenses.

This is an entirely realistic scenario, based on our experience in fund-raising, and the opinions of various professional fundraisers and officials of philanthropic organizations - an ongoing, established research center is exactly the kind of operation that attracts endownment gifts and large bequests. In addition, since this would be a National Center, it will draw its support from all those people, throughout the country, who still remember and miss the tree. Public interest is high, and with the understanding that something serious is being attempted, the support will be forthcoming.

The concept for the Center is that it would be located in the SW part of New York, because that part of the state is closest to the central American chestnut range. The researchers working at the Center would have adjunct appointments at one of New York's very fine higher education institutions, most likely either Cornell or the SUNY College of Environmental Science and Forestry at Syracuse. Frankly; those two institutions are part of the reason The American Chestnut Foundation is so interested in this proposal: New York is very simply one of the best possible places where the Center could be located. The Center would be on its own ground; the land would either belong to the Center or be on a very long term lease belonging to the Center. Several scientists would be living at the Center, and eventually several more would work part time at the university and part time at the Center.

In addition to the research going on at the Center, it is possible that a museum and interpretive center could be built there which besides serving many educational purposes, could also grow to be a considerable tourist attraction. The passion that the American chestnut tree generates in those who knew it is really astonishing. In the past 2 years I have given more than 40 seminars and lectures throughout the chestnut range, and I have acutally had people come up to me after my talks with tears in their eyes, saying how long it has been since they had hope of the tree ever recovering, and how glad they are to hear that once again something was being done. Many, many, people still love this tree and care about its history. A museum-interpretive center could realistically serve to pull tourists in from around the country, and would also, of course, bring people to the Center who may care enough to eventually make contributions towards the support of the Research Center.

A full proposal has been prepared by a special committee of The American Chestnut Foundation, which is available for your examination.

What we are asking for at this time is the passage of a study bill which will direct one of your state Departments to make a formal response to the proposal. It is our hope, of course, that after study, with whatever improvements or amendments come out of that procedure, and in conjunction with Assemblyman Pordum and his cosponsors, the State of New York will move to initiate legislation that will enable the funding and formation of the National Chestnut Research Center here in the Empire State.

The Foundation has had interest expressed by another state, but New York is currently our first choice for this site, and the proposal now being considered would accelerate chestnut research far faster than any other possibilities before us. We would prefer to be here.

It is our very realistic expectation that we can have this tree back once more, with all of its economic importance, all of its ecological significance, and all of the simple beauty and companionship that it affords us on this planet. But we need your help.

SUMMARY STATEMENT

There are several clear points to remember out of all this testimony.

1. The American chestnut was a unique, irreplaceable tree, highly valuable economically and environmentally. It is worth working to restore.

2. The US alone, of countries with native chestnuts, does not have a chestnut industry of any kind. All those countries with thriving industries also have the blight, in every orchard, but they have found ways to deal with it.

3. Chestnut researchers from around the country are united in their opinion that a National Chestnut Research Center would greatly enhance their own work, and greatly improve the probability of success in seeking a way to restore the American chestnut.

4. New York would be an ideal location for a National Chestnut Research Center. Its establishment in connection with one of your universities would be highly beneficial.

5. An independent Center is necessary, to ensure that long-term research can be carried out securely.

6. Public support for the tree and the Center is broad and sincere.

7. Under the current proposal New York would not be responsible for supporting this institution beyond the 10 year start-up phase, but it would draw on support from the whole nation beyond that time. Professionals in the field are confident the support is there.

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