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EDITOR'S NOTES -
JOURNAL SPRING/SUMMER 95

If wishes were horses then beggars would ride...

This issue of The American Chestnut Foundation Journal is dedicated to good intentions.

I'm not talking about false hopes, promising starts or recipes for success that turn out to be just pie in the sky. Not that kind of "good intentions."

So often today you hear of someone who has a great concept or vision, but no idea of how to make it come true, how to develop it, how to market it.

Why do some projects flourish while others languish?

Any enterprise must have a vision, but the scope of a project needs limits as well. Access to money, people, goodwill and facilities is essential. Elbow grease and commitment never hurt, and a little luck is always a blessing. But bottom line, nothing is ever accomplished with-out daily, persistent, productive, cumulative effort.

The myriad of approaches and efforts that people associated with The American Chestnut Foundation are taking makes for a marvelous study in how people consciously make an impact on the world, and how they in turn are affected by their dedication.

Dr. Fred Paillet charting the progress of hypovirulence in a few trees in a single place over a period of years, has come to conclusions about the ecology of this fungus. An interview with Dr. Paul Read reveals the precision required in tissue culture efforts - a program that will allow us to replicate the most promising hybrids we have developed so far. Dr. Charles Maynard is using biotechnology to save one species by drawing on genetic material from wholly different species.

And in his regular chronicle, Dr. Fred Hebard brings us up to date on several aspects of work at the Wagner Research Farm, the heart of our foundation.

Earlier articles have described how Dr. Charles Burnham's expertise in plant breeding established AC F's backcross breeding program; here an article by his neighbor, Sally Conklin, shows how his love of plants, trees, and creative thinking manifested itself in his home and among his family and neighbors.

Working in the mountains of North Carolina, architect Francis Bacon created a unique and material-specific style of architecture by strictly using American chestnut.

In these pages look for people who show a sense of determination, a sense of purpose and direction. None of their efforts is easy, short-lived or superficial. Look at the different styles each writer uses, look at the nature of the programs and subject matter. Each person is working along a different thread, but each effort also contributes to the fabric.

These are people who are bringing to fruition their good intentions.

Rachel Kelly

Letters To The Editor

Dear Editor:

An exceptionally interesting issue of The Journal (ref. Fall/Winter 1994). Are a few extra copies available? Some of the articles might well be reprinted in local newspapers.

My Best,

Guy Black

Winchester, Va.

Editor's Note: I'm very pleased to hear you enjoyed the last issue of The Journal. In redesigning the format and adding a wide range of topics, writing styles and areas of interest we hoped to reach the greatest breadth of ACF members. A tree with many, many uses, the American chestnut similarly appeals to many different people for different reasons. We hope to encourage them all.

Regarding back issues, we do have some, but in very limited quantities. Please contact the Bennington office regarding reprints.

Dear Ms. Kelly:

Thanks for the extra copy of The Journal of the ACF. The new for mat really looks nice.

When next year's Journal comes out, maybe you could print a correction to the text of my article about the Pennsylvania Germans use of chestnuts. Evidently part of a sentence got left out when the final paragraph on page 21 was typeset. The second to the last sentence should read "Each 11-foot section was called a Gfach, and the gate was called a Daerche or Daerli." Also, the tools in the picture were used to work chestnut, but weren't made of chestnut.

Thanks,

Doris Goldman

Waynesboro, Pa.

Editor's Note: I was very glad to have your article on the Pennsylvania Germans' use of chestnut for our last issue and appreciate the fact you wrote and pointed out the error made both regarding the references and the tools. Thanks again for your willingness to prepare an article for The journal; I hope to hear from you again in the future regarding new areas of scholarship and study on chestnut.

Dear Rachael:

Great job on the recent issue of The Journal. The graphics and layout make it happen!

Thought you'd be interested to see an article written about our chestnut ranch on the west coast. (The facts are not all correct, but the general gist is good.)

Happy Holidays,

Greg Dabel

Sebastopol, Ca.

Editor's Note: Thanks for the vote of confidence! Glad you liked the new design, we hoped it would strike a positive chord.

Dabel enclosed an interesting article published in West County Discoveries, a newspaper local to Sebastopol on successful chestnut ranchers in Sonoma County, Ca. Dabel, himself a chestnut rancher, is described in the article as switching from apple farming to chestnut ranching which he says is becoming quite lucrative. Best of luck to you and the Green Valley Chestnut Ranch!

SEED KIT GROWERS ESSENTIAL TO RESTORING THE AMERICAN CHESTNUT

A towering tree with broad sweeping boughs and plentiful nuts, a dream to timber growers, gourmets and backyard wildlife protectors alike, the American chestnut inspires great enthusiasm in nearly everyone who hears its story.

Restoring the American chestnut raises such hopes that many people want to become involved in the effort personally. Everyday we receive numerous calls from prospective members and longtime supporters who want to know where they can obtain American chestnuts to plant on their property and what they can do to help the foundation restore this remarkable tree.

The American Chestnut Foundation seed kit program allows chestnut enthusiasts to get involved and to help the foundation in its research. In recent months several people have written and asked us to explain how participating in the seed kit program contributes to restoring the American chestnut.

For many people planting chestnuts in their yards and woodlands is simply a way of actually seeing the tree and watching its growth. Even at this level, planting chestnuts helps the ACF effort by simply making more people aware of this tree.

But those who are willing to roll up their sleeves can be a great help. In this article we'll go over these points, as well as what the kits include, and briefly what is involved in raising chestnuts.

HOW DO SEED KITS GROWERS HELP?

The goal of The American Chestnut Foundation is to restore the American chestnut to our landscape - to reintroduce blight-resistant chestnuts with all of the growth characteristics of our native tree to its native range. Our work does not stop with the scientific aspect of creating a genetically suitable hybrid. In order to actually reintroduce this species, ACF will have to work with tens of thousands of trees, with different genetic makeup, in many different habitats. And any number of obstacles may develop.

For example, one chestnut hybrid may do very well in Virginia, but not be able to survive the winters in New York or Vermont. Likewise, as we breed for blight resistance and use different American parents we could unwittingly breed out a tolerance to specific local soil conditions or resistance to other pathogens and pests.

It is in combating some of these problems that seed kit growers can make a difference. By raising chestnuts in their locale, seed kit growers essentially are producing an army of mother trees for future breeding. They work with both pure American chestnut from their region and, beginning this year, with hybrids from ACF's research. Growers learn how to plant nuts, raise them to seedlings, protect them from squirrels and other pests, and in time will also learn to pollinate their trees with pollen from advanced generations of hybrids from ACF's research.

At that juncture, growers will be creating highly blight-resistant American-type chestnut trees from their own mature trees that should be suitable for their environment. The local aspect is very important. We collect and ship nuts to growers from trees in a grower's region. This way growers effectively preserve the genetic material that allows a tree to survive the local habitat. In terms of ACF's research, promoting many different populations with subtle differences in growth habit and tolerance preserves a diversity of genetically determined characteristics - traits which may become important in later research.

Just as many people feel that the South American rain forests contain unknown species which may benefit people and medicine in the years to come, so is it possible that a range of characteristics may be a key in restoring the American chestnut.

In addition to preserving the actual genetic material of the American chestnut species, seed kit growers are preserving another vital commodity: knowledge.

Because the American chestnut was decimated so long ago, most people today do not know this tree and its requirements. In working with American chestnut and hybrids, growers are developing a hands-on knowledge of the species' growth habits and requirements, knowledge which must be preserved if we are to successfully reintroduce this species to hillsides, woods, backyards, communities, forests and cities.

For example, it is vital to know that American chestnut has a tap root and does not transplant easily. It is important to know that American chestnut likes well-drained soils that are not alkaline. And it is important to know the procedures for pollinating flowers and collecting and storing nuts for future plantings.

Also, because it is important that the next generation develop an interest in the American chestnut, growers who include their children, grandchildren or neighbors' children in their hobby are promoting an appreciation for this once magnificent tree.

WHAT DOES THE KIT INCLUDE?

This year, for the first time, ACF is offering two different seed kits. The first kit includes 20 to 25 pure American chestnuts, a handbook on raising chestnuts and forms to track the progress of the nuts and seedlings. This kit costs $50 which covers the costs of collecting, storing and shipping nuts, the handbook, and other administrative costs of tracking the nuts and their progress.

The idea behind the pure American chestnut kit is to familiarize chestnut enthusiasts with the American chestnut, and to develop a known supply of future mother trees. These nuts, however, are not blight resistant.

The second kit includes 10 nuts, 5 pure American and 5 first generation hybrids between Chinese and American chestnuts. The hybrids should be quite blight resistant and show some American growth form. The kit also includes a handbook, and costs $75. The cost of these kits helps support our ongoing research programs.

The idea behind this kit is to get growers involved in breeding hybrids themselves using the pure American trees and the hybrids. **As** advanced generations of hybrids with greater resistance become avail-able, growers will have a chance to purchase pollen and nuts for more breeding efforts.

Growers who choose this kit will he asked to sign a license agreement to the effect that any offspring from breeding is the property of ACF. The cost of these kits helps to support our ongoing research programs.

WHAT IS INVOLVED IN RAISING CHESTNUTS?

For many people, becoming a seed kit grower is simply a novel way to support an environmentally sensitive cause. For others it will be a way to reach back into our country's natural history in a long-term commitment.

For these people there is a range of tasks involved: planting seed, acclimatizing seedlings, building seedling and sapling shelters and fences, fertilizing the seedlings, keeping grass and shrubs trimmed away, monitoring growth, pollinating trees, and collecting and recording nut harvests. As with any living thing, care is essential.

As ACF's effort unfolds, these seed kit growers will occupy a special place in the restoration of a native species, and they will possess knowledge for generations to come.

For additional questions, or to order a seed kit contact: The American Chestnut Foundation, P.O. Box 4044, Bennington, Vt. 05201.

Christmas Greetings, 1994
Notes from Angus

Editor's Note: ACF Board Director and former Journal editor Angus McDonald brings us up-to-date on his health and thoughts. In his fight against Amyotrophic Lateral Sclerosis, known also as Lou Gehrig's disease, Angus shows a rare courage and an ability to distill truths important to human life.

Whether poring over the chapters and watermarks of his life, exploring new territory philosophically as his body and mind experience the changes wrought by ALS, and or deepening his sensitivity to family, friends and the world around him, Angus is an inspiration.

We reprint his Christmas letter in full. Some of us know and love Angus' family;for the rest of us Angus' telling of his family's stories reveals insight and inspiration. For that we thank Angus, his wife Susan and the McDonalds, one and all. Our thoughts and prayers are with you, Angus.

William Forrest McDonald-Newman born February, 10th to Louise and Jim, is known as Will to his attentive parents and doting grandparents. To some others he's Billy Tree, Gerber Baby, Crawling Baby. Wonder Baby. I recently realized that he is not the infant he was last month. He is coming to resemble a little boy, with all the challenges and revelations belonging to that exciting state of being. Higher education is one 0£ the poles around which the Minneapolis branch of the clan is congregated.

After spending much of the summer in the Czech Republic with our exchange student from two years ago, Elizabeth is applying to colleges. Her process was inconvenienced by the volleyball team she co-captained. Only after the season could she begin to visit some of the colleges on her list of liberal arts institutions with strong Russian programs. Her process was (and will be) convenienced by the State and National Scholastic Journalism Association awards for a piece on living with a dying parent.

Angus Bill chose to go to grad school in psychology, which has been his field since high school days. He is at Pittsburgh. His planned August wedding with Anita was postponed by the bride, who nonetheless spent her summer vacation from Case Medical School with him (and us). During his year with the parents in Minneapolis, Angus was statistics guru for the project on hyperactive children in the university's department of psychiatry, where he learned something about the big "U" and co-authored some articles. By E-mail and telephone he indicates that Pitt has afforded him a satisfactory niche intellectually and socially. Where will his love lead? His parents do not speculate.

Louise gave up her job at the Minneapolis Art Institute several months after Will was born, but continued her work in the English department, gradually moving toward a focus on composition. She carried three courses this autumn, but in the weekly dinners with which we are blessed, she talks about the course on Japanese literature she is a TA for. Meanwhile, Jim is so busy in his software consultancy, operating from home so he can share equally in the child care, that I am updating to "parent" the noun in the sexist mantra of my grandfather: "I'm glad I'm not a young mother (parent), and not soon likely to become one .

Susan holds down a full-time job (still at North Hennepin Community College), and continues to take courses in pursuit of her doctorate in art history, and continues to plan a studio in a new artist-owned cooperative. That's her spare time. Most of the time Susan is a nurse. And manager. Physical therapist. Accountant. Lawyer. And encourager. And encouragee.

The other pole 0£ the Minneapolis McDonalds' activities this year has been the struggle to deal with my ALS.

Last year I wrote to you about two miracles in the offing: one medical, the other human. The medication may have slowed the disease's progress; it has not, however, stopped it in its tracks like a silver bullet.

Amyotrophic Lateral Sclerosis is quite painless. What does it do?

In computer speak we used to talk about Input, Processing, and Output. Input faculties are unimpaired: I hear better than others in the house and have full feeling throughout. The Processor, the mind, is not much impacted by disease, although you'd be hard put to tell judging from the Output. Output is the part where ALS is operative.

This letter is being written on my fancy new software that works with a single switch. It takes longer than the keyboard used to, but it works nicely. I do love high-tech toys.

On my computer, the portable that does my talking for me now
that the tongue's muscles have lost most of their neural controls, I have a number of helpful sayings programmed in that deal with foreseeable occasions. One of them expresses how I feel about the wonderful people, the family and

the Chestnuts who so enrich our lives: "How am I? Rarely better, but even more better because you are here."
Who? How about Gay, Susan's sister, who drives up from Texas every month to help for two weeks. Or, the widely scattered McDonalds who topped a year of much coming and going by gathering in Minneapolis to celebrate our Mother's 80th birthday, children, grandchildren, cousins and one great-grand: 20 some odd strong.
Perhaps I should mention the former across-the-street-neighbor who cooks a French gourmet dinner for us each week; or my erstwhile poker & prayer group buddy, proprietor of Minnesota's best German restaurant who provides another weekly meal. Or the Chestnuts who gather every month for a potluck supper and update session.
This Christmas I celebrate the miracle of the Chestnuts, the community of family and friends who have given us so much this year who contributed to the fund which has made life easier, who have visited for an hour or a weekend, who have written, and who have planted trees at my instigation. I do love the attention.

Do keep in touch.

Angus
Minneapolis, MN

P.S. Bluebirds nested nine yards from our picture window this summer. Each weekend visit to Susurrus, our place on Lake Superior, has been marked by the sight of their dutiful, beautiful nesting behavior.
Bird-watching is a good activity for the wheelchair bound, I find, and everyone knows that shy bluebirds come with happiness. Some people think that they bring good luck, but today I believe that's too heavy a burden for such a frail bird.

Meadowview Notes 1994

F.V. Hebard, Superintendent
Wagner Research Farm

In 1994, the Meadowview area again was blessed with abundant, well-spaced rains. We had one, brief dry spell from about June 5 to 25, but in the long run it benefited our efforts to pollinate the trees since rain did not hamper our field work.

1994 NUT HARVEST

We had our largest nut harvest ever from controlled pollinations in 1994: 2,606 nuts, including 205 nuts from pollinations performed by Peter Devin in Connecticut (Table 1). Once again his contribution was a great benefit. For the last couple of years Devin has pollinated trees in Connecticut and sent pollen down to Meadowview, thus sparing me the effort and expense of traveling at the farm's busiest time of the year.

The increase in nut yield compared with last year was due to greater nut production at the farm; more and more of the farm trees are beginning to bear fairly large crops. Furthermore, they come into production a week earlier than trees in the mountains, so our pollination season has been lengthened.

The yield per pollination bag was only average, about one nut per bag, which was fortunate in some respects, since we then had enough room to plant all the desirable nuts. Some nuts were not planted because we produced more F_1 offspring than we needed and some were held back to be sold in seed kits. Also, excessive pollen contamination in some crosses forced us to discard 341 nuts.

Regarding pollen contamination, I am now convinced that flowers need to be bagged as soon as they exert their styles. We had been using the onset of anthesis (pollen shed) as a guide to the best time to bag, but in some trees anthesis almost always lags behind the beginning of receptivity. Overall, I was pleased with our 1994 harvest. Perhaps next year it will be even better.

TABLE 1

American Chestnut Foundation

1994 Nut Harvest from Controlled Pollinations.

Nut Type	Female Parent	Pollen Parent	Pollinated nuts	Pollinated bags	Pollinated burs	Unpollinated Checks nuts	Unpollinated Checks bags	Unpollinated Checks burs	Number of American Chestnut Lines
BC_1	American	Mahogany F_2	153	130	390	15	15	50	1
BC_1	American	Nanking	352	371	768	7	47	84	8
BC_2	American	Clapper BC_1	174	127	270	6	18	28	6
BC_2	American	Graves BC_1	257	319	632	9	37	78	3
BC_2	American	Mahogany x Clapper	449	315	959	14	37	100	3
BC_3	American	Graves BC_2	115	123	276	8	13	40	4
Chin BC_1	Nanking F_1	Nanking	61	32	99	0	4	17	
Chin BC_1	Mahogany	Mahogany F_1	98						
Chin x BC_1	Mahogany	Graves BC_1	107						
F_1	Miller 65-4	American	5	42	104	0	6	15	1
F_1	Meiling	American	491	346	828	10	34	87	5
F_1	Nanking	American	130	101	278	0	6	13	6
F_1	Orrin	American	49	34	102	2	4	7	1
F_2	Nanking F_1	Nanking F_1	85	66	237	1	8	26	
LS F_1	American	Dare's Beach	56	67	152	0	6	5	2
LS F_1	American	Weekly	24	32	63	0	3	6	1
Total	2606	2105	5158	72	238	556			

LS - large surviving

There were several volunteers who helped out with pollinating this year. I have already mentioned Peter Devin. Once again, Chandis Klinger came down from Pennsylvania and was the great help he has always been. Frank McClaugherty helped out at a critical time on a Saturday when no other help was available. Larry and Bob Peters spent two hard days out in the woods bagging. ACF Board Director Bill Lord put in a day pollinating at the farm. And last, but not least, Barbara Cox and her son, Alan, worked for six days at the farm,

bagging, helping out with inoculations and transplanting grafted trees. They were joined Saturday by Barbara's husband, John, who worked for long hours on one of the hottest days of the year.

I would be remiss if I did not mention Tom Jayne, who has done all of our grafting the past five years. His grafts of the Nanking, Mewling, Kuling and Mahogany cultivars of Chinese chestnut serve as critical controls for blight resistance tests. Additionally, they serve as mother trees for production of F_1 hybrids, which also are critical controls for blight resistance tests.

This year, in 1995, we will begin producing third backcross nuts in earnest, using as parents second backcross trees selected for blight resistance based on their response to inoculations made in 1994. The cross for the selected second backcrosses was made in 1989. These second backcross trees are some of the largest trees at the farm, so we should be able to produce a fair number of nuts from them.

If you would like to help with the 1995 pollination season, please contact me at: 14005 Glenbrook Ave., Meadowview, Va. 24361 or call (703) 944-4631 after June 5. We expect our peak times will be the weeks of June 12 and 19. However, this can vary depending on the weather which is why I request you call after June 5 when the timing for this season becomes more apparent.

PLANTINGS

As I write this in the last week of March, 1995, we have finished sowing the 1994 nut crop and the farm is full! There is only room for a few garden-sized plots! In fact, we had to rip out a few' orchards to squeeze in this year's crop.

There are now 5,838 trees in the ground, including 1,607 nuts planted this year. Table 2 show's the combined totals for trees and planted nuts of various types. Tree growth has been good: 4-year-old backcross trees had a mean height and standard deviation of 111 1 inches at the beginning of the 1994 growing season. The crosses for these trees were made in 1989, and the nuts planted in 1990, using aluminum cylinders and plastic mulch. The 3-year-old backcross trees were 82 inches tall in spring 1994, the 2-year-olds 52 3 inches tall, and the 1-year-olds 21 inches tall. At the end of the 1994 growing season, a fair number of 4-yr-old backcross trees were over 20 feet tall.

We are also well on our way to completing the first backcross for trees with the Chinese chestnut cultivar Nanking as their source of resistance. Furthermore, we have reached our goal of 20 American chestnut breeding lines each from second backcrosses from the 'Clapper' and 'Graves' trees. (See note on Table 2 regarding second backcross trees(BC_2).) We expect to begin releasing BC_3F_3 nuts from the Graves and Clapper trees in 2005, ten years from now!

TUBEX TREE SHELTERS

I also have news regarding the experimental planting with Tubex tree shelters, which was planted in 1990. We sowed pure American chestnut seeds directly inside the shelters, first punching a hole in the ground with a bulb planter and filling it with moist peat moss. (The old pasture sod had been plowed first, then disked and fertilized.) We used translucent, plastic shelters which are 4 feet, 2 feet and 1 foot tall, as well as our standard aluminum cylinders which are 10 inches tall. We mulched around the aluminum cylinders with black plastic but left the ground bare around the shelters. Weeds were controlled twice a year around May 1 with glyphosate (Roundup[a]) and simizine (Princep[a]) and July 20 with glyphosate only. For three years the trees were fertilized every two weeks between May 15 and August 7 with 2 quarts of MirAcid[a] mixed at 1.25 tablespoons per gallon of water. In 1993 and 1994 the trees were fertilized by sidedressing twice a year, around May 10 and July 1 with 200 pounds per acre of nitrogen and 60 pounds each of phosphate and potassium, mixed as before.

At the beginning of the 1994 growing season, the trees in the 4-foot shelters averaged 92 inches tall, while the trees in the 2-foot shelters were 87 inches tall. Those in the 1-foot shelters were 75 inches tall, and those in the aluminum cylinders were 77 inches tall. Although the trees in the 4-foot shelters were the tallest, there were no statistically significant differences between the treatments. The tallest trees in the plot were in the 4-foot shelters. These had grown up to the top of the shelter in their first season of growth. Other trees in the 4-foot shelters struggled to reach the top of the shelter, because they were not very robust. Tree shelters have the potential of accelerating the growth of chestnut seedlings, however there is a drawback.

TABLE *2*

Type and Number of Chestnut Trees or Planted Nuts at the ACF Wagner Research Farm *in April, 1995, with the Number of Sources of Resistance and the Number of American Chestnut Lines in the Breeding Stock.*

Type of Tree	Number of Trees	Sources of American Resistance	Lines
American	899	17	
Chinese	308	30	
Chinese x American: F_1	175	5	27
American x (Chinese x American): BC_1	400	9	22*
American x [American x (Chinese x American)]: BC_2	2463	2	38
American x (American x [American x (Chinese x American)]} : BC_3	173	2	4
(Chinese x American) x (Chinese x American): F_2	321	3	3
[Amer x (Chin x Amer)] x [Amer x (Chin x Amer)]: BC_1 -F2	422	2	1
Chinese x (Chinese x American): Chinese BC_1	208		
Chinese x American x (Chinese x American)	116		
Japanese	18	3	
American x Japanese: F_1	-	1	1
		-1	
(American x Japanese) x American: BC_1	5	1	1
Castanea sequmii	48	3	
Chinese x *Castanea pumila:* F_1	9		
Large, Surving American	16	6	6
Large, Surving American x American BC_1	143	7	8
Large, Surving American x Large, Surving American: I1	19	2	2
Irradiated American	54	3	3
Other	40		
Total	5838		

* The number of lines varied depending on the source of resistance. We will have to make additional crosses

in some lines to achieve the desired number of progeny per generation within a line.

The problem is that trees tend to branch copiously at the point where they emerge from the top of the shelter, rendering them useless for timber production. However, the drawback actually ends up being a benefit for us because the branch-free stem creates an ideal surface for inoculating for blight resistance.

In my opinion, tree shelters are useful for chestnut when the expense can be justified, that is when raising chestnut in areas where browsing deer pose an overwhelming problem.

IMPROVING OUR PLANTING METHOD

Our basic planting method is outlined above, although I failed to mention that we cover the aluminum cylinders with Styrofoam cups until the sprouted nuts grow to the top of the cylinder. Over the last 4 years, about 85-90% of the nuts we have planted have sprouted and more than 80% have survived the first growing season. After the first growing season most are able to develop into trees. I find these rates quite acceptable, but I continue to experiment with and improve the planting method.

Some of you may recall during the 1993 Annual Meeting that Randi Parker spoke about an experiment she planned to do at the farm in 1994. Randi's experiment revealed some differences between experimental treatments. We planted 24 American chestnuts with Styrofoam cups over the aluminum cylinders and 24 without cups. Only 6 of the nuts with no cups sprouted, whereas 22 of 24 of those with cups sprouted. Also, the 6 nuts which did sprout in the "no cup" treatment produced seedlings which only averaged 1 1j6.4 inches in height while the 22 nuts with cups averaged 20 inches in height. Both these differences were statistically significant.

I had tried a similar test in 1993, but emergence in both the cup treatment and the no-cup treatment was greater than 85%. The difference between the two experiments hinged on weather: in 1993 very little rain fell after the nuts were planted, whereas we had at least 1 inch of rain per week after planting in 1994, which continued until the nuts sprouted in mid-May. These results indicate that we now have an experimental method for evaluating the various components of our planting method: make similar treatments with cups and with-out, and irrigate the plot if it does not rain.

The take-home lesson is as follows: keep rain away from planted chestnuts. This has a strong bearing on the use of tree shelters to protect trees from deer because if you plant nuts in tree shelters and cover the shelter to exclude rain, there is a good possibility that the translucent shelter will overheat and kill the nuts. My current recommendation is to use the aluminum cylinder/Styrofoam cup method for planted nuts. If deer browse is a problem, use tree shelters, but wait until the seedlings have outgrown the aluminum cylinders.

BLIGHT RESISTANCE SCREENING

In 1994, we inoculated 4-year-old second backcross trees with the blight fungus. After one season of canker expansion we classified 36 progeny as having the same level of blight resistance as the Chinese chestnut trees planted in the orchard as controls. Fifty-two progeny were classified as hawing the resistance of the F_1 hybrid controls, and 34 progeny were classified as having the resistance of the American chestnut controls. These numbers fit the 1:2:1 ratio expected if two incompletely dominant genes control blight resistance. I should note that none of the 36 resistant progeny were as resistant as most of the Chinese trees. After further analysis, we rejected the hypotheses that blight resistance is controlled by either one or three major genes.

These results confirm our finding from the 1993 resistance tests in F_2 and BC_1-F_2 progeny. In those tests, 9 of 185 F_2 trees survived after the second season of canker expansion while 105 of 399 BC_1-F_2 trees survived. There may have been better survival in the BC_1 -F_2 trees because they were more vigorous than the F_2 trees; the F_2 trees were inbred whereas the BC_1-F_2 trees were not. The pure American chestnut controls and the F_1 hybrids succumbed to blight early in the second season of canker expansion. Also, 7 of 12 Chinese chestnut seedlings succumbed, as did 1 of 5 grafts of the highly blight-resistant Chinese cultivar, 'Nanking', and 1 of 5 grafts of 'Meiling.'

Given these results, it appears that it will be a relatively straight-for-ward process to backcross the blight resistance of Chinese chestnut into American chestnut.

LANDSCAPING WITH NATIVE TREES:
ACF MEMBERS AUTHOR BOOK

Trees give dimension to our landscape and ecology: the tallest species, the oldest living; springing from the ground, yet filling the skies above. They, more than most species, define the character of a habitat or region - how it changes and how it stays the same. And native trees do it best.

"They are beautiful and they belong. They reinforce our sense of place, evoking childhood memories and reassuring us that this, indeed, is home. When their basic needs are respected, they give us a landscape that makes few demands yet bestows the aesthetic benefits and seasonal nuances that only the most well-adapted plants - the natives - can provide."

So begins a new book entitled *Landscaping with Native Trees, writ* ten by two ACF members, Guy Sternberg and Jim Wilson. Sternberg is a registered landscape architect and holds a research position at the Illinois State Museum Botany Department. Wilson co-hosted the television program Victory Garden. To be released in March by Chapters Publishing Ltd., of Shelburne, Vt., this new title describes the habits, benefits and requirements of more than 100 native tree species -including our favorite, the American chestnut.

Written in a clear and lively style, this book contains nearly 300 pages of practical and aesthetic advice generously illustrated with dozens of photographs. The authors cover propagation, purchase, natural regeneration, wild collection and preservation of native trees. They have provided a section on specialty trees, a glossary of technical terms, a state-by-state list of nurseries that sell native trees, a list of conservation organizations and agencies, an extensive bibliography, detailed index and USDA hardiness zone map.

The authors define a "native" tree as one which existed in what is now eastern North America prior to the arrival of European settlers and as "one which has proven its adaptability to your climate and soil conditions over the past several thousand years!"

"Scientists know from tree-ring analyses, fossil records, glacier ice cores and other data that our pre-history was marked by frequent environmental upheavals that only the most adaptable species survived."

"... Considering the threats to our environment - ozone holes, global warming, air pollution, soil disruption, habitat destruction and the introduction of exotic pests to new habitats - nothing is certain. We live in an evolving system, and our actions - demographic and environmental - are accelerating the spiral of change. Thus it makes increasing sense to rely on our native plants, the survivors that have adapted to the changes in our regional environment and that continue to grace our wild lands, unaided by (or in spite of) human intervention."

According to the authors one of our most adaptable trees is the American chestnut - a fact that has become legendary. Its aesthetic value is nicely described: "... A grove of blooming chestnuts swaying in the wind looks like a pale green sea with creamy whitecaps."

The authors give considerable coverage to the American chestnut, describing its history, habit, the blight fungus that is still with us, related species and several paragraphs to efforts to restore this magnificent tree. ACF is named specifically, and efforts from introducing hypovirulence to genetic engineering are also discussed.

"We all begrudge what has been taken from us by the blight fungus. But there is a biological war in progress, and the formerly invincible blight is beginning to stagger."

Hopefully more people will see the merits of the American chestnut - one of our most important native trees.

Landscaping with Native Trees will surely be a handy book for any homeowner, gardener or conservationist. Suggested retail: $24.9S for the paperback edition, $34.95 for hardcover. Order the book through your local bookstore or directly from the publisher by calling: 1-800-892-0220.

DR. BURNHAM AT HOME

by Sally Conklin

I have enjoyed *The Journal* and *The Bark* since their inception partly because of my family's keen interest in horticulture, forestry and Christmas tree farming. But my interest in the American chestnut is due particularly to a special connection with an unusually optimistic man with whom I share fond memories.

Dr. Charles Burnham, beloved neighbor and visionary, spearheaded the American chestnut backcross breeding project and the establishment of The American Chestnut Foundation. Now past 90, Dr. Burnham resides at the care center in Roseville, Minn. I visited him in February on a visit home. when I arrived I was advised he might not be up for an extended interview. He had already had visitors and was experiencing some physical difficulties that might require hospitalization. But he spoke with relish about the current status of the ACF breeding project and our shared recollections, and three-quarters of an hour slipped away in seconds.

One of the things we share is a fondness for lamb. Charles grew up on a farm just west of Fort Atkinson in central Wisconsin, and on occasion, for a special meal, his mother would prepare lamb. When my son Craig began raising sheep on a farm near Menomonie, Wis., to complement the truck gardening, beekeeping and Christmas tree production our family was already engaged in, Charles was one of our half-lamb, freezer-ready customers for several years. This was a treat he especially enjoyed with his home-grown peas.

Following his rural upbringings, Dr. Burnham went on to the University of Wisconsin in Madison to complete his undergraduate education and to Cornell University for his doctorate. Nobel Prize geneticist Barbara McClintock was a classmate. Dr. Burnham had his first faculty appointment in West Virginia and he and Lucile Burnham were married in 1932. While at West Virginia Dr. Burnham first noticed male catkins (flowers) being formed on shoots that were emerging from the stumps of dead American chestnut trees; this information he filed in his memory for the future.

The Burnhams moved to St. Paul in 1937 to accept a position at the University of Minnesota in the College of Agriculture. St. Anthony Park, the community they chose to live in, is home to many faculty members at the nearby Lutheran seminary as well as the University of Minnesota. The St. Paul campus is still surrounded by experimental fields for agricultural crops where Dr. Burnham focused his professional attention on grain hybridizing, especially corn.

My grandparents had built a home on Branston Street in 1921. A young family in the contracting business, they may have chosen the neighborhood as one where churches and schools supported their values and intellectual pursuit was prized. In 1941 Charles and Lucile Burnham moved into an early American home which they designed and built to house the antique collection they received as a wedding gift.

The Burnhams lived on Branston Street in St. Anthony Park across the street from my grandparents for as long as I can remember. I grew up a few blocks away, but as a child I was struck by the similarities in the families' habits and interests. The Burnhams had two daughters, Sarah (called Sally) and Barbara; in our family I was named Sarah and called Sally and I have a sister Barbara.

The four girls shared a creative interest in designing and sewing our own clothes, an effort greatly encouraged by Lucile Burnham's example. An accomplished seamstress, she tailored wool coats and suits which garnered admiration for her stylish appearance, according to my mother. My sister and I were both 4-H club members who later went on to pursue careers in home economics. We all attended modern dance classes at the Community Interest Center in the library where both our mothers were active as board members and volunteers. They also shared an interest in books and reading.

Both our mothers had the enviable task of designing a family home according to their personal taste and interest. Both used oak extensively. The Burnham home had a lovely living room floor of random width tongue and groove oak boards, pegged and mortised with butterfly joints of darker wood. According to Sarah, who recently restored the home for sale, the window and door frames as well as the fireplace mantle were all made of pine in the early American tradition.

The home has always been shared by scholars and students. During a sabbatical leave to study at Cal Tech in 1947 and 1948, their home was occupied by the Sheldon Reeds. Dr. Reed was also a geneticist and later settled with his family a few blocks away in the same community. Interestingly, Dr. Reed has been a contributor of specially bred African violets to a local church bazaar for many years. Supporting the community in ways that utilize creative talents has been a common thread among these families.

The family home my mother designed was built a decade later than the Burnham's so the oak was light in finish and applied as plywood paneling. Inset shelves, trim and many cabinets were made of solid oak set off by contemporary accents such as flat, light-colored sandstone for the fireplace and glass blocks for admitting light in the entry.

Both yards were shaded by oak trees so shade-tolerant wildflowers predominated. This preference was likely encouraged by the weekend trips both families took into naturally wooded areas of the state. Today, both Burnham daughters live away from cities. Barbara is in Cook, Minn., near the north shore of Lake Superior, and Sarah lives in Gays Mills, in southwest Wisconsin near the Mississippi River.

My family's interest in horticulture and forestry' began with weekly Sunday afternoon trips to a 40-acre farm overlooking the St. Croix River which divides Minnesota and Wisconsin just east of St. Paul. Though no longer operated for profit, 'The Farm on Valley Creek' had once been planted to fruit crops - grapes, apples, plums and pears. Bitterly cold Minnesota winters and killing frosts as late as Memorial Day had made raising fruit a risky business effort. The farm became a spot for respite, not revenue.

Back home in St. Anthony Park, trees were truly appreciated. Streets were lined with elms and backyards were densely shaded by stately oaks. This might explain, in part, why the 1950s Soil Bank program which offered tree seedlings to homeowners for pennies was so well received. I remember my family tried to be tree farmers by planting and caring for the conifer seedlings on the Valley Creek farm. Now, as a "real" tree farmer's spouse I realize our efforts were some-what uninformed. We planted the tiny 4-inch tall seedlings among existing native grasses which grew to nearly 3 feet each summer. Of course, this kind competition destroyed all but the hardiest survivors. Of hundreds, even thousands planted, only a handful are alive today. Commercial tree growers must do better than that.

Though my spouse and I were both educators, our a vocation was Christmas tree farming, which eventually became a full-time business. We learned the finer points of raising forest crops for landscaping, Christmas trees, poles, posts and timber.

In 1969 we returned to St. Anthony Park where we bought a house on Branston Street, circa 1916. There our sons grew up and we became neighbors of the Burnhams for nearly 15 years before moving from St. Paul to our Wisconsin tree farm. The Christmas tree business provided jobs for many students in the neighborhood (including some who roomed with the Burnhams) doing summer tree shearing, fall harvest and winter delivery and sales.

During these years, our common interests in gardening, trees and plant genetics kept our families connected. The Burnham home featured an unusual backyard garden which seemed utilitarian as well as naturally suited to the site. Dr. Burnham's pride was a huge clump of pink and white Showy Lady's Slippers, the Minnesota state flower, *Cypripedium reginae.* Neighbors were invited to visit and see the flowers blooming, but otherwise the family did little socializing.

Sarah said she thought the clump died out due to the severe drought in 1987. However, as a scientist Dr. Burnham had a different explanation; he said a progressive root disease eventually weakened the clump. He refuted the drought theory because of the proximity to the bird bath which provided constant watering even during dry spells.

In the rest of the garden, profusions of meandering wildflowers grew among flowering shrubs, and the whole was heavily shaded around the edges. In the center of the yard a small vegetable garden provided some common crops such as carrots, potatoes, tomatoes, and squash. The Burnhams also tried some more unusual crops such as peanuts, parsnips, salsify (vegetable oyster) and yams, but the short growing season stunted growth. And to accompany his lamb, Dr. Burnham raised peas; in fact his peas were the earliest of any in the neighborhood.

Another connection between our families involved decorative, colored corn. After Mrs. Burnham was confined to a nursing home following a stroke, Dr. Burnham walked past our house every day to be with her for at least one meal. He also continued her volunteer work by collecting donations for the March of Dimes. On one of these collection visits he noticed the unusual colored corn decorating our door. Our discussion revolved around colored pericarp, the outermost layer of a corn kernal (the bit that gets stuck in your teeth) and dark red husks which I felt would make "rainbow" or "Indian" corn more saleable at our farm market in Wisconsin. He also agreed to try to develop miniature corn of the long, flint-cob type rather than the short strawberry type. This project lasted several years and resulted in some unusual combinations of pericarp color, cob size and dark or streaked husks.

We are no longer raising and selling decorative corn (again the short season interferes with product quality), but found the time spent together working on the project very enriching. When we tried to pay Dr. Burnham for the corn breeding work, he suggested we make a donation on his behalf to the then newly formed American Chestnut Foundation.

Because of our interest in trees and wood we were especially intrigued when Dr. Burnham described the goals of the foundation. He said that the American chestnut might be restored as a timber species by developing a backcross breeding program using Chinese chestnut, which is exactly what ACF employs today. Dr. Burnham's own interest in American chestnut had been piqued by reading a forestry bulletin written by Dr. Frank Kaufert, Dean of Forestry at the University of Minnesota, which mentioned chestnut as the finest American timber species and by articles reporting early but abandoned USDA efforts to breed a blight-resistant chestnut tree. He explained that the missing piece of the puzzle was an understanding of genetics and the principles of incomplete dominance of one trait over another.

After speaking with Dr. Burnham recently, I realize this endeavor drew from his early observations surrounding chestnut stumps and from intermittent reading about a topic which interested him. He realized that backcrossing to develop a blight-resistant American chestnut could work, and he garnered support from colleagues in many disciplines to pursue that goal. I thought how admirable this was, and what an unusual and special person would engage in such hopeful optimism. He seemed to apply both understanding and acceptance of the forces of nature as he used his scientific perspective to unravel mysteries of plant reproduction. Perhaps his efforts will be memorialized by naming one of the successful progeny after him.

Our final trade with Dr. Burnham, while he still lived on Branston Street, was a rhizome of his White Siberian Iris exchanged for some of our deep purple ones. When my husband recently brought me an iris bouquet of both colors cut from a "gone wild" garden on one of our Wisconsin tree farms I was reminded of the many contacts with the Burnhams we have enjoyed over the years. I think of his optimism and devotion when I realize that a man well past 70 was embarking on a 20- to 30-year project he would probably never see completed.

Currently I am working on a Ph.D. at the University of Pennsylvania in Philadelphia, but our home is in Wheeler, Wis. We maintain our ACF membership in the name of Roger and Sally Conklin. We sold our home on Branston Street in 1983 in order to build a new house with lots of oak trim, cupboards and some antique furniture on one of our tree farms. This saved us many hours of commuting and long distance phone bills, but we do miss the old neighborhood where I grew up.

Now, ironically, my mother, brother and his wife have bought a home on Branston Street. Sarah Burnham has restored her family home and sold it to new owners. I hope the irises bloom on schedule this coming June. The elm trees have mostly succumbed to Dutch Elm disease and have been replaced with Pin oaks, Green ash, maples and ginkgoes. The backyard oaks are still tall, healthy and provide even deeper shade. Perhaps someday, thanks to the astute reading and vision of Dr. Charles Burnham, Branston Street will be shaded by blight-resistant American chestnut trees.

IN THE MOUNTAIN SPIRIT

Using the bark from local chestnut trees architect Henry Bacon added rustic charm to Linville, North Carolina.

by Philip Morris
PHOTOGRAPHS BY TIM BUCHMAN

There are no buildings in the South more evocative of a particular place and time than the shaggy-bark architecture found in Linville, North Carolina.

Begun in the late 189Os, the mountain resort's lodge, houses churches, and other structures were mostly clad in shingles made from the bark of American chestnut trees. These trees, which once constituted as much as 40 percent of the forest, were wiped out by a blight in the 1930s. Though their memory lives on, you have to imagine great chestnut trees towering above buildings wrapped in their deeply fissured bark to appreciate the rustic poetry of the scene.

To make a connection from Linville to the great marble-clad classical cube of the Lincoln Memorial in Washington, D.C., would at first appear unlikely. But, in fact, Henry Bacon, the architect of the memorial (which opened in 1922), also established the Linville bark-clad style in the first house he designed at the resort in 1895.

Bacon had become a boyhood friend of Hugh Mac Rae in Wilmington, North Carolina. And though he moved away, later studying architecture in Illinois and subsequently becoming an apprentice at McKim, Mead & White in New York, Bacon kept in touch with MacRae. MacRae's family had, in the meantime, bought the fledgling Linville resort company of which he became president in 1891.

After several invitations, Bacon visited in 1895 and designed a series of houses and other structures off and on for the next 1 5 years from his base in New York City. While rustic style had already been established and some structures, such as the original Eseeola Inn, had been at least partly clad in wood shingles, Bacon set subsequent style for decades in his use of chestnut shingles. He further tied architecture to locale by using exposed beams of unstripped logs, lattice railings of the same material, and wide-plank entrance doors.

But being a classicist at heart (he had won a traveling scholarship to Europe and a visit to Greece confirmed his favored style), Bacon produced designs that are almost always symmetrical despite their rustic materials. Only those thought to be remodelings and additions to existing structures have elevations that are irregular.

Bacon's last project at Linville is believed to be All Saints Episcopal Church, which was completed in 1913. It has the features he most favored - a deeply recessed porch, exposed roof rafters under a deep overhang, log columns, and chestnut bark shingles covering both exterior and interior walls. The exposed roof trusses altar railing, and other interior features give the house of worship an unforgettable mountain forest aura. The architect's exquisite hand is particularly visible in the rondel window above the entrance where the shape is emphasized by bark cut and inset to outline the circle.

Claudia Brown, supervisor of survey and planning for the North Carolina State Historic Preservation Office, wrote the National Register of Historic Places nomination for Linville in 1979. She visited Linville a few years ago and found, happily, little had changed. (The stockholders of Linville Resorts Inc. are the "cottagers," and great care is taken to preserve the character of the place.)

"I found that Bacon's church was easier to see than before, because overgrown vegetation had been cut back or removed," Claudia points out. "But some streets have been made private and others converted to cul-de-sacs. I can understand the owners' desire for privacy, but it does make it more difficult to see the architecture."

The durability of the chestnut shingles is remarkable, deriving from the fact that the trees were almost totally insect resistant. All the more surprising, then, that a blight would wipe them out. But the distinctive shingles' long-term survival is threatened. Wind, sun, and moisture will one day take their toll.

"We have been patching with shingles salvaged from other structures for ten years and even more in the past five," says John Blackburn of the Eseeola Lodge. "There is no question that eventually they will have to be replaced."

Locust bark might be used, but it does not weather so well. Poplar bark is another option, but it lacks the deep, shaggy texture of the chestnut. And either may be beyond reasonable cost to do. Commercial cedar shingles may be the only alternative available.

Sad as that would be, the remarkable thing is how fresh and enduring the Linville style set by Henry Bacon 100 years ago still is today. The combination of rigorously detailed architecture realized in materials so right for the setting and spirit of the place - is like a breath of sweet mountain air.

LOGGING AND OTHER MEMORIES OF THE AMERICAN CHESTNUT

by Donald Swecker

Logging in the north-central part of West Virginia had passed its peak by the beginning of the 19OOs. Thereafter, and up through World War I and the Great Depression, lumber companies traveled to remote woodlands of the region's higher elevations where thousands of acres of high quality forest trees were still available. Such was the case on the steep ridges and plateaus of Cheat Mountain and the headwaters of Shavers Fork and Tygart rivers near Huttonsville, where I was born.

American chestnut was still plentiful in this region when I was a boy in the 192Os. The forests contained many other species of trees, chiefly oak and cove hardwoods. Chestnut grew almost everywhere, but preferred the dry slopes and ridges with southern exposure. At elevations of about 2,5OO feet, chestnut gave way to northern hardwoods.

Chestnut trees were most visible during their blooming period in late spring. Their white crowns rising slightly above the forest, reminded me of heavy frost or snow. The chestnut would attain heights of up to 100 feet and diameters of 48 inches or more. Individual trees often exceeded these dimensions.

My father was a woodsman and a blacksmith. Until his death in 1974 at age 93 he maintained a vivid memory of "wild chestnuts " as he called them. Born in 1881, he grew up during the period when chestnut and oak dominated the mountains of this section of West Virginia. His father advised his children not to cut a chestnut on the family farm until the tree grew to a height of 70 feet or more.

I cannot remember when I became aware of the chestnut blight, but it must have been in the mid-1920s. There was a chestnut grove on our farm, and individual trees grew along fence rows and the roadway. On their way home from school, children would fill their pockets and lunch pails with the tasty nuts. Families gathered and sold them to local merchants for about 4 per pound to buy school books and other necessities.

The smooth bark of younger chestnut trees was an ideal place for people to carve names and messages. The bark of the tender sprouts could easily be twisted off and fashioned into a crude, but popular whistle. The limbs of a "spreading chestnut tree" made solid foundations for tree houses and swings. To anyone thinking of venturing into a chestnut grove barefoot: beware of the prickly burs!

The nuts of the chestnut not only served many household uses but were fed to domesticated animals. Wildlife particularity benefited when the nuts fell in the fall. Gradually, though, the chestnut trees began losing their limbs to the blight and consequently their productivity. By the early 1930s the trees were all dead in this part of the state. Their legacy was bequeathed to the lumber companies that salvaged as many of the blighted trees as they could while they were still marketable.

My father was the blacksmith for a number of different logging companies over the years. His last job was with Wilson Lumber Company. He and mother had a large family, and all their children were born in or near logging camps. Our frequent invitations to enjoy dinner and entertainment at the camp gave me an opportunity to observe camp life and learn about the logging operation. A favorite time was Thanksgiving Day, when the camp cook prepared a special feast for the woodsmen and their families.

The Wilson camp was a complex of buildings along a creek and a company-owned railroad. A bunkhouse, kitchen, blacksmith shop, barn and other facilities served the camp. The company's offices, sawmill and general store were located in Mill Creek, several miles down the valley. Two trains, each powered by a Shay locomotive, visited the camp daily to deliver mail, provisions and passengers, and to pick up logs. A log loader, on tracks, was used to load the logs on flat cars.

When sawyers were felling trees in the woods, there was always a lot of yelling and hooting going on. Often, I could hear trees crashing to the ground and the voices of teamsters urging their horses along as logs, tied together by grabs, were pulled down the skidroads and slides to the landings. On steep slopes, teamsters sometimes used grousers (chains wrapped around logs in a trail) to slow the logs down. A J-grab, or similar device, permitted a team to become detached from a trail of logs running too fast, preventing injury and perhaps death to the horses.

At this camp, the woods crew consisted of a woods boss, sawyers, buck swampers and their crews, road monkeys, saw filers, scalers, grab drivers, teamsters and landing tenders -- all working for wages and receiving board and room. A sawing crew's equipment included a crosscut saw which was operated by two men, spuds, peaveys or cant hooks, a measuring stick, wedges, axes and sledges.

My father shod horses, as many as three teams per day, five days a week. Sometimes a horse would "throw a shoe" on a skidway or steep slope and need re-shoeing immediately.

All teams received new shoes, toes and corks on a regular basis. His shop was equipped with an anvil, forge, tongs, vises, hammers, punches and other blacksmithing equipment. Repairing broken tools and often forging new ones kept a smith busy.

The camp kitchen and dining room were operated by a chief cook and his apprentice, who was called a "cookee". The company store supplied fresh meat, vegetables, canned and dry fruit and other staples. Hogs were kept nearby and butchered from time to time. Plenty of pork was salted and peppered for winter use.

The logging camp, general store, horses, tools, trains and track and all other equipment was owned by the company. Timberlands were either company-owned or leased. Workers were responsible for supplying their own clothing, including cork shoes, gloves and boots.

Logging companies helped supply lumber and other forest material for homes and industrial purposes in distant cities. Chestnut was much sought after because it was ideally suited for framing, building foundations and for paneling. Locally, chestnut was used for building homes and other buildings. Rail fences, entirely of chestnut, are still in use on mountain farms. Chestnut posts, sunk into the ground on my own family farm nearly a century ago, are still serving their purpose.

Like the American chestnut, early methods of logging have all but disappeared. Modern equipment and technology have replaced horses and Shay locomotives once used to haul logs. Logging operations follow better forestry practices. Woods workers and other logging personnel enjoy better working and living standards. American chestnut made up more than 25% of the forest hardwoods of West Virginia; while 7 million board feet of lumber was produced in this state in 1993, it is unlikely that a single board foot came from an American chestnut tree.

SAVING THE AMERICAN CHESTNUT THROUGH GENETIC ENGINEERING

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This article is adapted from a piece which originally ran as "The American Chestnut and Test Tubes" in the New York Forest Owner, March/April 1994.

INTRODUCTION

We are attempting to design an entirely new gene for blight resistance; one which when inserted in American chestnut will help this tree species fight off blight. Our research is a joint effort between Dr. William Powell in the Faculty of Environmental and Forest Biology and myself in the Faculty of Forestry with a team of dedicated graduate students. We are working at the College of Environmental Science and Forestry in Syracuse, New York, and our efforts are partially funded by the New York Chapter of The American Chestnut Foundation.

CONCEPTS

There are two parts to the project. The first part is to identify a naturally produced compound capable of stopping the growth of the blight fungus. The second part is to develop a method of delivering the gene that codes for that compound into individual cells of chestnut and regrowing those cells into a whole tree. Within each of these two areas of research there are dozens of steps, any one of which may take weeks to months to accomplish. It will be a long project.

PROCESS

The first step in identifying a potential resistance gene is to examine ways in which other organisms combat fungal attacks. One defense mechanism that combats fungi directly employs enzymes designed to break down the fungal cell walls. Many plant species, including chestnut, use this defense mechanism. Unfortunately, the blight fungus evades the chestnut's defense enzymes by producing enough acid in the immediate area of a developing canker to inactivate the enzymes.

Another defense mechanism organisms use involves releasing very short strands of specialized defense proteins that are just long enough to span the cell membranes of attacking fungi. Essential minerals then leak out, and the fungus dies.

Although they do not attack as directly as an enzyme that simply rips apart the fun gal cell wall, these tiny proteins can be just as effective. A number of different organisms including some moths, frogs, bees, pigs, and probably many others, produce mini-proteins with these properties, but to our knowledge, American chestnut does not -not yet that is.

Dr. Powell and his graduate students are testing several of these small proteins to see which are most effective against the blight. The ideal mini-protein would be one that is deadly to the fungus at a very low concentration, but causes no harm to the plant even at much higher concentrations. In addition, it should be completely non-toxic to humans and wildlife who will someday eat the chestnuts. After identifying a mini-protein that comes closest to this ideal, the next phase of the project will be to build a gene to make these mini-proteins inside the plant cell.

The second part of the project involves actually transferring the gene into-cells of a chestnut and regenerating those cells back into a whole tree. Since the mini-proteins are still under development, we are working with other engineered genes to develop the gene transfer and plant regeneration techniques. In this way, both parts of the project can move forward simultaneously.

The gene-transfer process will actually be carried out by a bacterium called *Agrobacterium tumefaciens,* a natural genetic engineer. Wild *Agrobacterium* live in the soil and invade small wounds near the root collar of many plant species, including chestnut. When this bacterium invades a wound it attaches itself to a plant cell, pokes a microscopic hole into the cell, and injects small pieces of DNA. The DNA travels to the nucleus and is incorporated into the chromosomes of the plant. Wild *Agrobacterium* injects genes that cause the plant's cells to divide rapidly, producing a warty gall, called a "crown gall". The bacteria then live and multiply happily inside the gall.

Bacteria are much easier to manipulate than plant cells. It is a routine procedure to remove the small segments of DNA that *Agrobacterium* injects into the plant, cut out gall-inducing genes, replace them with "designer genes," and reinsert the segment of DNA into *Agrobacterium.* These "tamed" laboratory strains can no longer cause gall formation, but they can transfer the desired DNA to plant cells.

The final step is to regenerate whole plants from the transformed cells. At the tip of every growing shoot is a region of a few cells called the apical meristem. These cells are unique in that they grow and divide very rapidly, and are capable of producing all the above-ground portions of a plant. We are now attempting to cut thin slices through the tips of tiny chestnut shoots and transform them with *Agrobacterium.* We know that we can regenerate new shoots from these shoot tip slices, but we do not know yet if the *Agrobacterium* can successfully transform them. This work is just beginning, and we won't know if it is successful for several months.

COMMENTS

What I have outlined above is a research plan and a description of work in progress, not a finished project. We have enough results to be excited about continuing, but we are many years away from having blight-resistant trees. However, the basic philosophy and procedures for genetic engineering of plants outlined above have been used successfully in transferring useful genes to other valuable crop species such as tomato, corn and potato. Closest to commercial release is the Flavr Savr¨ tomato. This new variety produces fruit that turns bright red and sweet just like the standard varieties, but the flesh stays **firm** much longer. Typical "store-bought" tomatoes must be picked green so that the fruit can withstand shipping, but Flavr Savrs can be vine-ripened and should arrive in the grocery store with much more of their "just-picked" flavor. Thanks to biotechnology, Christmas dinner may include salads topped with sweet, juicy tomatoes and American chestnuts roasted once again over an open fire (or, perhaps in the microwave).

DEVELOPMENT OF AN AMERICAN CHESTNUT TREE INFECTED WITH HYPOVIRULENT BLIGHT

Frederick Paillet

Borehole Geophysics Research Project
US Geological Research

The tragedy of chestnut blight is well-known to members of The American Chestnut Foundation. We all know how quickly the blight spread and how universally lethal it proved to be for the large chestnut trees in our forests. We also know that the root systems of chestnut trees are somehow immune to the blight, so that the surviving roots serve as living mausoleums for the former forest trees. These root systems continue to produce sprouts that survive as shrubs or small trees in the understory of oak-chestnut forests.

I have studied these populations of chestnut sprouts in an effort to understand how they interact with blight, and a number of facts have become apparent. First of all, many of the sprouts seemed to have arisen from the roots of former seedlings that had never been much bigger than they are today. Second, there are other hazards to stems living in the understory that seemed to be more important than blight. I suspected that when the actual mass of living chestnut material was small and the blight lethal to small stems, blight was not a significant factor in the life cycle of chestnut sprouts. I reasoned that there was little material for the blight to grow on in such forests. Small stems died so quickly after infection that active colonies of blight weren't around very long to serve as a source of further infection. Only when there was a major disturbance to the forest, resulting in sudden release of chestnut saplings, did blight develop into a real epidemic. In such situations, the amount of living chestnut tissue increases enormously, and blight finds fertile ground for growth and propagation.

The appearance of hypovirulent blight will probably have a profound effect on the life cycle of chestnut sprouts in the forest. Hypovirulence results when a viral infection of the blight fungus renders blight much less damaging to chestnut. I make such a suggestion about the long-term effect of hypovirulent blight because the ability of chest-nut sprouts to survive with blight infection means that both host and parasite can coexist. Trees surviving infection can serve as a source of blight infection for neigh-boring trees and for other parts of the infected trees over an extended period. With more pro-longed infections in single trees, one expects to see the incidence of blight increase dramatically in the forest. I suspect that these changed conditions may increase the natural tendency to select for blight resistance. All of this is mostly speculation. Some hard study and the collection of data in the field will be needed to determine the long-term effects of hypovirulence on the chestnut sprouts in our forests.

In this short report I present strictly anecdotal evidence. I have been following the career of a typical chestnut sprout at one of my study sites through multiple rounds of blight infection. The original stem was already decades old in 1986, has suffered several rounds of blight infection, and survives today. Although limited tests on canker tissue from this tree were inconclusive, I suspect that this tree has survived through the agent of hypovirulence. Line drawings made at several stages in the life of this one tree illustrate the shape of the future to come. My drawings show how the survival through multiple cycles of infection has changed the shape of a typical chestnut sprout. Based on my examination of numerous trees surviving through hypovirulence in Connecticut, I believe this tree is typical of many others. The only difference is that I have been able to record the specific changes in cankers and tree shape over time.

The sprout we are following grows on a small island of forest which was once part of a continuous woodlot in Reston, Virginia, a few mile away from Dulles International Airport. The land was once planted to tobacco, but was abandoned to natural regeneration some time about 1880. Abandoned fields in eastern Virginia quickly become populated with a dense cover of eastern red cedar and Virginia and shortleaf pine. There are still a few living red cedars and Virginia pines in this woodlot, but the forest has mostly become a mature stand of mixed oaks - white, southern red, and black - and chestnut. The forest also contained a number of smaller chestnut trees in the 1920's when blight appeared in this area. Today there are many typical chestnut sprouts in this woodlot, along with about an equal number of somewhat smaller, but otherwise similar, chinquapin sprouts.

The sprout in my drawings originated about 1955, a figure derived from annual increment rings counted from a boring in the stem about 3 feet above ground level. The single upright stem must have originated from the base of a small sprout killed by blight, or by many of the other hazards of life in the understory (Figure 1A). I suspect that this was not a case of severe damage to a healthy stem, because such damage usually releases several new sprouts, producing a multiple-stemmed tree. A more likely scenario is that an older stem reached the end of a long career in the understory, and a single vigorous sprout was released. It is possible that this tree originated about 1955 as a seedling, but the extremely limited seed source for chestnut at that time makes this highly improbable. We know for certain that the single stem I found in 1986 had originated in 1955, and there were no remains of a stump or log to indicate that this sprout came from the base of a former large tree.

The location where this chestnut sprout was growing was sold for industrial development in the 1960's, and an access road constructed within a few feet of the sprout. Opening of the forest canopy resulted in improved light conditions for this sprout, indicated by an accelerating growth rate as shown by the series of ring widths we measured in the late 1970's. We can be pretty certain of this series of events because we know the road was built about 1968. By about 1982 this tree was a thrifty-looking chestnut sapling more than six inches in diameter, and reaching almost into the canopy (Figure 1B). The shape of this tree is typical of the form of most chestnut sprouts subjected to partial release, as are the diameter increase rates of about a centimeter per year we measured on the core.

When I first spotted this tree in 1986, it stood out in the forest because the top was clearly dying (Figure 1C). The cause of the distress was obvious: there was a very typical looking blight canker on the lower trunk of the tree. I was mildly surprised that the top of the tree was not actually dead, because the branches induced by the injury in the vicinity of the canker had become unusually large. In short, this did not seem to be a typical blight canker. The top of the tree had been alive too long, and it was unusual to see small, secondary branches at the canker remaining so healthy.

A return visit to the same tree the next year produced the astounding observation that the upper crown had lost most of its distressed look, and the canker seemed to be healing. Later, the observation did not seem so surprising, because hypovirulence had begun to appear at several different locations including Michigan and Virginia, indicating that it had "spontaneously" developed in the wild. The canker of this tree seemed to be healing (Figure 2A), and I assumed that this was yet another example of hypovirulence in the wild.

Over the next year I made arrangements for a colleague to visit this tree and collect a sample of tissue for analysis. Subsequent culture of samples from this canker showed no blight at all. An inspection of the tree the following year suggests why. The canker had healed so completely that there was probably no living blight at the time the sample was taken. So the hypovirulence could not actually be documented. In 1989 the tree itself appeared to be completely healthy except for the major scar from the former canker (Figure 2B). The branches near and just below the scar lost some of their vigor as vascular transmission to the upper crown resumed, and as the top of the tree shaded the lower part. The smaller of the lower branches were failing or dying, while the growth of the one major lower branch had definitely slackened. I also noted several burs on the ground, demonstrating that this small tree was producing a few female flowers. Some of the burs were empty, but this may have been a result of the lack of pollination rather than the condition of the tree because only a few of the many other sprouts in the area were big enough to serve as pollen sources.

Another visit to this tree two years later showed that hypovirulent blight continued to be actively infecting the tree. The old scar from the first canker was completely healed, but a new canker was forming at the base of the tree (Figure 2C). The crown of the tree was showing the effects of the new infection. Even so, or perhaps in response to the stressing of the tree crown by the vascular constriction produced by blight infection, this tree managed to produce a number of fertile burs which were evident on the ground beneath the tree. Although the overall shape of the tree had not changed in this mid-winter view, brown leaves clinging to two large branches indicated that the crown was dying back (Figure 3A).

My last visit to this tree in the fall of 1994 showed that the number of hypovirulent cankers has continued to increase. The second canker at the base has healed, leaving another patch of exposed, dead wood (Figure 2D). At least three more developing cankers were evident as swollen bulges of tissue between the sites of the two earlier infections. The shape of the tree has come to resemble that of the trees infected with hypovirulent blight in Connecticut (Figure 3B). The overall shape of the tree is characterized by the central trunk with a number of large, dead upper branches. New growth continues as a dense mass of foliage carried by small shoots from the main trunk, and from the basal parts of the larger, dead branches. The old, lower branch joining the trunk at the site of the original canker has once again become the most vigorously growing part of the tree, and is shading out other small branches that had been growing in the lower part of the canopy.

I suspect that the tree as we see it now represents the future of many chestnut sprouts infected with hypovirulent blight. The growth form of these trees will be characterized by cycles of rapid growth of new shoots and side-branches, followed by die-back. Probably the most important aspect of this life form is that such trees can produce nuts. The ability to reproduce sexually while being influenced by blight means that the infected trees can be selected for blight resistance. The most vigorous trees will be able to produce nuts, and the vigor of the trees will influence the rate of seed production. Although trees such as those illustrated in my drawings are not very pretty to look at, their survival bodes well for the long-term future of chestnut in American forests.

Generating New Plants through Tisue Culture Methods

work in progress by Dr. Paul Read and Erika Szendrak

Editor's note: In December of last year we asked ACF members to contribute to a scientific effort that would test advanced generations from our breeding program for both blight resistance and conformity to American chestnut growth form. Described below are the methods Dr. Paul Read and his graduate students use to create new plants from the ACF hybrids, plants which can then be planted in the field and studied.

INTRODUCTION

Trees can be as individual in their genetic makeup as people. The gene pool is complex enough that each seed grows into a plant that is a

complete individual. For example, all apple trees that bear Golden Delicious apples originally came from one tree that is located on a hillside in West Virginia. The same is true for the tart, bright green Granny Smith apple; all these trees hail. from one tree in Australia located on Granny Smith's property. These trees developed as chance seedlings, and efforts to propagate these specific varieties sexually would not produce trees with the same characteristics. But by propagating them asexually - tissue culture is one such method - the genetic integrity of the clone or cultivar is maintained.

The American Chestnut Foundation is funding a tissue culture project this year for many of the same reasons. We want to be able to reproduce exactly several of the most promising American chestnut hybrids and we want to see how these cloned trees fare when planted in different settings.

BACKGROUND

Many different research efforts are under way worldwide to perfect techniques in tissue culture, but we began in the late 196Os with chrysanthemum. Often referred to as micropropagation, the process involves taking tiny samples of living tissue and regenerating them into large numbers of intact plants under sterile laboratory conditions. At the start there were only a handful of plants that people had successful regenerated. Over the years we've been very successful with many species; the process is now routine for petunias, azaleas, and blueberries and we've successfully regenerated plants of more than 300 different species. We began working with chestnut in the early 1980s, about the same time ACF formed.

PROCESS

The process of culturing American chestnut hybrid tissues begins at the Wagner Research Farm. Dr. Fred Hebard, ACF staff researcher, cuts stems from some of the most promising hybrid trees during the dormant season and sends them to our laboratory.

All work done in the lab is conducted under very sterile, almost hospital-style conditions - tools are sterilized and all surfaces are very hygienic.

We begin by cleaning up the stems and then "forcing" them to come out of dormancy and begin producing new shoots. We do this by putting the cut stems into a solution that is very similar to the materials one adds to the water for roses to keep them fresh longer. We want the buds to elongate into soft new shoots. In the case of chestnut, we use an auxiliary bud, which is formed in the angle between the leaf and the stem.

Once these shoots have grown to length of about 1/2 inch we cut them into pieces called explants and put them into a flask on a medium of several materials. The composition of the medium is precisely calculated and varies from species to species.

A culture medium includes nitrogen, zinc, phosphorous, and other elements to fertilize the little shoots and nutrients that plants normally make for themselves such as sugar, vitamins and several different hormone-like substances. Cytokinin stimulates shoot formation and auxin induces roots. Since the objective with tissue culture methods is to generate as many shoots as possible from each little plant, having the right balance and type of plant growth regulators on the medium are vital. All these materials are then jelled together with agar, a substance derived from seaweed, that works to solidify the medium in much the same way pectin does in jams and jellies.

We allow the explants to sit on the medium for several months, but within four to six weeks we see the first flush of growth. In six to 10 weeks we cut those shoots off and use them to start new cultures on fresh medium. We continue this way to build up the numbers of shoots to about 400.

When the shoots are about 2 inches in height, we transfer them to a new medium where they can form roots. Our goal is to get these shoots to form roots the way a cutting does and then work through the process of adjusting the new plants to the real world - the most difficult stage of the process.

OBSTACLES AND HOPES

Some plants which have been micropropagated are more difficult to root than others; in fact, there seems to be a hierarchy with some easier to root than others. The easiest are plants like tomato, petunia and chrysanthemum; next on the ladder are shrubby plants like potentilla and spiraea followed by plants like lilac. Shrubby plants, are, in turn, easier to root than trees, with willows and poplars are easier to root than hardwoods such as oak and chestnut.

And, although chestnut is difficult to root, it is also highly variable in the number of cultures each parent stem will produce. Of the stems Hebard sent last year, one stem has produced more than 400 cultures, but another stem has produced only one or two cultures. Chestnut is that variable.

Nonetheless, as Hebard sends stems from only the most promising plants, any micropropagated plants we can generate will be useful for field testing. Furthermore, once we have the system well enough under way we can include more advanced hybrids and multiply them faster.

Our goal is to develop a minimum of 100 rooted plants from each individual with the idea that ACF could then plant these hybrids in a range of locations across the United States.

Acknowledgement: This work reflects the efforts of a number of individuals who have worked in our laboratory including: Yang Qiguang, Rod Serren, Charles Auko, and Guochen Tang.