Islands of Chestnut Trees *Castanea dentata* (Marsh) Borkh

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THE purpose of this paper is to emphasize the importance of conserving the great genetic pool of the American chestnut stock in this country. We wish to encourage those who are willing to seek sprouts and plant them in islands where they will be protected so they can grow and survive. Local school yards, parks, scout camps, etc. may provide practical places. Science clubs, garden clubs or scout troops could be encouraged to do this work because it provides an opportunity to learn and may promote the American chestnut's survival. In the future, such a genetic pool might provide the trees from which researchers could find a solution to save it from the blight.

An aesthetic appreciation of the American chestnut is probably essential in any effort to save this former forest giant. Henry Wadsworth Longfellow's famous lines are familiar to most of us:

> *Under the spreading chestnut*
> *The village smithy stands.*
>
> (Longfellow 1839)

Henry David Thoreau wrote:

> What a perfect chest the chestnut is packed in! With such wonderful care Nature has secluded and defended these nuts as if they were her utmost precious fruits, while diamonds are left to care for themselves. (Comstock 1939)

In the early development of this country, the American chestnut (*Castanea dentata*) comprised as much as a quarter of the eastern hardwood forest and probably had a natural range of as much as 200 million acres (Kuhlman 1978). The chestnut is a large beautiful tree in any season: a deep green in summer, a golden yellow in fall and a distinctive silhouette against a winter sky. The wood is rather light in color and weight, fairly hard, strong, stiff and splits quite easily. Trees often grow to a height of 70 to 100 feet and a diameter of four feet, although there have been reports of some American chestnuts growing to a height of 120 feet and a diameter of 13 feet (Braun 1961). The largest trees were found in the Great Smoky Mountains of Tennessee and North Carolina.

In 1905, H.W. Merkel, then chief forester of New York City's parks discovered a disease of the American chestnut in the Bronx parks. This disease was caused by a fungus which was first called *Diaporthes parasitica*, but later changed to *Endothia parasitica* (Murr). It is probable that this disease had been present for several years but unnoticed. It is generally agreed that the fungus entered this country when Asian chestnut trees were brought into New York at the turn of the century. The blight spread rapidly, and by 1909 the U.S. Department of Agriculture indicated that most of the chestnut trees within a 30-mile radius of New York City were infected and that it had spread to at least eight states (Jaynes 1978).

Endothia parasitica is a highly specific fungus that grows well on the substrate provided by the American chestnut tree. Any growing tree will incur small wounds such as those caused by insect borers, woodpeckers, wind breaks, freezing, etc. Any wound results in cellular injury, with a loss of fluid at that point. This material provides the unique environment for germination of the blight's spores. The spores of *Endothia* are extremely small, almost smoke-like in particulate size. They are either wind-borne or carried by insects, birds or other living things. A wound provides the spore with essential nutritive materials, allowing it to germinate and produce hyphae, filaments structurally similar to those visible in moldy bread. The hyphae of the chestnut blight grow, resulting in the destruction (digestion) of the cells between the bark and the underlying wood. This area contains the tree's differentiating cells and its active fluid-conducting vessels. The destruction of these cells results in a canker. A tree girdled by a single canker or by several different ones dies (Horsfall & Dimon 1959).

In 1938 a blight of the European chestnut tree (*Castanea sativa*) was reported in northern Italy. It seems that *Castanea sativa* is as susceptible to *Endothia parasitica* as is the American chestnut. This malady spread through the European chestnut trees in much the same way it had spread in this country. In 1951 Antonio Biraghi, an Italian plant pathologist, found trees that seemed unusually healthy after repeated

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attacks by the fungus. It is not surprising that few people took Biraghi's report seriously. He was persistent, however, in his claims of chestnut tree recovery, and his work was supported by the French mycologist J. Grante. In 1950 Grante went to Italy where he studied the recovering chestnut trees and took samples of their bark back to his laboratory in Clermond-Ferrand. He isolated the blight fungus that seemed to have reduced virulence and called it hypovirulent.

Such strains have been carefully studied in culture and it seems the (H) hypovirulent strain segregates into (H) hypovirulent and (V) virulent strains while the (V) virulent strain remains constant. The recovery of the Italian chestnuts was due perhaps to the introduction of a different strain of *Endothia parasitica* (hypovirulent) by some natural means. A theory with some support was that the hyphae of the (V) virulent would anastomose with the (H) hypovirulent hyphae of *Endothia parasitica* in the host tree. It would introduce some genetic determinant to the (V) virulent strain and convert it to the (H) hypovirulent strain, from which the tree could recover.

Using hypovirulent strains of *Endothia parasitica* in controlling American chestnut blight has been studied at the Connecticut Agricultural Experiment Station at New Haven, The University of West Virginia, etc. Some progress has been made.

There is now a better understanding of the nature of (H) hypovirulence. It is currently thought that hypovirulence is caused by a viral disease or perhaps several closely related viral diseases of the blight, *Endothia parasitica* resulting in the hypovirulent strains. This seems to lessen the malignancy of the (V) virulent form without lessening its ability to grow on the American chestnut. When hypovirulent strains were examined, they were found to contain double stranded RNA (ds RNA); ds RNA has not been found in the (V) strain. There is evidence that ds RNA is present in some virus components affecting fungi (Anagostakis 1978).

An effort to produce blight-resistant chestnuts was begun in this country in 1909 by the USDA's Division of Forest Pathology. There are 13 recognized species of chestnut native to Asia, Europe and the United States. Only the American chestnut was really a worthy forest tree and, in addition, produces a nut of excellent quality. Various hybridization work has been carried out in this country in an effort to find a suitable blight-resistant forest chestnut tree. Such work is certainly valuable, but it is slow and requires many years of continued effort. This effort was initiated by Arthur H. Graves and has been continued by Richard A. Jaynes since 1931. This work is still carried on at the Connecticut Agricultural Experiment Station. A large hybrid planting was established in Lesesne State Forest in Virginia; as many as 10,000 hybrid seedlings were planted there from 1969 to 1975 (Jaynes 1979). This was done with financial assistance from Mrs. Arthur Valk and the cooperation of the Virginia Division of Forestry (Jaynes 1978). This short-term effort is most important; equally important, though, is its long-term goal of finding a substitute for the current American chestnut.

A comprehensive study to breed blight resistant chestnuts was completed in 1986 by C.R. Burnham, P.A. Rutter and D.W. French of University of Minnesota's department of plant pathology (Plant Breeding Reviews Vol. 4, 1986). This study emphasizes a Mendelian approach to solving the problem. However, it is a long term program that requires trees to be old enough to produce viable nuts. It should be possible to reduce this time by using American chestnuts that have been hybridized with the blight-resistant Chinese chestnut (*Castanea mollissima*). With careful selection and proper backcrosses, it is logical that a resistant strain that has the qualities of the American chestnut could be obtained.

This work has been well publicized with the establishment of the American Chestnut Foundation and publication of the August 1986 issue of its journal (Willeke 1986).

A statement by E. Lucy Braun in her 1961 book, *The Woody Plants of Ohio,* has challenged this effort. "Chestnut has a remarkable power of sprouting from stumps, and formerly sometimes formed dense coppices with as many as 300 sprouts from a single stump. Few living sprouts are now seen" (Braun 1961). However, it is evident to anyone who has roamed the wooded ridges of northern Ohio that this statement is untrue.

It is so easy to say the chestnut is gone and where it once stood the other hardwoods—maple, beech and oak—have taken its place. The soft woods would perhaps grow more rapidly, be more easily secured and handled to offset any unique quality of chestnut. Even though change is the universal constant there is certainly a deep aesthetic desire on the part of the American public to save *Castanea dentata.*

Many sprouts that are still living continue to hang on in their struggle for survival. It might be that the vegetative habit of the American chestnut may in the past have carried it through other periods of adversity. Unfortunately, it seems it is just generally assumed that since the parent trees died of the blight, if and when their sprouts get to be a reasonable size they will also die of the blight. It is, however, no more logical to assume that all parent trees died of the blight than it is to assume that they did not. Is it possible that somewhere there is a genetic constitution resistant to the disease?

Man has played a most serious role in this tree's close approach to extinction. During the settlement of Ohio, mostly after the War of 1812, these trees were

cut in great numbers. The finest were probably the first to be taken. The remains of chestnut fence posts and fence rails, still common throughout this tree's range, attest to its wide use; it was used to fence thousands of acres in Ohio and neighboring states. If the parent trees did die of the blight, then it is true that the asexual sprouts will probably die of the blight; but this assumes that *Endothia parasitica* is not struggling for existence. Robert Frost has written it well in his brief poem:

Evil Tendencies Cancel

Will the blight end the chestnut?
The farmers rather guess not.
It keeps smoldering at the roots
And sending up new shoots
Till another parasite
Shall come and end the blight. (Frost 1964)

Eyvind Thor of the University of Tennessee's department of forestry wildlife and fisheries wrote in 1979: "It may be concluded that we have been through two of the three stages in the history of the disease:

(a) Period of great concern
(b) Period of resignation
(c) Period of solution."

In this final period of solution the chestnut must be given all the help possible. Most would agree that every effort should be made to conserve the present living genetic pool. It can be increased by planting nuts from those trees that are producing fertile chestnuts and then carefully caring for the seedlings. Another way which is less often thought about is to protect the chestnut sprouts, which are much more widely distributed throughout the original natural range than generally thought. Chestnut seedlings and chestnut sprouts cannot compete in the shade of other trees. They must have good light.

Early in 1974 we decided to do some constructive things to help the struggling sprouts. Establishing groups of sprouts (we called them islands) free from competition with oak, maple, beech, etc. would accomplish several objectives:

1. Provide a better environment for growth, with more light, water, etc.
2. Provide better opportunity for fertilization if blossoms occur
3. Provide better protection from vandals if islands are isolated in locations that will remain undisturbed for long periods of time.

The Islands

With these objectives in mind, we have established 22 "islands" of American chestnut sprouts containing some 250 numbered and mapped growing sprouts. These islands are on public land and are in places that should remain undisturbed for many years. They will be increased in size and additional sprouts transplanted as they are found in the vicinity. These islands were selected because sprouts were growing naturally there and because other sprouts growing in the general area could be transplanted to the site.

The Cleveland Metropark System has supported us in many ways. It has made island clearings and a chief forester, John Gerlack, has provided expert help and advice. The Lake County Metropolitan Park, through Donald Schrock, has provided similar support. The Ohio Highway Department and numerous private owners have also been enthusiastically helpful. There are countless locations—parks, school grounds, highway margins, scout camp areas, etc.—that would be ideal for American chestnut plantings. Various community groups likely would lend support to this effort.

In Ohio there are thousands of living chestnut sprouts. These sprouts, if a reasonable distance apart, are from different parent trees and, therefore, are more different genetically than most seedlings produced from the nuts of a successful tree. The thousands of American chestnut sprouts, if protected, would provide a great genetic pool. It is probable that in this great genetic pool there may be some sprouts that are resistant to the blight.

Vegetative Propagation

It is not difficult to propagate *Castanea dentata* vegetatively if you stay within the plant's habitat. The first island was created in 1974 on the Baldwin-Wallace College campus. It was done by simply locating chestnut sprout clusters, digging the soil away from the base of the cluster and, with a good sharp chisel, cutting off a single sprout with a reasonable root shank. If care is taken and the soil is carefully packed back around the remaining sprouts, very little damage is done to the original clump. Single sprouts often are found. Sprouts taken during February and March, wrapped in plastic, and replanted within a few hours, will grow.

Twenty sprouts made up the first island, with almost complete transplant success. No attempt has been made to select sprouts to be placed in an island; it is simply assumed that those sprouts that still survive have already shown potential. From the individual islands of sprouts it should be possible to better select those that seem worthy of propagation. As each single sprout grows, it usually produces a cluster of sprouts in a couple of growing seasons. It is possible to carefully cut up such clusters and successfully propagate those that show promise. If blight-resistant chestnuts are found, it would be essential to propagate them vegetatively.

Grafting seems to have been more successful than

root cuttings or layering (Keys 1978). Other techniques that may prove to have real worth include tissue culture, rooting microcuttings and budding (Dirr & Hausser 1987).

Creating Islands

Permission

It is important to seek permission for an island site before planting sprouts in a place where they will be undisturbed, well drained and have access to an open sky.

Locating Sprouts

Finding sprouts is somewhat difficult. In Ohio, American chestnuts are most often found in mature forests with a closed canopy, in recent clear cuts, or on the margins and ridges of valleys. There are 13 well recognized species of the Genus *Castanea;* our concern is the native chestnut *Castanea dentata.* Its leaf is sharply serrated with a bristle on the end of each serration. The leaf is smooth (without a pubescence) and three times as long as it is wide. The base of the leaf is symmetrically wedge-shaped at the petiole. The twigs are dark and the buds are pointed.

Marking Sprouts

Marking can be done in many ways. A strip of white cloth tied to a twig of the sprout is simple and effective. Finding sprouts is easiest during the summer.

Digging & Planting

It is best to dig and move sprouts late in the fall or winter or in early spring. Sprouts that are more than an inch and one-half in diameter are difficult to move. It is sometimes possible to create an island around such sprouts by planting them about eight feet apart. Carefully dig up the sprouts with as much dirt as is practical. Prevent the roots from drying out by wrapping them in plastic or placing them in plastic bags for transport. The more quickly they can be planted in a permanent site, the better.

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