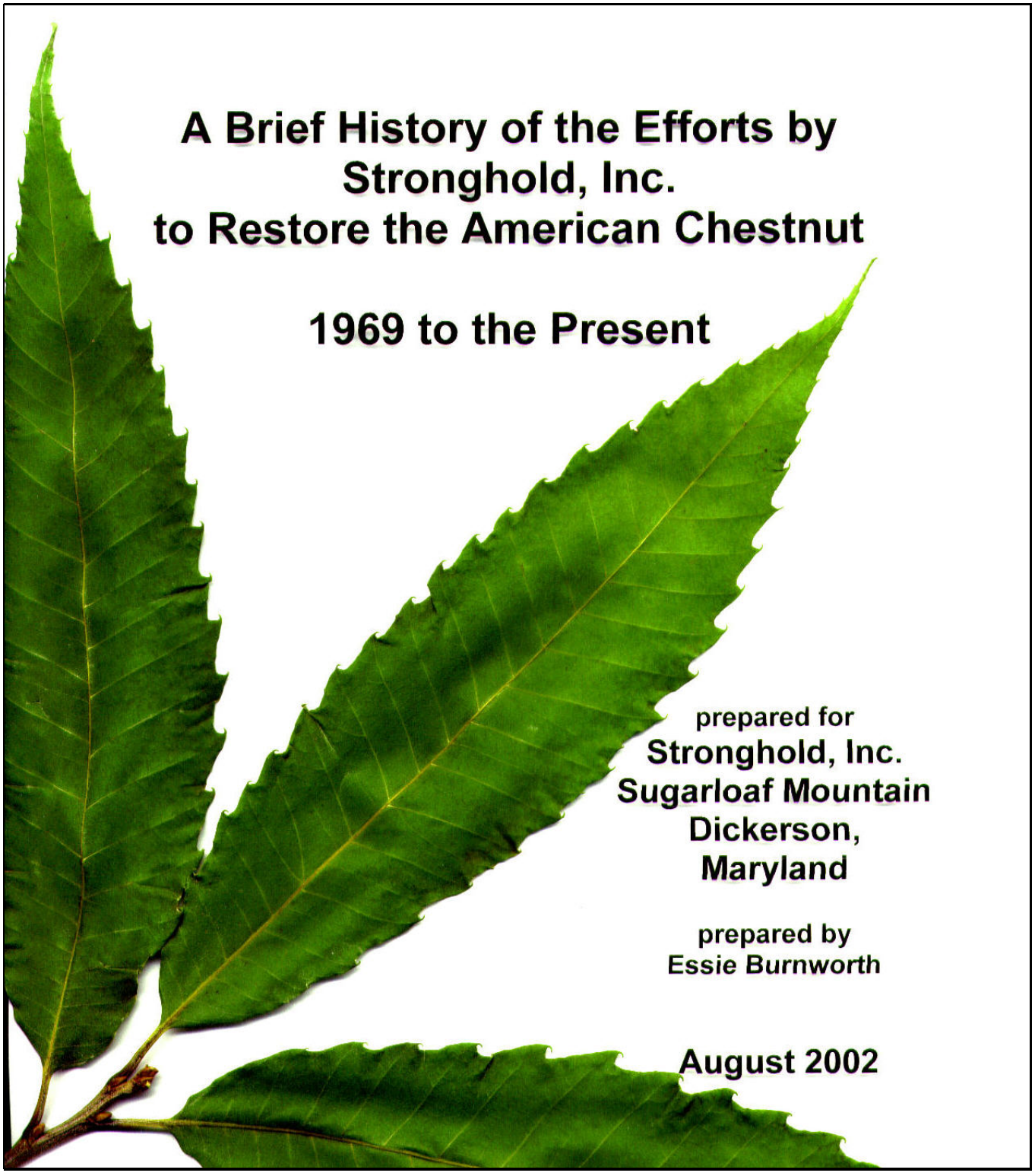
A Brief History of the Efforts by
Stronghold, Inc.
to Restore the American Chestnut
1969 to the Present
prepared for
Stronghold, Inc.
Sugarloaf Mountain
Dickerson,
Maryland
prepared by
Essie Burnworth
August 2002

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Cover design by Tommy Tamarkin using a photographic process and American chestnut leaves from Stronghold's American Chestnut Research Area – West Field.

Preface

This history is based on the information contained in the private files of Stronghold, Inc. at their Sugarloaf Mountain Headquarters. Access to these files was graciously provided to me by Mr. David Webster, Executive Secretary of the Board of Directors of Stronghold, Inc. on June 14, 2002. Exhibits include a full bibliography of the contents of the files as well as a timeline of events and a list of the names of the individuals who figure prominently in the story these files tell. Some of the most interesting items are freely quoted from in the History, demonstrating these individuals' state of knowledge, enthusiasm, and their dedication to restoring the American chestnut to its former glory.

I tell the story as revealed by these materials; omissions and inaccuracies are possible. I have made no attempt to verify or confirm the information in the files, and the inferences made in the narrative are mine alone. There are gaps in the records, and I welcome any recollections and supplemental information that will make this story more complete. As part of the continuing American chestnut restoration project on Sugarloaf Mountain, I will document the research activities and maintain the historical records of Stronghold, Inc.

With high hopes for the ultimate success of the restoration project,

E. B.
August 2002

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Introduction

One hundred years ago the airborne chestnut blight was on the move, dooming the millions of American chestnut trees throughout the Northeast and mid-Atlantic states and setting in motion a determined, if largely unsuccessful, campaign to restore this economically important and magnificent tree to the forest.

Today, the prospects for the American chestnut's recovery have never been brighter. Careful research, inspiration, dogged field work, and serendipity have yielded promising results in both empirical selection of blight resistant trees and in cross-breeding blight resistance traits into American chestnut stock. Much is also being learned about how to reintroduce this giant to its native environments, once blight resistance has been achieved. All in all, there is every reason to be optimistic that American chestnut may once again be legendary in the Eastern United States, perhaps in the 21st century.

Stronghold, Inc. has played a small but pivotal role in helping to advance American chestnut research, and on its Sugarloaf Mountain property it fosters a large repository of American chestnut survivors. In accepting the proposal to "Restart the American Chestnut Restoration Project at Sugarloaf Mountain" in June 2002, Stronghold, Inc. rededicates itself to its mission and begins a new phase of actively promoting research.

This History demonstrates how Stronghold has contributed to the search "for a blight-resistant chestnut with the fine timber characteristics of the native tree," in the words of Donald A. McCormack, Trustee and Executive Secretary –Treasurer of the Board of Directors of Stronghold, Inc. who started the Stronghold program in 1969. It is a fascinating story.

Background

The chestnut blight, having been inadvertently imported to the United States from Asia at the turn of the century, was identified in the New York Zoological Garden in 1904. Efforts were made to stop its inexorable spread, at the rate of about 20 miles per year. The blight is a fungus that attacks the bark, forming a canker that grows around the perimeter of the tree. Once the tree trunk is encircled, death is certain. A quarter of the trees in the Eastern forests were American chestnut, and their death eliminated a way of life and livelihood for many people. Over the next thirty years, the trees slowly died in the forests, no longer blooming and producing the versatile nuts. (Anderson)

Throughout its range, from Maine south through the Appalachian Mountains, the American chestnut tree had been valuable for its timber, for the tannin in its bark (used in tanning leather), and for the rich food source of its nuts for feeding animals and people. The mature trees grew straight, often over a hundred feet high, and yielded light, strong, and beautiful lumber that was used for fence rails, buildings and furniture. (Wheeler)

It was known that chestnut trees in Asia had strong resistance to the blight. More recently, chestnut trees in Europe that had been attacked by the blight later than in this country, had begun to recover. Both of these observations held promise for learning how to restore the American chestnut in this country.

The US Department of Agriculture initiated a vigorous research program, and state forest scientists and plant pathologists at several universities pursued various breeding strategies throughout the 20th century. Today, the future of the American chestnut is largely in the hands of private organizations and volunteers. To put the present situation in perspective, it is worthwhile to review the major steps that have led to our current state of knowledge and to identify the significant contributions of many people along the way.

The First Fifty Years

As the blight marched up and down the eastern states from the original site of identification in New York, the dead American chestnut trees became huge ghosts in the forests. Plant scientists tried everything to stop the spread, from cutting off infected wood to chemical spraying, but nothing worked.

Early Attempts to Control the Blight

The toll on chestnut shade trees in Philadelphia led Pennsylvania to mount its own campaign against the blight. They proposed to cut a "fire break" across the state to stop its advance. Though the Legislature appropriated $240,000 for this purpose in 1913, the airborne fungus breezed across the proposed gap before the barrier could be completed. Within two years, the Pennsylvania Chestnut Tree Blight Commission abandoned its plans. (Beattie & Diller; Sayers)

In 1912 and again in 1913, the US Congress appropriated $80,000 for research by the US Department of Agriculture Bureau of Plant Industry. In cooperation with state forestry scientists, USDA forest pathologists measured the progress of the blight and learned how it was spread by wind, squirrels, and birds. Confirming that the blight fungus came from Asia, plans were made to search for blight-resistant trees there. However, the outbreak of World War I disrupted foreign travel and funding for research, and the government efforts to control the blight went into a quiescent period for a decade. (Shea)

The USDA researchers did establish that the dead trees remained sound. Throughout the fifty year period these trees were culled for their valuable lumber and used for everything from the guard rails along the Blue Ridge Parkway to flooring and furniture. Sugarloaf Mountain shares in this legacy. (Shea)

Sugarloaf Mountain

A wonderful story is told by Mr. Donald McCormack, trustee and Executive Secretary-Treasurer of Stronghold, Inc., in a speech in 1969. As Gordon Strong bought up the 150-odd parcels of land that make up the Sugarloaf complex today, he tried in vain to purchase

the top of the mountain from three very wealthy Washingtonians. Being familiar with the resources of the distinguished Mr. Strong, these three put an exorbitant price on the parcel, and Mr. Strong declined to buy and bided his time. In due course, Mr. Strong enlisted the help of an "old man" with shaky penmanship and blue-lined paper who wrote to the owners as an old-time lumberman wanting to buy the mountaintop parcel to harvest the dead chestnut lumber. They sold it to him for a song. They did not know until much later that Mr. Strong was the real buyer. (McCormack, 1969)

Mr. Strong did harvest the chestnut, and some of it was used for fence rails and for the floor in the old school house on the Stronghold property, according to an article By Cheryl Hogue in The Montgomery Journal, February 7, 1986. There are still American chestnut sprouts growing on Sugarloaf Mountain. Since the blight does not kill the roots, many sprouts grew up from the stumps, got the blight, and died back in a repeating cycle. Some of these sprouts have attained the size of small trees.

US Department of Agriculture

By the mid-1920's, the war restrictions were over, the chestnut losses were being sharply felt, and the USDA revived its plan to search Asia for blight resistant varieties.

Dr. R. Kent Beattie was sent to China, Formosa, Japan, and Korea in 1927 to collect Asiatic chestnut seeds for planting in the US so that the known blight resistance of these chestnut types could be studied and possibly used to retard the dying of American chestnut forests. From 1927 to 1930, he imported 250 bushels of chestnut seeds, and the USDA grew 320,000 seedlings that were sent to 32 eastern states to establish experimental Asiatic chestnut plantations. (Diller & Clapper)

By the mid-1930's, the USDA had refined their approach, and between 1936 and 1939, they established twenty-one Asiatic chestnut climatic test plots in eight eastern states. They planted 22,000 trees in these test plots at 8x8 foot spacing, randomly representing 25 strains of Asiatic chestnut. (Diller & Clapper; Shea)

During the 1940's, the USDA's extensive breeding program produced many hybrid chestnut seedlings that were distributed for outplanting in several eastern states. In fact, in 1942, Stronghold received twelve hybrid trees from the USDA and planted them in the square by the entrance to Sugarloaf Mountain. At least some of these survived to produce nuts. (McCormack, 1983)

Chinese and American Chestnut Hybrids

After twenty-five years of research, one Asiatic chestnut emerged as the one with growth characteristics most like the American chestnut and with strong blight resistance. This tree was from Nanking, China, and it became one of the primary Asiatic trees for cross-breeding with the American chestnut. (Diller & Clapper)

One of the most distinguished of the USDA researchers was Dr. Russell B. Clapper who worked at the Connecticut Agricultural Experiment Station. He was one of the first to experiment with crossing Asiatic trees with American chestnut to encourage blight resistance.

Hybrid trees produced from this first generation crossing of American and Asian chestnuts were more resistant to the blight and retained the desirable straight growth forest form of the American chestnut trees. To increase resistance to the blight, these first generation trees were back-crossed to Japanese and Chinese chestnuts, but most of the resulting seedlings reverted to the short, spreading growth form typical of the Asiatic trees. Of all the hybrid trees produced, only about 3% exhibited the sought-after characteristics of blight resistance, rapid growth, and forest-tree form. (Diller & Clapper)

However, Dr. Clapper persevered in his crossing-breeding research, back-crossing his first generation hybrids with American chestnuts, and developed what came to be known as the "Clapper chestnut," that continues to be used in hybrid breeding programs to this day. (Diller & Clapper)

Perhaps even more importantly, Dr. Clapper's experimental breeding research led him to postulate in 1952 that blight resistance in the Asiatic chestnuts was associated with only two genes and that these

genes were different from those genes determining growth characteristics. (Burnham; Schlarbaum)

In 1953, the Division of Forest Pathology, which had sponsored chestnut research, was moved from USDA's Bureau of Plant Industry to the Forest Service. Although Dr. Jesse D. Diller continued his hybrid breeding research for another decade, the American chestnut research program was judged to have largely failed to produce a "new" American chestnut with blight resistance and the desirable growing characteristics of the native tree. (Shea)

Thus, 1963 marked the end of major federal government research support. Further progress in chestnut research was now in the hands of the scientists working in state forestry departments and in universities.

Atoms for Peace

In August 1955, President Dwight D. Eisenhower's concept of "Atoms for Peace" was the subject of a conference convened in Geneva, Switzerland, to explore opportunities for adapting nuclear technology to peacetime applications. One of the speakers was Dr. W. Ralph Singleton of the University of Virginia who discussed mutant breeding. He discovered in his research with corn that if seeds are irradiated, the rate of mutations is greatly increased, and characteristics of the crop are sometimes improved by these mutations. (Singleton, 1969)

Dr. Singleton's findings were of great interest, and he was asked to speak in Atlanta, Georgia, at a symposium on atomic energy and agriculture in December of the same year. The sponsors asked him not to deliver the same address but rather to "dream a bit." He did. He proposed irradiating American chestnuts to accelerate mutations that could improve blight resistance. (Singleton, 1969)

Dr. Albert Dietz, a chemist with Pittsburgh Plate Glass in West Virginia, read a newspaper account of Singleton's speech and sent Dr. Singleton two quarts of American chestnut seeds that he had collected along the Blue Ridge Parkway. They were irradiated in the reactor at Brookhaven National Laboratory and planted at the Blandy

Farm in Boyce, Virginia, in the spring of 1956. (Singleton, 1971; Dietz, 1978)

Mutant Breeding

This was the beginning of mutant breeding of chestnuts. In this breeding strategy, the second and subsequent generations may display a given mutation. There was speculation at the time that the third generation could include blight-resistant trees. (Singleton, 1969; Dietz, 1978)

This strategy is a scatter-shot approach. Lots of nuts are irradiated to cause mutations and planted; nuts from the resulting trees are collected and planted in areas to promote open pollination among the mutants. Assuming that blight resistance triggered by a mutation is inheritable, then nuts from trees that demonstrate resistance could be distributed and planted as widely as possible, carrying blight resistance with them. (Dietz, 1978)

Dr. Dietz continued to collect American chestnuts wherever he could and had them irradiated at the National Labs and then at the University of Virginia and at Virginia Polytechnic Institute and State University, when they got their own reactors. Then he sent them to interested people to plant and hope for the best.

One of his primary sources of American chestnut seeds was what is now known as the Lunde Farm in Galesville, Wisconsin. It had a grove of 100-year old American chestnut trees without the blight. This is an area beyond the normal range of American chestnuts growing wild, and the airborne blight fungus had not reached that area. The story goes that the grove was planted by a Civil War soldier returning home to Wisconsin with a pocketful of chestnuts! (Singleton, 1969)

Evolution

It was known that the American chestnut trees reacted differently to the blight. Some succumbed right away while others, though infected with the cankers, managed to heal over some of the infestation and lived years until they finally died. From these observations, the scientists deduced that blight resistance was a matter of degree and therefore it had a genetic component.

Consequently, over enough time, naturally occurring mutations would hasten the natural selection of genes with blight resistance, and the native American chestnut would be able to survive the blight. This was thought to take hundreds of years. Hence the idea of irradiation where the evolution of beneficial mutations could be speeded up and magnified in a shorter time.

It was thought that only resources and painstaking field work stood in the way of genetically selecting a blight resistant chestnut, and it was an impassioned plea to take up this work that sparked the Stronghold Chestnut Program.

The Stronghold Chestnut Program

Donald McCormack, Executive Secretary-Treasurer of Stronghold, Inc., read the March 1966 issue of the National Parks Association Magazine and was captivated by an article the editor, Paul Tilden, wrote about saving the American chestnut. Mr. Tilden noted the failure of the USDA sponsored research and decried the many efforts at hybridization, calling instead for a restoration of the native American chestnut tree. He noted the irony that we could put a man on the moon but could not figure out how to save this magnificent tree.

This article so inspired Donald McCormack that he began a life-long effort to restore the American chestnut. He first thought of organizing an American Chestnut Society for this purpose, but in discussion with others who shared his enthusiasm, he decided to pose to the Board of Trustees of Stronghold, Inc. that they take on this challenge. They reasoned that an existing organization would be more immediately effective at raising funds and supporting research activities than would a brand new organization that would begin without a member base or staff. (McCormack, 1973)

When the Board of Trustees considered his proposal, they agreed to take on the challenge of saving the American chestnut and added only the caveat that they would not be able to give much funding to the program. However, they could promote fund-raising on behalf of the program as it was entirely consistent with the overall guidelines

on which Stronghold, Inc. was based. To this day, the welcome brochures and membership applications for Stronghold, Inc. include the trustees' commitment to the restoration of the American chestnut trees and state that membership contributions will be "supporting the American Chestnut Research Program."

The Stronghold Chestnut Symposium

The beginning of the Stronghold Chestnut Program was a highly successful symposium held on Sugarloaf Mountain on November 5, 1969, jointly sponsored by the Frederick Forest District Conservancy Board and the National Parks Association. More than seventy people attended, and the speakers included Dr. Dietz, Dr. Singleton, Dr. Jesse Diller from USDA and other scientists excited at the prospect of coordinating efforts to save the chestnut.

Donald McCormack introduced the program and said:

> We have just embarked on a program to breed a blight-resistant American chestnut by genetic selection. This could take several hundred years, but we believe the process can be cut to thirty years by irradiating the nuts… If this is successful in bringing back the chestnut, we will have more than justified our existence. This is one of the things for which this mountain is especially suited.

At the time of this symposium, mutant breeding by irradiating chestnuts with Cobalt-60 was the most promising direction of research. Dr. Singleton's speech, "Atomic Energy and Chestnuts: Can the New Bring Back the Old?" detailed the process and communicated the optimism that M3 trees – third generation trees from irradiated nuts – would be resistant and have only native American chestnut germplasm. The most resistant trees would then be crossed using controlled pollination, and in a hundred years or more, the American chestnut would be restored.

What this research program needed was space for planting the large numbers of mutant trees necessary to reveal those truly resistant. Dr. Singleton, who at that time was not only a professor at the University of Virginia but was also the geneticist at the National Colonial Farm in Accokeek, Maryland, identified three sites in his speech ready to take on the responsibility of providing research areas

for outplanting the mutant trees: the National Colonial Farm, Sugarloaf Mountain owned by Stronghold, Inc., and the Lesesne State Forest in Nelson County, Virginia, dedicated to chestnut research just six months before, in 1969.

This highly successful symposium launched Stronghold as an enthusiastic and energetic partner in chestnut research and began a decade of very active participation in mutant breeding.

Chestnut Planting

On April 20, 1970, one thousand seedlings were planted in what is now the American Chestnut Research Area – East Field. Dr. Al Dietz had grown these first generation, M1, seedlings from irradiated nuts. In a letter from Dr. Dietz to Stronghold on December 28,1981, he states that the:

> source of the original seeds was the George Washington National Forest near Marlington, West Virginia…I also collected seeds at that time along the Blue Ridge Parkway between Big Island, Virginia, and Roanoke, Virginia.

He also states in the same letter that:

> The original seeds were irradiated with 3000 RADS (gamma radiation from Cobalt 60) at the University of Virginia Radiation Facility at Boyce, Virginia, under the supervision of W. Ralph Singleton.

From the Sugarloaf Mountain Bulletin we learn that Dr. Dietz sent 500-600 more mutant seedlings, thought to be second generation or M2 seedlings, to Stronghold on April 12, 1971, from Ohio, and they were planted in what is now the American Chestnut Research Area – West Field. By January 1973, 1450 seedlings from irradiated nuts had survived and were growing on Sugarloaf.

Research Support

Through the efforts of Donald McCormack, the early years of the Stronghold Chestnut Project began to bring in donations and generated interest. A $25,000 gift was used to make a movie about the chestnuts which was shown to elicit both support and funding. In 1973, Stronghold helped to get a three-year grant from the Allegheny Foundation for $18,000 to support laboratory research. (McCormack, 1973)

According to the Sugarloaf Mountain Bulletins and correspondence in their files, Stronghold became a focal point for Dr. Dietz' mutant breeding program in 1972 when a local Dickerson, Maryland, company, Neutron Products, Inc. donated their services and began irradiating the nuts with 3,000-5,000 rads. [To put this in perspective, a whole-body dose of 1,000 rads is fatal to a person.] Dr. Dietz got nuts from Wisconsin, and still collected them along the Blue Ridge Parkway, and kept them over the winter. Then in the spring, he sent them to Mr. Robert Holland, Superintendent of Stronghold, Inc. who took them to Neutron Products, Inc. for irradiation and then sent the nuts back to Dr. Dietz or out to cooperators who planted them.

Dr. Dietz got state tree nurseries to plant the nuts and grow them to two-year old seedlings. The seedlings were then distributed to state forestry departments, to the National Colonial Farm, Lesesne Forest and to Stronghold for planting and for sending to their cooperators. (Singleton, 1971)

Mrs. Bryan at Stronghold maintained the orders and list of cooperators. Stronghold's Bulletin of November 1973 stated that they had distributed 3,000 irradiated seeds to 63 people. Of those, 30 cooperators had reported back that 1,262 seeds had germinated after 6-8 weeks. Half of those were growing a year later.

As reported in the Sugarloaf Mountain Bulletin, in April and May of 1974, Stronghold distributed 2,450 irradiated seeds, 1,854 1-year seedlings, and 1,735 2-year seedlings, all grown from irradiated seeds.

Seed Distribution

Stronghold continued to distribute seeds to cooperators through the 1970's. In an interesting article, "What Stronghold Is Doing About Chestnut," in the 1978 Northern Nut Growers' Annual Report, Donald McCormack stated that Stronghold had 1500 cooperators receiving seeds and estimated that they had sent out between 6,000 and 11,000 seeds annually. He also reported that at that time Stronghold had 1200 trees of second generation from irradiated nuts that were 4-5 years old, and "800 trees of the first generation from irradiated nuts, many of which have been bearing for several years."

Though Stronghold's primary emphasis was on providing nuts from the mutant breeding begun by Dr. Dietz, Mr. McCormack also said they wanted to cross trees in the wild that had shown resistance. Sugarloaf Mountain was rich in wild American chestnut, and selective logging and a tornado on the mountain on July 31,1978 opened up areas to abundant new sprouts.

The Spring 1974 Sugarloaf Mountain Bulletin included an item that Dr. Dietz would cross pollinate trees at Sugarloaf showing blight resistance, but there is no further report on whether this was done or, if so, what the outcome was.

Publicity

Mr. McCormack realized that generating publicity was one of the most important ways to promote interest in American chestnut research and to raise funds for this purpose. In his 1978 progress report, he said that Stronghold had:

> supplied the information for 15 newspaper articles, 12 magazine articles as well as numerous writings in conservation publications. Through our semi-annual Bulletin we serve as a clearinghouse for information and try to get across that chestnut is a valuable tree that can be brought back. We encourage those who are willing to work at it. Professor and Mrs. Braun worked with us and produced a color movie… that helps to arouse interest. Our Ohio consultant, Al Dietz, showed it to a group in West Virginia. Now we learn that Senator Byrd has seen to it that funds were appropriated for chestnut research by the Forest Service at Morgantown, West Virginia. Cooperating in this study they have West Virginia University, Concord College, and Virginia Polytechnic Institute.

Five years later, in 1983, there is an update on "Stronghold's Chestnut Program" by Mr. McCormack in which he enumerated the following accomplishments since the program start in 1969: 1) advertised the plight of the American chestnut and gotten the attention of lawmakers, 2) ensured a supply of nuts, and 3) achieved some mutations – big burs and nuts, but the associated blight resistance was unknown.

Other Developments

The Autumn 1988 issue of the Katuah Journal published in Leicester, North Carolina, (and saved in the Stronghold files) was devoted to "Restoring the Chestnut," and it contains several very interesting articles about the state of chestnut research in the 1980's. Professor Scott E. Schlarbaum, Associate Professor of Forest Genetics in the Department of Forestry, Wildlife, and Fisheries of the Institute of Agriculture at the University of Tennessee, wrote that by the end of the 1970's, breeding programs to cross relatively blight resistant American chestnuts and to create hybrids of American-Asiatic chestnuts had both proven disappointing. However, new developments rekindled chestnut restoration hopes.

The first of these developments, the identification of **hypovirulence,** a weakness of the blight fungus caused by a virus, did not provide the biological control that many scientists had hoped for. However, the second development, a refined **back-cross breeding** approach, has proven to be a significant breakthrough and is promising blight-resistant American chestnut trees in the 21st century.

Hypovirulence
Recognition of a weaker strain of the blight fungus was first made in Italy in 1964 when a French mycologist, Jean Grente, observed that this weaker, or hypovirulent, strain could infect the regular blight fungus and permit the chestnut tree to recover. The infected chestnut tree was then able to overcome the weaker fungus and heal the cankers. Grente inoculated infected trees in France with the hypovirulent strain of the blight, and soon that was the strain that was spreading naturally. Although the blight was identified in Italy in 1938 and had spread across Europe by 1950, the presence of the hypovirulent strain of blight appeared to be responsible for the recovery and subsequent survival of the European chestnut trees. (Schlarbaum)

In 1976, when naturally occurring hypovirulent strains of blight were identified in Michigan and in Virginia, there was great optimism that a biological solution was at hand. Starting in 1977, researchers at Michigan State University led by Dr. Dennis W. Fulbright found that

hypovirulent strains appeared to be spreading in infected groves in Michigan. Hypovirulence was the focus of the federally funded research sponsored by Senator Byrd of West Virginia, mentioned above.

Instead of being a weakened form of blight fungus, hypovirulence turned out to be the result of a virus infection of the fungus. According to an article in The Washington Post on November 29, 1985, written by Boyce Rensberger, Dr. Fulbright isolated a virus that infects the blight fungus and disables it, giving the impression of a "hypovirulent" strain of blight. [Further research with virus infection of the blight fungus has not resulted in a workable strategy for eliminating the blight, according to discussions with Dr. Fulbright in August 2001.]

Although the study of hypovirulence has not yet yielded a cure, it was an important step in the evolution of scientific understanding of chestnut blight. Moreover, of importance to this historical account, this research was the earliest mention of Dr. Fulbright who came to Sugarloaf Mountain in 1988 with Dr. William MacDonald to evaluate the stands of second-generation mutant chestnuts from Dr. Albert Dietz in Stronghold's West Field.

Back-cross Breeding

In 1986, Dr. Charles R. Burnham, Professor Emeritus at the University of Minnesota, published a detailed breeding strategy based on a careful review of past research and an adaptation of methods used to breed agronomic crops. (Schlarbaum)

He proposed that one should first produce a hybrid by crossing American and Chinese chestnuts (F1), and then this hybrid is back-crossed with American chestnut stock (BC1). The progeny of this generation are selected for evidence of blight resistance and then back-crossed again with American chestnut stock (BC2). Once again the progeny are screened for evidence of blight resistance and are back-crossed a third time with American chestnut stock (BC3). The progeny from the BC3 generation, like the previous generations, will have some individuals that are blight resistant, some partially resistant, and some that are susceptible to blight. Intercrossing the BC3 blight resistant trees will yield the F2 generation with a

percentage of trees having the blight resistance of the Chinese strain and the growth characteristics of the American chestnut. (Schlarbaum)

Dr. Burnham's strategy is the basis for the extensive back-cross breeding program of The American Chestnut Foundation, centered in several research farms in Meadowview, Virginia, under the direction of Dr. Frederick V. Hebard. (Burnham)

Dr. Burnham continued to refine his breeding strategy, based on Dr. Clapper's early theory that blight resistance is related to only two genes. He was a member of Stronghold, visited Sugarloaf Mountain, and wrote to the then Stronghold Executive Secretary of his interest in their program.

Dr. Burnham sent updates of his breeding approach to Stronghold as recently as July 1994. In an accompanying hand-written letter, he notes that "Progress is being made! Fred Hebard has been able to get early flowering." He then goes on to say:

> That row of 7 trees opposite the Stronghold Headquarters Building came, I believe, from open pollinated nuts from the "Clapper" first backcross survivor in the Carterville, Ill. USDA forest-type test planting of hybrids. When I visited there, at Stronghold, I brought back leaf samples from each of the trees. I collected several burs from one or two trees – they had large nuts, 3 to the bur – perfect seed set… I examined the leaves I brought back – as I remember them, only one or two trees had the stellate hairs typical of the Chinese chestnut.

Cloning

Cloning both to preserve surviving American chestnut germplasm and to accelerate nut production from tested blight-resistant trees can be accomplished by grafting the scion onto existing American chestnut root stock. In the 1970's, Weyerhauser invested over a million dollars into cloning American chestnut survivors but were apparently unsuccessful on a commercial scale. (McCormack, 1978)

Another interesting article in the Autumn 1988 issue of the Katuah Journal devoted to chestnut research was written by Lucille Griffin, a researcher and wife of Dr. Gary Griffin at Virginia Polytechnic Institute

and State University. She described a new breeding program based on grafting scions from surviving American chestnut trees onto other [chestnut] rootstocks. Dr. Griffin and Dr. John Elkins of Concord College had collected genetic material from survivors in several states. They formed the American Chestnut Cooperators' Foundation and joined with Dr. Albert Dietz and Bruce Given to propagate the surviving trees by grafting.

When the grafted trees flower, they are tested for blight resistance and then hand-pollinated to intensify blight resistant traits. One advantage is that scions grafted onto established root systems can reach maturity, producing nuts, within three to four years versus seven to ten years for a nut to grow into a nut-producing tree. Ms. Griffin wrote of research by Dr. Elkins on a test for blight resistance using only tannin which would vastly shorten the interval between planting a nut and selecting offspring for evidence of blight resistance.

The American Chestnut Cooperators' Foundation continues to sponsor research in breeding native American chestnuts with evidence of some blight resistance. Their nurseries are to provide the 300 new American chestnut seedlings that Stronghold plans to plant in the Fall of 2002.

Research Focus on Stronghold

It is unclear from the file materials how long into the 1980's Stronghold continued to collect nuts, irradiate nuts, and distribute nuts and seedlings to members and cooperators, but an editorial in The Frederick Post of March 4, 1983, exhorts readers to become members of Stronghold and to make contributions to their American chestnut program.

In April 1988, Stronghold was appointed as the State Coordinator for Maryland for The American Chestnut Foundation (TACF) by Phillip A. Rutter, its President. There is no further evidence of state-wide activities on behalf of TACF. However, at that time, Mr. Rutter, noticed that "something peculiar" was occurring with the trees at Stronghold. As a result, Dr. Dennis W. Fulbright from Michigan State

University, and Dr. William L. MacDonald of West Virginia University, began an evaluation of the outcome of Dr. Albert Dietz' experimentation with irradiated nuts. An undated paper entitled "American Chestnut Trees at Stronghold," written by Dr. Fulbright and attached to a letter to Stronghold dated February 9, 1993, describes how he and Dr. MacDonald came to Sugarloaf Mountain to investigate the blight tolerance shown by some of the trees there.

Blight Resistance Observed at Sugarloaf

Quoting from their "Research Plan for Chestnut Trees in Maryland," undated but believed to be written in 1988, or shortly thereafter:

> American chestnut sprouts at Sugarloaf Mountain and the National Colonial Farm in Maryland appear to be surviving chestnut blight… We do not believe that the recovery is due to the biological control associated with hypovirulent forms of the fungus. The chestnut at both locations are from seeds treated with radiation in the late 1960's. Indications are that 100% of the trees that emerged from the radiation-treated seed became infected with chestnut blight and nearly all of the young trees died back from the blight infection. Sprouts originating from the chestnut roots or trunks near ground level have been emerging with regularity since the death of the original sprout. This has resulted in fields of sprout clumps or coppice groups. Not all coppice groups are presently responding equally to blight infection. Some seem very successful with sprouts now beginning to look like trees, others are moderately successful and some coppice groups are continuing to die back. Within the successful coppice groups are sprouts that are responding differentially to blight infection with some sprouts more successful in resisting infection than others. An interesting observation is that the ability to resist blight is similar on each stem but not necessarily similar among stems from the same coppice group. In other words, each stem seems to represent an unrelated separate event – like those induced through mutations.

Fulbright and MacDonald set out "to discover the phenomenon responsible for perpetuating the recovery of American chestnut stems at Sugarloaf Mountain and The National Colonial Farm." They wished to determine whether the observed resistance was associated

with a new biological control, other than the hypovirulence observed previously in Michigan and in Italy, and/or with something unique about the host tree resulting from the radiation treatment of the seed.

Research Approach

The methods to be followed in pursuing this research, as stated in Fulbright's and MacDonald's Research Plan, are briefly summarized below, as they pertain to Stronghold:

1. Stake the trees and take an inventory of the clumps of sprouts and their characteristics.
2. Eliminate the dead stems and clean up the base of the trees.
3. Select clump sprouts and isolate fungus from cankers on these sprouts to compare with known fungus strains.
4. Inoculate selected stems with virulent fungus to determine reactions to infections.
5. Observe chestnut blight on sprouts in the surrounding areas of Sugarloaf Mountain.
6. Collect seed in the fall from the best trees showing the best recovery and outplant them. After five years, inoculate with the blight and cross the survivors.
7. Evaluate plantings at Sugarloaf to determine the feasibility of selectively crossing the existing trees and cross them, if appropriate.
8. Initiate a vegetative cuttings program in an attempt to root chestnut cuttings, though this is very difficult to do.

From notes on the Research Plan and letters, it appears as if the Stronghold staff did clean up the Research Areas, prune selected trees and collect nuts in support of the research. There is also a schematic map of the plantings in the West Field (Exhibit A) that was prepared by Al Webb, a Stronghold employee, and dated March 8, 1990. It shows eight trees in the West Field as being inoculated with blight fungus. In a grant proposal Dr. Fulbright prepared in 1995, he describes inoculating multiple stems representing eight trees from Sugarloaf Mountain with five types of blight fungus in the spring of 1989.

Since it was M2 seedlings that were planted in the West Field, it is reasonable to assume these were the objects of the research. The

East Field was planted with M1 trees, not themselves expected to show blight resistance as a result of irradiation.

These deductions are borne out by a letter from Dr. Fulbright to Mr. Ben Smart, Superintendent of Stronghold, Inc., on April 17, 1994, in which he states, "…Dr. MacDonald and I have been interested in the possibility that some of the trees at Stronghold are showing some degree of resistance to chestnut blight…To test this possibility we inoculated several of your trees in the west field and have observed several others in both the west and east fields."

Positive Results

Although the work done in accordance with this Research Plan is not detailed in the files, Dr. Fulbright wrote an update on the research progress to Mr. Smart, on February 9, 1993, reporting positive results. He stated that hypovirulence was ruled out as the reason for the survival and growth of the chestnuts at Sugarloaf and at the National Colonial Farm, and the scientists decided to study the trees displaying the greatest resistance. Quoting from Dr. Fulbright's report:

> Selecting trees at Stronghold and at National Colonial Farm where more of Dietz's trees were planted, [the scientists] inoculated the trees with chestnut blight to observe how the trees responded to the artificial infections. In most cases, the trees positively responded to the inoculations and a few trees have survived both the natural blight infections and the inoculated blight for three growing seasons.
>
> More questions need to be addressed. How long will the best trees stay alive? Why are they surviving? Are the trees genetically more resistant than unirradiated American chestnuts? If so, can the resistance be improved by breeding? Right now, even the best trees in the plantations continue to fight more and more blight as they live longer. How long can each individual tree fight the infections? As time is important in this research, Stronghold hopes to provide an opportunity for these important trees to reach their genetic potential while providing scientists and other interested people an opportunity to continue Al Dietz's [work] into the 21st century.

To address other aspects of the research Plan, Dr. Fulbright said in a letter to Mr. Smart that he had "planted at my research farm over 1500 seedlings from open-pollinated, irradiated, chestnut seed collected in fall 1992 from Stronghold, National Colonial Farm [and elsewhere]. I have also obtained rooted cuttings and grafts from some of these irradiated mother trees." Letting these trees mature, inoculating them, and selecting those showing blight resistance for cross breeding were the remaining steps. However, to speed up this process and to more quickly pursue the positive results of the research to date, Dr. Fulbright suggested breeding the superior trees at Sugarloaf.

Superior Tree Breeding

In a letter to Mr. Smart on April 17, 1994, Dr. Fulbright proposed that Stronghold conduct a somewhat radical open breeding program by cutting back all but the best stems in both the East and West Fields, and letting the remaining "superior" stems pollinate each other and produce nuts that could then be planted elsewhere as a "superior germplasm seedling bed."

Since the job of destroying all but a few superior chestnut stems had to be completed before any pollen was produced, the plan was not implemented until the following spring. Dr. Fulbright thanks Mr. Smart for cutting back the trees in both the East and West Fields before flowering and pollination in a letter dated June 5, 1995. According to the timeline attached to this letter, the nuts resulting from the open pollination were to be collected in the fall of 1995, kept in cold storage and planted in the spring of 1996 at the Michigan State University Tree Improvement Center nursery in East Lansing, Michigan. A subsequent letter confirms these steps and says that the seedlings were moved to field plots in Jackson, Michigan in the fall of 1996.

The proposed plan then called for collecting nuts from superior trees again in the fall of 1996 and planting them in spring 1997. Subsequent steps included moving the seedlings to research plantations, inoculating them at five years, and assessing the evidence of blight resistance.

From the correspondence, it appears that nuts were not collected in the fall of 1996, and Dr. Fulbright wrote to Stronghold that all the non-superior stems would have to be cut back again to repeat the superior breeding and collect nuts in the fall of 1997. [From conversations with Dr. Fulbright and the Stronghold Park Manager, Russell Thompson, in August 2001, it appears as if Stronghold collected nuts from the American Chestnut Research Areas in 1997 and sent them to Dr. Fulbright.]

Rooted Cuttings
Fulbright's and MacDonald's original Research Plan had called for establishing a vegetative cuttings program, and Dr. Fulbright had apparently taken some cuttings from Sugarloaf in December 1995. Though these had been too small, and the propagation specialist had not been able to establish them, Dr. Fulbright wrote to Stronghold in February 1996 asking that they cut a branch, marked in a photo, from one of the "superior" trees. Mr. Smart cut the requested branch and sent it to the propagation specialist in Michigan in the spring of 1996.

Findings?
The last letter in the files from Dr. Fulbright was written at the end of 1996. Hopefully, the preparation of this history of the American chestnut research, and Stronghold's place in it, will prompt an update on the status of the experiments in Dr. Fulbright's field plots.

A New Beginning

At their June 2002 meeting, the Stronghold, Inc. Board of Directors approved a "Proposal for Restarting the American Chestnut Restoration Project at Sugarloaf Mountain," dated 13 September 2001 and written by Mr. Burnie Burnworth of Potomac, Maryland. Working with Stronghold, Inc. staff and Dr. Douglas H. Boucher, Associate Professor at Hood College in Frederick, Maryland, Mr. Burnworth proposed a Baseline Project plus two Options with the stated "goal of developing a blight-resistant timber-type tree that can survive in a forest environment."

Baseline Project
This project will begin in the fall of 2002 with the planting of 300 American chestnut seedlings from the American Chestnut Cooperator's Foundation on the Turner Farm site and in the American Chestnut Research Area – West Field.

Baseline Project Plus Option I – Grafting
In the spring of 2003, grafting of American chestnut scions from trees demonstrating a level of blight resistance onto existing Sugarloaf chestnut rootstock will be considered. This option would accelerate the growth of trees for later evaluation because nuts could be produced by the grafted stock within 3-4 years as opposed to the seven to ten year interval to be expected from seednut to nut-producing tree.

Baseline Project Plus Option II – Grafting & Backcross Breeding
In the spring of 2003, Stronghold, Inc., will also consider whether to introduce controlled pollination of the surviving Sugarloaf Mountain American chestnut trees using pollen from backcross trees at The American Chestnut Foundation's Meadowview Research Farms.

American Chestnut Inventory
To start off the Baseline Project, Burnie Burnworth volunteered to inventory the surviving American chestnuts on Sugarloaf Mountain. Both East and West Fields have been inventoried as well as a few surviving American chestnuts on the mountain itself. The largest and most vigorous of these trees at each site were tagged, and their details were collected for the Maryland TACF American chestnut database being maintained by Essie, who can be reached at hburnworth@msn.com or (301) 762-6715.

A description of the West Field summarizing the trees that are there today is contained in Exhibit B. At this site, 25 of 254 surviving trees were tagged, and their details recorded for the database. The schematic map of the West Field was drawn in July 2002 and shows the current layout of the remaining trees. Note that tulip poplars and a pin oak tree provide reference points on both this map and the map drawn in 1990 as shown in Exhibit A.

A description of the East Field summarizing the trees that remain there today is contained in Exhibit C. Five trees out of the 55 trees in the East Field were tagged, and their details recorded. The schematic map of the East Field was drawn in August 2002 and shows its current layout.

Four surviving native American chestnut trees were found on Sugarloaf Mountain and were identified and tagged in July 2002. They are described in Exhibit D, and their location is shown on a copy of the Sugarloaf Mountain Trail Map.

Continuity of Purpose

In the 33 years since Stronghold, Inc. took on the responsibility to support American chestnut research, progress has been made toward restoring this magnificent tree. Empirical evidence of enhanced blight resistance from irradiated nuts is still being studied and refined by Dr. Fulbright at Michigan State University.

It is an appropriate time for Stronghold to once again have an active local role in promoting research and to be a showplace of American chestnut restoration activities. In June 2002, Stronghold's Board of Directors made a fundamental decision to begin a new phase of the American Chestnut Restoration research program at Sugarloaf by approving the proposal submitted by the Burnworth family. In doing so, they are making a long-term commitment of resources to the research objectives written in their mission statement 33 years ago.

Exhibit A -- Stronghold West Field Plantings

Transcribed from a handwritten sheet attached to the map of the Sugarloaf Mountain American Chestnut Research Area – West Field drawn by AWW (Al Webb) of Stronghold, Inc. on March 8, 1990.

West Field (so named in January 1990) is one of two areas now planted with seedlings from Cobalt 60 irradiated seeds of American chestnuts (*Castanea dentata*) gathered by Dr. Albert Dietz, who also arranged for their irradiation.

West Field is located to the south of Turner Field, and is bordered by Mt. Ephraim Road to the east and the Frederick Gutheim property to the southeast.

No written records can be found which indicate the exact dates of the planting nor the irradiation treatment of the seeds. [The January 1973 Sugarloaf Mountain Bulletin shows a picture with a sign stating that the trees were planted on April 20, 1970. An excerpt from a letter to Stronghold from Dr. Dietz on December 28, 1981, states that "the original seeds were irradiated with 3000 rads."] It is presumed that only seedlings germinated elsewhere were planted. Many have survived, although a number have not thrived and blank spaces in the regular planting pattern are presumed to represent seedlings which died some years ago.

There are 13 columns of plantings with up to 42 rows in a column (see plot plan). Twelve of the columns are marked with blue painted plastic pipe about 1½ " in diameter and 4 ft above ground. Each pipe has a painted serial number near its top. Column 1 is in the NE corner of the field and the numbers run serially to the SE. All columns run on 230 degrees magnetic and the rows 1 through 42 at right angles.

The plantings are regularly spaced approximately on a 20x20 foot spacing. [This is evidently in error since surviving trees are located at 12 foot spacing.]

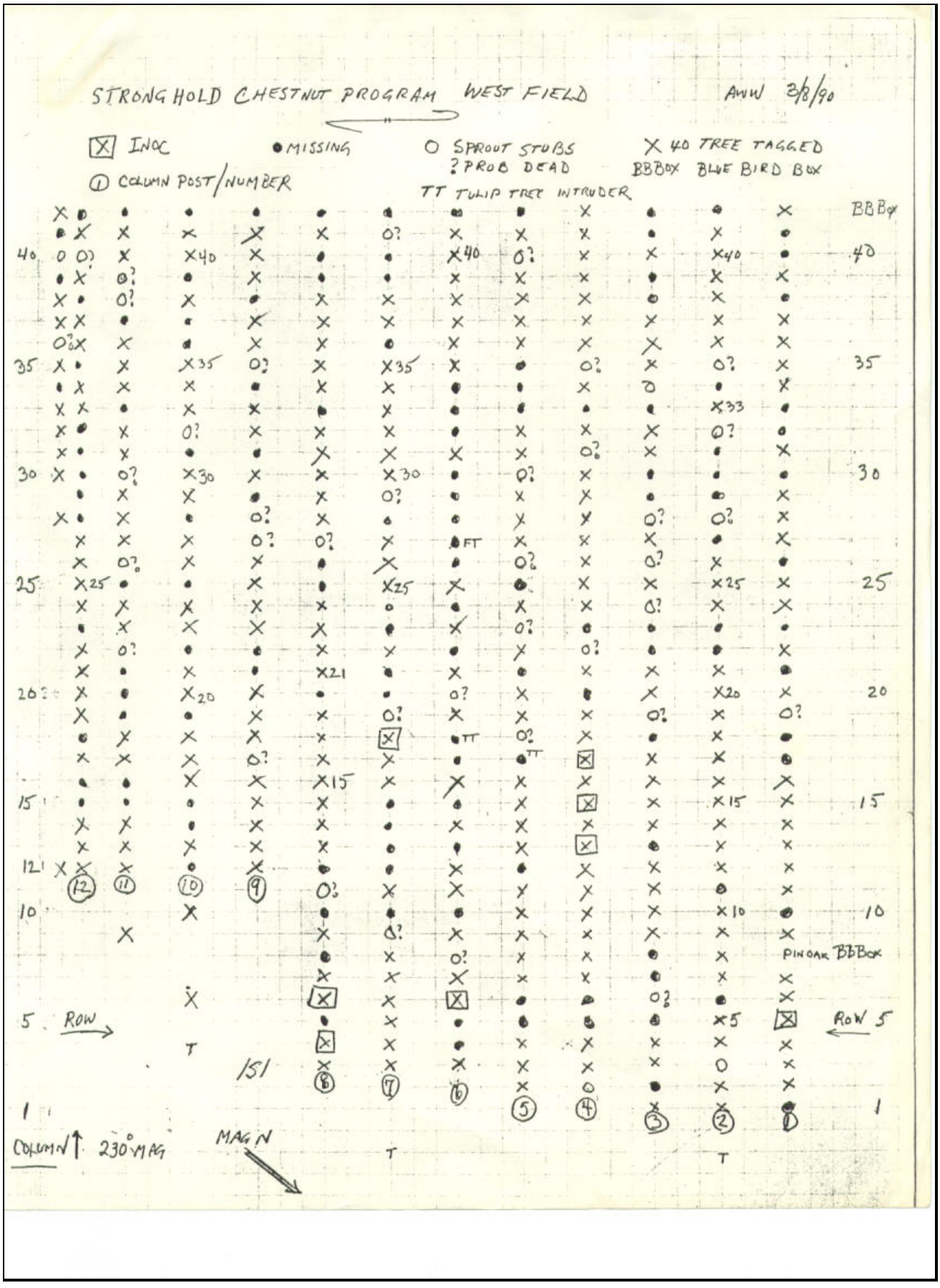

STRONG HOLD CHESTNUT PROGRAM WEST FIELD
AWW 3/8/90
X INOC
• MISSING
O SPROUT STUBS
? PROB DEAD
X 40 TREE TAGGED
BBBox BLUE BIRD BOX
① COLUMN POST/NUMBER
TT TULIP TREE INTRUDER
BBBox
40
35
30
25
20
15
12
10
5
1
ROW
ROW 5
PIN OAK BBBox
COLUMN
230° MAG
MAG N

Exhibit B – Description of the West Field

The Sugarloaf Mountain American Chestnut Research Area – West Field is located on the west side of Mt. Ephraim Road approximately 0.3 miles south of the intersection with Comus Road. The area contains 254 surviving chestnut trees as of June 29, 2002. Surviving chestnuts are generally in the form of multiple sprouts (2 to more than a dozen) from existing root systems.

The trees, which were evidently planted with 12 foot spacing, are arranged in rows running east to west, which we have numbered 1-13, north to south consistent with a map from the Stronghold files dated 3/8/90 (Exhibit A). Rows 1- 6, each of which extends for a distance of approximately 560 feet, contain an average of 25 surviving trees per row. These rows represent the most dense planting and include the most mature trees. Rows 7-13 are partial rows of trees, apparently planted later, that are generally in poorer condition with overgrowth by multiflora rose and vines.

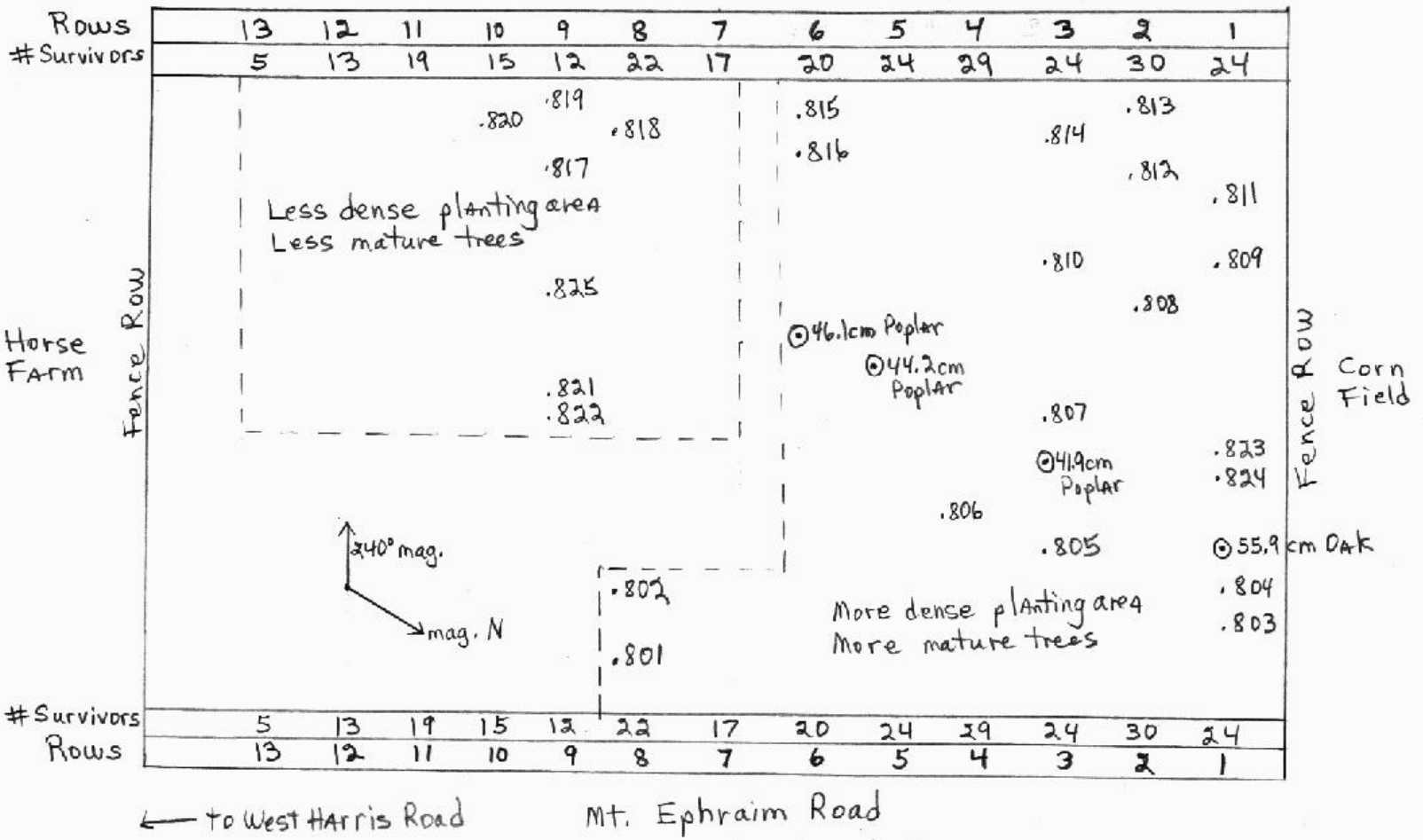
Assuming that the West Field was originally fully planted at 12 foot spacing between trees, Rows 1-6 would have had a total of 281 trees. Today these rows contain 151 trees, representing an overall survival rate of 54%. Similar assumptions for Rows 7-13 suggest a survival rate of 41%.

The chestnuts in the West Field Research Area are believed to be second-generation trees. These trees were grown from the nuts of first generation trees, which are trees that grew from irradiated nuts. This description may not apply to trees in the partial rows 7-13.

The trees were inventoried over the weekend of June 29-30, 2002, by Burnie and Essie Burnworth and their son, Jonathan. Numbered aluminum tags and blue flagging tape were installed on the 25 most vigorous sprouts, chosen by trunk diameter and evidence of blooming, as suggested by an on-site inspection by Dr. Doug Boucher. Tag numbers used in West Field go from 801 through 825.

An approximate map of the tagged trees is attached.

Schematic of Selected Surviving Trees Tagged June 28-30, 2002



Sugarloaf Mountain
American Chestnut Research Area - West Field

Not to scale
Revised 7/6/02

Exhibit C – Description of the East Field

The Sugarloaf Mountain American Chestnut Research Area – East Field is located on the north side of Comus Road approximately 0.2 miles east of the Stronghold Administrative Offices. The area contains 55 surviving chestnut trees as of August 4, 2002. Surviving chestnuts are generally in the form of multiple sprouts (2 to more than a dozen) from existing root systems. All trees in the East Field are in full sunlight.

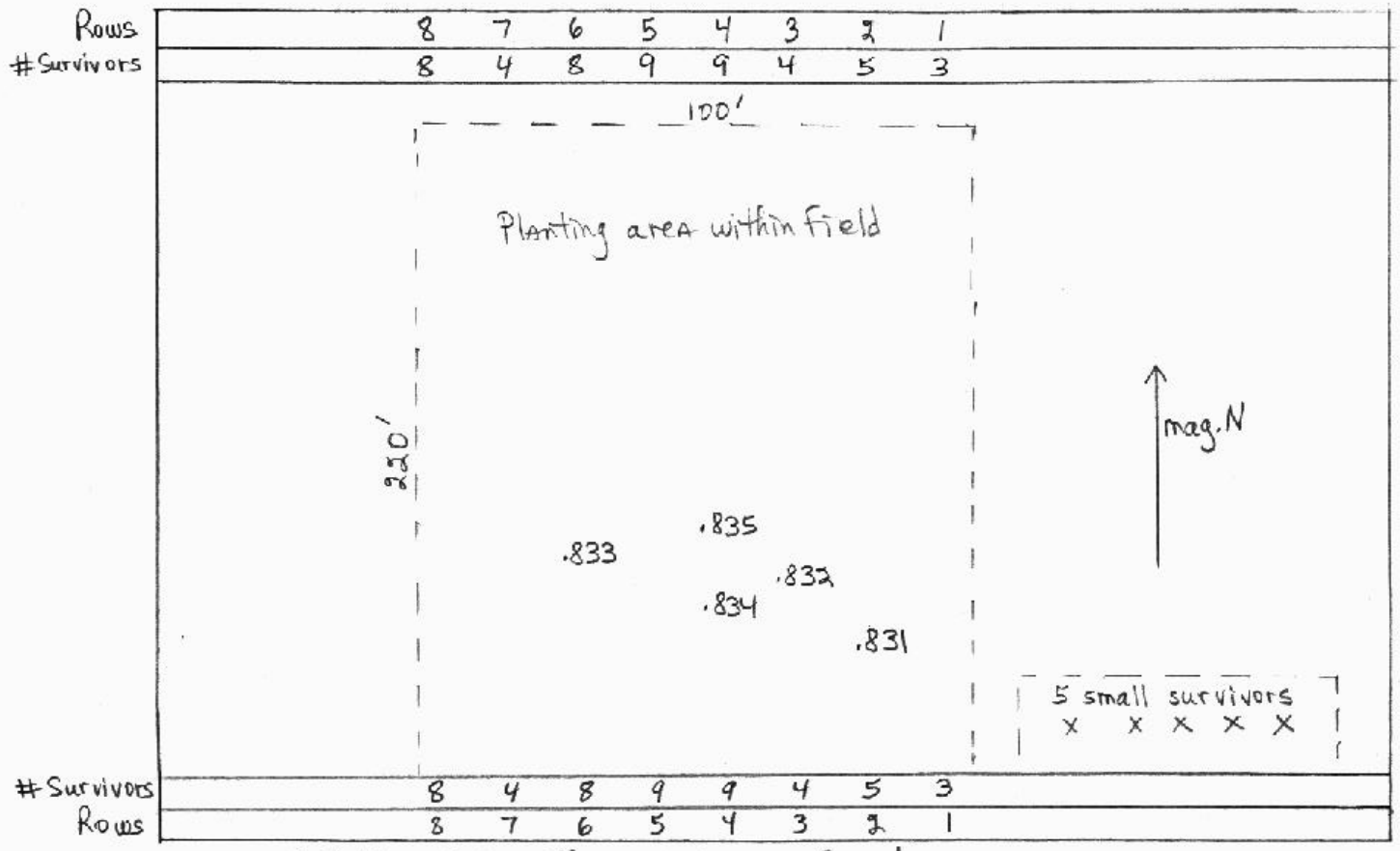
The trees, which were evidently planted with 12 foot spacing, are arranged in rows running south to north, which we have numbered 1-8, east to west. The longest rows extend for a distance of approximately 220 feet. The rows contain an average of 6 surviving trees per row. To the east of the main block of trees, there is an east to west row of five trees, generally in poorer condition with extensive chestnut blight apparent.

The chestnuts in the East Field Research Area are believed to be first-generation trees, which are trees that grew directly from irradiated nuts.

The trees were inventoried on August 4, 2002, by Burnie and Essie Burnworth and their son, Jonathan. Numbered aluminum tags were installed on the five most vigorous sprouts, chosen by trunk diameter and production of large numbers of burs. Tag numbers used in East Field go from 831 through 835.

An approximate map of the tagged trees is attached.

Schematic of Selected Surviving Trees
Tagged August 4, 2002



Sugarloaf Mountain
American Chestnut Research Area – East Field

Not to scale

Exhibit D -- Description of the Forested Area

Four surviving American chestnut trees were located in the forested area of Sugarloaf Mountain. These trees are believed to be totally native and unrelated to the earlier restoration efforts in the East and West Field Research Areas.

The trees are located on steep terrain in a clearing approximately 130 – 160 feet south of a landmark referred to as the “stone bench” along the Sugarloaf access road. All four trees are stump sprouts, although three are mature enough to produce flowers and burs.

The trees were inventoried on July 3, 2002, by Burnie Burnworth, and numbered aluminum tags and blue flagging tape were installed on the most vigorous sprout on each tree. Tag numbers used in this area are from 827 through 830.

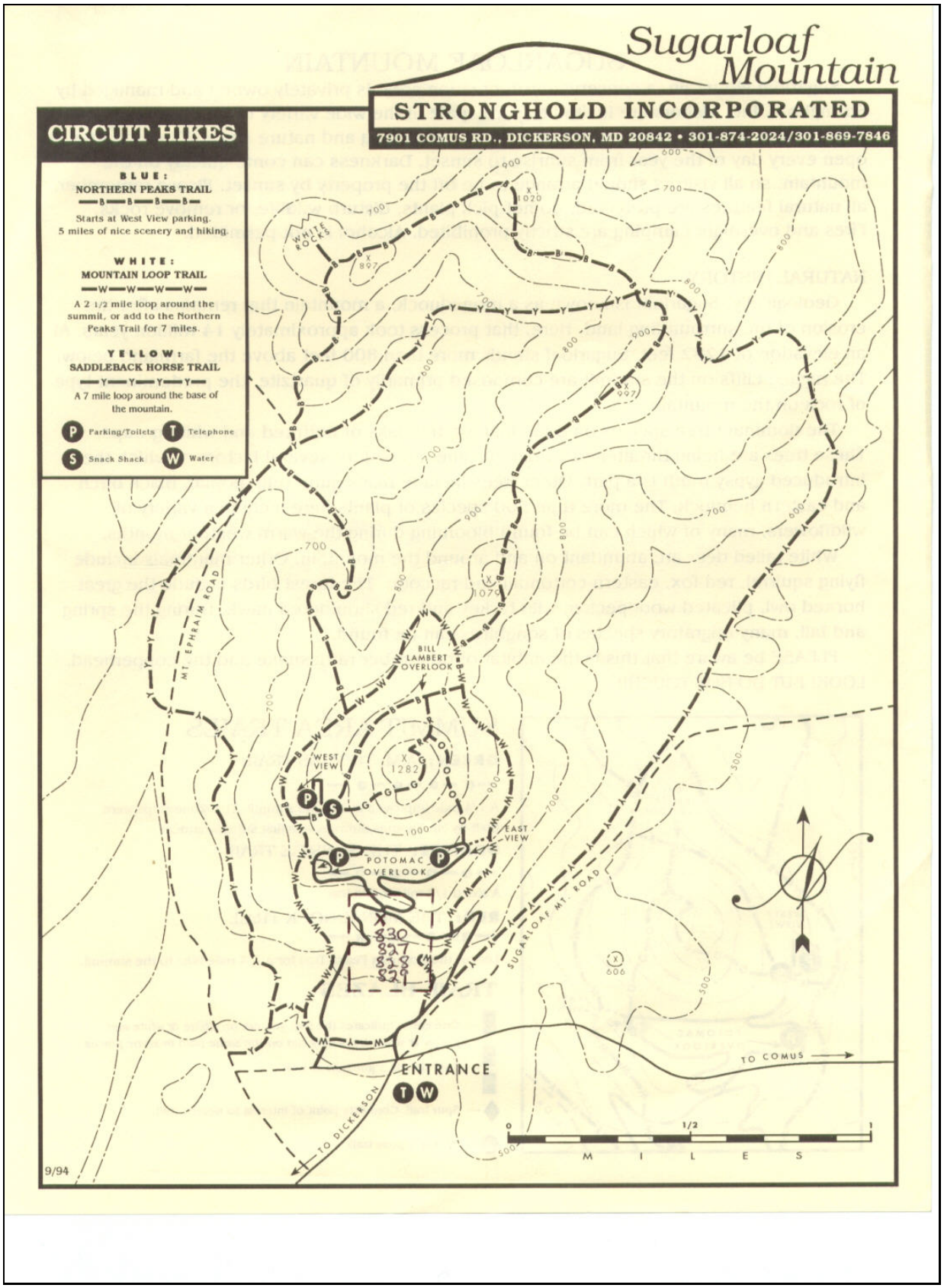

Sugarloaf Mountain
STRONGHOLD INCORPORATED
7901 COMUS RD., DICKERSON, MD 20842 • 301-874-2024/301-869-7846
CIRCUIT HIKES
BLUE:
NORTHERN PEAKS TRAIL
Starts at West View parking.
5 miles of nice scenery and hiking.
WHITE:
MOUNTAIN LOOP TRAIL
A 2 1/2 mile loop around the summit, or add to the Northern Peaks Trail for 7 miles.
YELLOW:
SADDLEBACK HORSE TRAIL
A 7 mile loop around the base of the mountain.
P Parking/Toilets
T Telephone
S Snack Shack
W Water
WHITE ROCKS
MT EPHRAIM ROAD
BILL LAMBERT OVERLOOK
WEST VIEW
EAST VIEW
POTOMAC OVERLOOK
SUGARLOAF MT. ROAD
ENTRANCE
TO COMUS
TO DICKERSON
0 1/2 1
M I L E S
9/94

Exhibit E -- American Chestnut Timeline

1904 – American chestnut blight discovered in New York
1913 – Pennsylvania tries to stop advance of the blight
1927 – USDA sends Dr. Beattie to Asia to collect chestnut seed
1938 – Chestnut blight observed in European trees
1942 – Stronghold plants 12 hybrid chestnut trees from USDA
1955 – Mutant breeding described at Atoms for Peace
1955 – Dr. Singleton proposes irradiating American chestnuts
1956 – Dr. Dietz begins irradiating chestnuts at Brookhaven
1964 – Hypovirulence appears to save European chestnuts
1966 – National Parks Assn. publishes appeal to save chestnuts
1969 – Stronghold convenes the American Chestnut Symposium
1969 – Stronghold Board votes to champion American chestnut
1970 – Stronghold plants 1,000 seedlings from irradiated nuts
1970 – Stronghold sponsors American chestnut movie
1971 – Stronghold plants 600 2nd generation seedlings
1972 – Neutron Products, Inc. begins irradiating Sugarloaf nuts
1973 – Stronghold plants 50 nuts from Clapper hybrid in Illinois
1970's and 80's – Stronghold distributes nuts and seedlings
1976 – Hypovirulence observed in US
1982 – Clapper hybrids bloom at Sugarloaf Mountain entrance
1980's – Dr. Griffin & Dr. Elkins graft survivors & form ACCF
1986 – Dr. Burnham devises back cross breeding strategy
1988 – Dr. Fulbright and Dr. MacDonald begin study at Sugarloaf
1989 – Dr. Fulbright inoculates select Stronghold trees
1990 – Stronghold maps West Field Research Area
1994 – Dr. Fulbright proposes superior tree breeding
1994 – Dr. Burnham updates back-cross breeding strategy
1995 – Dr. Fulbright prepares Research Plan
1995 – Stronghold cuts non-superior trees in East & West Fields
1995 – Stronghold sends superior nut harvest to Dr. Fulbright
1996 – Dr. Fulbright proposes additional nut harvest
2001 – Restart of the American Chestnut Program is proposed
2002 – Stronghold Board approves proposal
2002 – Surviving American chestnuts at Sugarloaf inventoried
2002 – Stronghold files used to prepare history of program

Exhibit F - People Pertinent to the History

- **Dr. R. Kent Beattie**, USDA researcher who was sent to Asia in 1927 to collect Asiatic chestnut seeds for experimentation in the US
- **Dr. Charles R. Burnham**, Professor Emeritus at the University of Minnesota and member of the National Academy of Sciences who published a back-cross breeding strategy in 1986 that became the basis for The American Chestnut Foundation's research at the Meadowview Research Farms in Virginia
- **Dr. Russell B. Clapper**, USDA researcher who experimented with crossing Asiatic chestnuts with American chestnuts and developed the "Clapper" hybrid
- **Dr. Albert Dietz**, a chemist with an abiding interest in American chestnuts who believed mutant breeding would produce blight resistance and who collected and had irradiated thousands of American chestnuts for planting all over the eastern US
- **Dr. Jesse D. Diller**, USDA scientist who pursued hybrid chestnut breeding into the 1960's
- **Dr. John Elkins**, an American chestnut researcher at Concord College, who formed the American Chestnut Cooperators' Foundation in the mid-1980's with Dr. Gary Griffin
- **Dr. Dennis W. Fulbright**, Dept. of Botany and Plant Pathology, Michigan State University, who began in 1988 to study the trees from irradiated nuts planted at Sugarloaf, and who continued through the 1990's to research blight resistance among the survivors
- **Dr. Gary Griffin**, American chestnut researcher at Virginia Polytechnic Institute and State University, who formed the American Chestnut Cooperators' Foundation with Dr. Elkins in the mid-1980's
- **Mr. Robert W. Holland**, Superintendent of Stronghold, Inc. from 1971 to 1989, who took nuts from Dr. Dietz to Neutron Products, Inc. in Dickerson, MD, for irradiating and returned them to Dr. Dietz or sent them to cooperators for planting
- **Dr. William L. MacDonald**, Professor of Forestry Pathology, West Virginia University, who collaborated with Dr. Fulbright on the early research at Sugarloaf Mountain

- **Mr. Donald A. McCormack**, trustee and Executive Secretary - Treasurer of the Board of Directors of Stronghold, Inc., whose interest in restoration of the American chestnut led to the Stronghold Chestnut Symposium in 1969 and the start of the Stronghold Chestnut Program
- **Mr. Phillip A. Rutter**, collaborator with Dr. Burnham on his mutant breeding strategy and President of The American Chestnut Foundation in 1988 who noted the evidence of blight resistance among American chestnut trees at Sugarloaf in 1988, leading to Dr. Fulbright's and Dr. MacDonald's research into the progeny of the irradiated seedlings planted at Sugarloaf
- **Dr. W. Ralph Singleton**, professor at the University of Virginia and geneticist at the National Colonial Farm, who first articulated the idea of irradiating American chestnuts to induce mutations that could lead to greater blight resistance
- **Mr. Ben Smart**, Superintendent of Stronghold, Inc., during the 1990's who assisted Dr. Fulbright in his superior tree breeding strategy by selectively cutting back the American chestnuts in Stronghold's East and West Field research Areas and collecting nuts
- **Mr. Gordon Strong**, the founder of Stronghold, Inc., who amassed the 3,000-acre Sugarloaf Mountain complex and dedicated it to the public's enjoyment of the outdoors
- **Mr. David Webster**, Executive Secretary of the Board of Directors of Stronghold, Inc. since 1992, who endorsed the writing of this History and the inventory of American chestnuts at Sugarloaf and who is sponsoring the restart of Stronghold's American chestnut research program in the fall of 2002

Exhibit G – Bibliography

The following is a list of the materials in the files of Stronghold, Inc., provided to me in July 2002 by Mr. David Webster, Executive Secretary of the Board of Directors of Stronghold, Inc.

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3. Beattie, R. Kent and Jesse D. Diller. "Fifty Years of Blight Resistance in America." Journal of Forestry May 1954: 323-329.
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6. Burnworth, Burnie. "Proposal for Restarting the American Chestnut Restoration Project at Sugarloaf Mountain." Submitted to the Stronghold, Inc., Board of Directors on September 13, 2001.
7. Dietz, Albert. "American Chestnut Seed Collection, Storage and Planting Practice" February 1974: *This paper is included in a folder with detailed information from ACCF and TACF websites on how to harvest, store, and plant nuts.*
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14. Griffin, Lucille. “Continuing the Quest.” Katuah Journal Leicester, NC, Fall 1988: 8-9.
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21. McCormack, Donald A. “What Stronghold is Doing About Chestnut.” Northern Nut Growers Association Annual Report 69 (1978): 110-111.
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39. "Sugarloaf Mountain Bulletin." November 1973: *This is a single page copied from the Bulletin showing photographs. of the planting of the original 1,000 seedlings grown from irradiated nuts supplied by Albert Dietz. Dr. Dietz and Dr. Singleton are shown in the photographs.*
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