"THE BEGINNING OF AN ARTIFICIAL FORESTRY IN MID-19TH CENTURY MICHIGAN"

THE CONTRIBUTIONS OF W.J. BEAL TO SILVICULTURE

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The loss of the native forests and timber resources to logging in the eastern and midwestern United States by the mid and late 1800's was cause for an increased interest in both conservation and forest regeneration. In Michigan, the northern half of the Lower Peninsula was cleared of white and red pine with the first wave of lumbering, and a second wave of hardwood cutting was underway by the close of the 1880s. Support for forestry programs was in its infancy at the federal level. However, a greater degree of support was developing within states of the affected area. Activities developed to stimulate the regeneration of cut-over forest lands received much attention at the state level and were supported by research at higher educational institutions. Michigan State Agricultural College (MAC) Professor of Botany, W.J. Beal1 was very concerned about the extensive harvesting of trees and loss of forested land (Figure 1). Shortly after his arrival in East Lansing, Dr. Beal realized the need to explore the possibility of growing trees to regenerate the forests that had been lost, and to encourage farmers to begin planting trees as a potential crop. Professor Beal expressed these concerns several times in his annual reports to the Michigan State Board of Agriculture, as well as a need to develop test plantings, including an arboretum, with the specific intent of determining how best to grow trees capable of producing timber in Michigan. In his 1876 report (Beal 1876), he stated: "I think this raising of forest trees is a promising field to demand our attention. When these different kinds of trees are well started some people of our State will want to learn how each variety thrives, that they may plant also. Indeed it does not now seem too soon for some farmers to be starting for profit, a plat of hickories, black walnuts, and white ashes, and perhaps chestnuts, European larches, and others." By 1888, Dr. Beal's title was expanded to Professor of Botany and Forestry. He continued to teach forestry and wood anatomy as single courses at M.A.C. for

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1 Michigan State Agricultural College, often referred to as Michigan Agricultural College (MAC), was founded in 1855. After passage of the Morrill Act of 1862, it became the first Land Grant Institution. In 1925, the name was changed to Michigan State College (MSC) and in 1954 to Michigan State University (MSU). William James Beal, a Michigan native and student of Asa Gray, joined the faculty of MAC in 1870 and remained until 1910. (Detailed historical accounts of Michigan State can be found in: Beal 1915, Kuhn 1955, Hannah 1980, Dressel 1987.)
twenty years until the Department of Forestry, under the direction of Professor Ernst E. Bogue, was formed with a distinct curriculum in 1902.

DEVELOPMENT OF THE ARBORETUM

A professional interest in silviculture led to what Professor Beal referred to as “the beginning of an artificial forestry” (Beal 1875a), and his first experiment in the field of “artificial” forestry was the development of The Arboretum on the campus of Michigan Agricultural College in 1873. Little was known regarding

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The date of establishment of The Arboretum varies in Professor Beal’s annual reports from 1873 to 1877. Professor Beal gives two dates for the beginning of The Arboretum, 1873 and 1875, in his book, History of the Michigan Agricultural College. The most widely cited date is 1875. However, as is evidenced in Beal’s 1873 annual State Board of Agriculture Report, the production of seedlings began off site in 1873 and actual planting on the site was reported in the fall of 1874. These dates are corroborated by data presented in the Notes on Arboretum, by V.R. Gardner (1903). Therefore, if the germination of trees to be planted in The Arboretum is considered the beginning of the planting, a founding date of 1873 must be accepted.
the growth requirements and hardiness of tree species, especially non-native species introduced from Europe and Asia. Beal acknowledged these facts and set out to begin defining the growth requirements for both native Michigan trees and trees from other regions of the U.S., Europe, and Asia. The studies in silviculture began with the germination of tree seeds in a nursery bed in 1873\(^3\). These seedlings were later transplanted to The Arboretum after 1874. The first plantings in The Arboretum began in the fall of 1874 with the planting of two rows of swamp white oak (*Quercus bicolor*) acorns. In subsequent years, seeds and seedlings collected from a variety of sources were planted directly in The Arboretum. Dr. Beal repeated his concern for the need for improved silviculture in his 1877 report regarding progress in the arboretum:

"It is too early in the history of our State to make much of a stir on this subject. Timber is abundant in many portions of the State, and the stumps in the neighboring fields have not yet rotted; still, many a thoughtful farmer and mechanic is interested to know that we are making a small beginning. The time is rapidly coming in which good, straight, second-growth ash, hickory, larch, etc., will bring a high price even in Michigan" (Beal 1878a).

Trees were planted in The Arboretum in rows running south to north, four feet apart (Beal 1878a, 1880) on a parcel of land just east of a grove of swamp white oak to the north of the brick dwelling-houses on campus. This location is south of Michigan Avenue and west of the Abbott Road entrance and today is bounded by Campbell Hall to the southeast, a parking drive to the south, Mayo Hall to the west, and Michigan and Grand River Avenues to the north. Professor Beal planted and recorded The Arboretum in his field book which was later transcribed and typed in 1903 by Dr. V.R. Gardner, Chair of the Department of Horticulture (Beal 1880, Gardner 1903). Unfortunately, Professor Beal's original book has apparently been lost; however, the typed transcription of Dr. Gardner has survived. The soil of The Arboretum was described as a naturally well drained sandy loam. A dirt road which coursed through the site had removed the topsoil along the road's path, creating an interesting comparison for tree growth on disturbed and non-disturbed soils (Beal 1880, Gardner 1903).

By the third year, The Arboretum consisted of one and a quarter acres of land with plans to expand the site in the following year (Beal 1876). The focus of the collection was on trees and shrubs native to Michigan and/or species which would be hardy in the climate of central Michigan. In 1875, in addition to species collected within the region, 35 species, including foreign species, were received from Professor C.S. Sargent of the Bussey Institute, Massachusetts. With a particular interest in timber species, Professor Beal included plantings of European larch (*Larix decidua*), black walnut (*Juglans nigra*), hickory (*Carya* sp.), basswood (*Tilia* sp.), chestnut (*Castanea* sp.), catalpa (*Catalpa* sp.), box elder (*Acer negundo*), white ash (*Fraxinus americana*), sugar maple (*Acer saccharum*), swamp white oak, and American beech (*Fagus grandifolia*). During

\(^3\)Two hundred taxa of foreign tree and shrub seeds were received from the Royal Botanical Garden at Kew and an additional sixteen from the U.S.D.A. All were planted in the nursery in 1873 (Beal, 1875b).
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<tr>
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The summer of 1876, The Arboretum was increased to about two acres (Beal 1878a).

By 1878, The Arboretum was reported to contain about five hundred species, but this estimate was reduced to around two hundred and seventy five in 1879\(^4\) (Beal 1878a, 1880). A species list prepared from existing records is presented in Appendix 1. Beal understood the value of his collection of trees in education and demonstration, using the plantation to introduce students and visitors to the potential of growing trees as a crop. To increase the educational value of the planting, all the trees in The Arboretum were labeled in 1878. Labels were made from painted zinc strips seven to ten inches long and three inches wide, and were attached directly to larger trees in the collection by one nail through the label and three holding the edges, providing movement of the label as the tree increased in girth. Smaller specimens were labeled using 3 × 3 inch pine stakes two feet long, the ends of which were dipped in coal tar and

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\(^4\)The total number of taxa planted in The Arboretum will probably never be known, as the numbers reported by Professor Beal in his annual reports vary widely, and the original planting notebook appears to be lost. Part of this variation may be a reflection of the additions of new taxa which did not survive more than a few years and were removed from subsequent inventories. The best estimate of the taxa planted is represented by the species list in Table 1. Many of the taxa represented are non-hardy species which would have not survived the Michigan winters. The hardiness of these taxa were unknown at the time and the testing of hardiness was and still is an important function in silvicultural studies.
pitch (Beal 1878a). In the spring of 1879 some of the trees and shrubs growing in The Arboretum were transplanted to the expanding collection of woody plants (Campus Woody Plant Collection) installed around buildings and in groupings on the lawn of the campus. Again, Professor Beal acknowledged the contributions of trees and seed from Professor C.S. Sargent, who assumed the duties of the Director of the Botanic Gardens and Arnold Arboretum of Harvard University by 1878 (Beal 1878b). Additional plant material for The Arboretum planting was secured from regional sources, the U.S.D.A., and the Royal Botanic Gardens, Kew, Surrey, England.

The last reported planting dates were 1888 and 1890, and represented collections of willow (Salix spp.) and dogwood (Cornus spp.) cuttings received from the Forestry Division of the U.S.D.A. (Beal 1891a, 1891b). There appear to be no more additions to the collection after 1890. In 1886, Professor Beal wrote of The Arboretum: “Of the various things attempted since my connection with the Agricultural College few have given greater satisfaction, considering the outlay of time and money, than the selection and growing of trees” (Beal 1886). By this time, he was Professor of both Botany and Forestry. The Arboretum contained 215 taxa of trees and shrubs, many of which were not represented elsewhere on campus. Since the seeds and seedlings were planted so close together, regular thinning of The Arboretum was conducted. This included cutting out trees and moving trees onto the campus. The Arboretum was also cultivated regularly in mid-August and again in late autumn between the rows of trees to reduce the growth of weeds (Beal 1886).

Twenty years after its establishment, Beal reported that all cultivation of the Arboretum had ceased, but some thinning continued (Beal 1894). Twenty-five years after initiating this experiment, Beal reported his findings in a paper presented to the Society for the Promotion of Agricultural Sciences meeting held in Boston in 1898. The paper was entitled “Notes concerning a few trees in The Arboretum at the Agricultural College” (Beal 1899a). This is the summary paper in which he presents a quarter century of observations regarding the growth of trees. After four to six years, the best growth was observed in black walnut, catalpa, red elm (Ulmus rubra), and butternut (Carya cinnerea). After 11 years, the growth rate of the butternut declined, catalpa was damaged by the cold, the chestnuts were not healthy, but black locust (Robinia pseudoacacia) and European larch showed much promise. After 23 years, he recommended the planting of chestnuts with a mix of box elder, evergreens, or bough to shade the ground and keep down the growth of weeds and grasses. He also recommended the planting of “. . . white ash, white pine, Norway pine for poor sand, and white oak, shag-bark hickory, basswood and sugar maple for suitable places.”

In 1898 the Board of Agriculture gave permission to the Professor of Horticulture, L.R. Taft, to fence in about two acres of land consisting of the wood lot to the west of the Arboretum and the south-western corner of The Arboretum for a deer park. Deer and elk were introduced to the site. As suggested by Professor Beal, the activities of the deer caused considerable damage to the wood lot and Arboretum (Figure 2) (Beal 1900). After thirty-five years of growth, Professor Beal expressed concern for the future of The Arboretum given the recent distur-
bances. Feeling the pressures of the growing college, Professors Beal and Bogue realized the value of the land occupied by the planting and feared it would be sought for building or other purposes. Anticipating this change, an annex arboretum was planted by Professor Bogue south of the Red Cedar River east of the Pere Marquette railway spur shortly after his arrival at M.A.C. as head of the newly created Forestry Department in 1902 (Bogue 1903, Beal 1907). Today, the remains of this arboretum annex are located to the east and north of Wells Hall and north of the International Center.

The original Arboretum (Figure 3) has survived the development of a dormitory complex during the 1930s and loss of the southern 3/4 of the total area to a parking lot. An inventory of trees was conducted during the spring of 1996 and compared to the original planting plans. A total of 69 original trees have survived, including 19 sugar maples, two black maples (Acer nigrum), two Norway maples (Acer platanoides), one tartar maple (Acer tataricum), five Tree-of-Heaven (Ailanthus altissima), three shagbark hickories (Carya ovata), one hackberry (Celtis occidentalis), two white ash, one northern red ash (Fraxinus pennsylvanica var. austini), one blue ash (Fraxinus quadrangulata), four black walnuts, one black cherry (Prunus serotina), seven white oaks (Quercus alba), 15 swamp white oaks, one red oak (Quercus rubra), one black oak (Quercus velutina) and one possible hybrid cross of butternut and black walnut (Juglans nigra × Juglans cinerea).
FIGURE 3. Rows of sugar maple trees can still be seen in the Arboretum. These particular trees were planted by Professor Beal in 1875. Students of Michigan State University use the Arboretum for education and recreation. (Photo credit: Bruce A. Fox)
THE STATE FORESTRY COMMISSION

Dr. Beal presented papers on forest preservation and tree planting at meetings of the State Horticultural Society, partly based on his experiments on tree growing in The Arbor. It was these presentations that stimulated the public to pressure the Michigan Legislature into action (Garfield 1905). In 1887, a bill was introduced into the Michigan Legislature by the Honorable N.A. Beecher of Flushing, Genesee County creating an Independent Forestry Commission within the State Board of Agriculture (Reynolds 1888). The objectives of the commission were defined in sections 2 and 3 of the legislation:

"SEC. 2. It shall be the duty of said Forestry Commission to institute an inquiry into the extent to which the forests of Michigan are being destroyed by fires, used by wasteful cutting for consumption or for the purpose of clearing lands for tillage or pasturage. Also as to the effect of the diminution of the wooded surface of the land upon ponds, rivers, and water power of the State, and in disturbing and deteriorating the natural conditions of the climate. Also as the protection of denuded regions, stump and swamp lands."

"SEC. 3. Said Commission shall make report of the results of their inquiries to the Governor of the State, together with such legislation as seems to them expedient to propose to preserve and restore the forest wealth of the State, sixty days before the assembling of the legislature for the year eighteen hundred and eighty-nine, and the State printer, under the direction of said Commission, shall cause to be printed as many copies of said report for distribution as they may deem expedient."

Professor Beal was appointed co-Director of the Commission along with Mr. Charles W. Garfield, a colleague of Beal's at M.A.C. Together, they organized the first state Forestry Convention held in Grand Rapids on January 26th and 27th, 1888. The purpose of the convention was to meet the objectives of the new Commission outlined in the original law. Speakers presented papers on the state of Michigan's forests, the markets for wood products, requirements for growing trees, and protection of trees from forest fires. Bernhard E. Fernow, Chief of the Division of Forestry, U.S.D.A., was an invited speaker and presented a paper entitled "Proper Basis of Forestry Legislation" (Fernow 1888).

Professor Beal traveled extensively in Michigan gathering information and facts for the required Report of the Forestry Commission, due in Lansing 60 days prior to the meeting of the legislature. His survey of the jack pine plains of Michigan was conducted from a canvas-topped lumber wagon crossing from Harrisville on the Lake Huron shore to Frankfort on Lake Michigan. This region of Michigan once supported the great pineries of the state, but became a wasteland following logging and the subsequent fires which swept the area. In addi-

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5 In 1888, feeling the pressures on his time for teaching, research, and management of the Botanie Garden, Arboratum, Museum and Herbarium, Professor Beal reported to the Honorable Edwin Willisc, President of MAC, that co-director of the Forestry Commission, C.W. Garfield, was in "...continued bad health..." which "...has made it impossible for him to render the assistance that both of us had anticipated." He continued by stating "The work of this commission has been very pleasant and no doubt very profitable, but it has taken time which I had hoped to give to the study of other subjects. I need not tell you that the position assigned to me in this commission was neither sought nor desired" (Beal 1888c).
tion to surveying the extent of damage that lumbering and fire had caused to the sandy soils, he was also keen to find grass species which could flourish in these sands. Beal was accompanied by four other botanists, including former student Liberty Hyde Bailey who was preparing for his professorship at Cornell; Mr. Charles F. Wheeler, a pharmacist and Michigan flora authority; and two of Beal's students, Lyster H. Drewey and Daniel A. Pelton. Their travels were recorded and published in the Detroit Tribune and Free Press by reporters who traveled with the group. This trip resulted in Beal authoring a publication entitled "The flora of the Jack-Pine plains of Michigan" (Beal 1888a).

The final report of the Forestry Commission, edited by Dr. Beal and Mr. Garfield, and authored primarily by Beal, was 92 pages long and contained observations, line drawings, and plates covering topics including: Forest management in southern Michigan, Forest fires, Observations on the succession of forests in northern Michigan, Large trees, The names of pine trees as known to lumbermen, Cutting and removing logs for lumber, A lumber camp, New uses for certain kinds of timber, The amount of pine yet remaining in Michigan, List of trees and shrubs belonging to Michigan, Trees and shrubs of Michigan compared with those of the rest of the world, Why has Michigan so many and Great Britain so few?, and Questions sent to supervisors and their replies (Beal and Garfield 1888).

The recommendations of the commission focused on section 3 of the act providing for a forestry commission. The first called for a repeal of the duties of the commission related to the collection and compilation of information from township supervisors, instead giving authority to the commission to identify the most reliable sources for any required information. The second called for a law prohibiting burning by persons clearing land during the period from April first to November first without the written consent of the township supervisor and notice to owners of adjoining lands. The third recommendation called for authorization to investigate the possibility of acquiring land on behalf of the State for forest preserves. The final recommendation requested additional funding to support the work of the commission through 1890.

Fernow would later comment that Michigan was the third state to initiate state-wide legislation related to forestry and forest regeneration; however, the first Forestry Commission was voted out of existence by the State Legislature in 1892 due to public pressure. Ironically, in an article published in Michigan Natural Resources Magazine (Horstik 1987), Professor Beal was erroneously credited with writing a letter in response to the Forestry Commission's questionnaire. Horstik (1987) cites this letter as one of the reasons leading to the repeal of the Commission, and falsely credits Professor Beal with the following statement: "Reforesting a large area is such a preposterous project that you would not wish to father it, I know." In fact, this quotation is from Mr. A. C. Glidden of Paw Paw, Michigan. The quotation was contained in a letter in response to Professor

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6 In addition to his interest in trees and forests, Professor Beal was an authority on the grasses, primarily because of their importance as a forage crop. He published a two-volume series, *Grasses of North America* (Beal 1887, 1896), and the botanical garden on the MSU campus named in his honor was initiated in 1873 as a collection of grasses.
Beal's Forestry Commission survey question #6: "Is reforestation desirable in your section?" (Beal and Garfield 1888). A subsequent article (Sodders 1995) perpetuated this error and stated: "Legislative reaction to Beal's statement led to repeal of the Forestry Commission Act, and efforts to re-establish our forests were postponed for another 12 years." This statement is false. The responses of some of the County supervisors, such as Mr. Glidden's, to the Commission's survey regarding enacting Forestry Legislation were negative. However, Professor Beal never discouraged reforestation, nor did he call for the repeal of the Forestry Commission. He was firmly committed to the ideals of the Commission and authored the recommendations for expansion and land acquisition presented above. Unfortunately, this error has been propagated and has appeared in interpretive programs at the North Higgins Lake State Park state nursery site.

In a report presented in 1895 to the Farmers' Institute entitled "Some needs of forestry," Professor Beal stated the need to re-establish the Commission. A resolution was adopted at the conclusion of the meeting requesting a reinstatement of a forestry commission (Beal 1895a). Action in the state was delayed until 1899. In that year, a permanent forestry commission of three was appointed and charged with the task of submitting a bill in 1901 to the state legislature to carry out a forest reservation policy to include 200,000 acres of state tax homestead lands and swamp lands owned by the state. Although the original bill was defeated, a second bill introduced in 1903 enabled the Commission to secure 70,000 acres in Roscommon and Crawford counties as a start towards a statewide forestry policy (Fernow 1902). Dr. Beal participated in the new Forestry Commission, contributing papers in the 1902 and 1903-4 Reports, but never served as a member of the new Commission (Beal 1903, 1905a, 1905b).

EXPERIMENT STATION PLANTATIONS

The year following the first Forestry Convention must have been a very busy and fruitful year for Professor Beal. In that spring, he was ready to apply some of the knowledge gained from the arboretum experiment and that shared during the January meeting at a series of experiment stations established in the late 1880s across the northern half of Michigan's Lower Peninsula. This region, dominated by sandy soils, was difficult to farm or to support natural forest regeneration. On May 15, 1888, Beal planted 35 taxa from the Iowa Agricultural College from stock originating from central Russia (Beal 1888b, Anonymous 1913) on a rented parcel of land at Grayling, MI. Beginning on May 22, 1888 he planted an additional 5260 trees and cuttings representing forty-one taxa on a 4 acre portion of the 80 acre experiment station in Grayling (Crawford County, the southwest corner of Section 17, T26N R3W, shown in Figure 4). Three different site preparation methods were tested. One acre of land was intensively prepared by plowing. A second one-acre site, containing a few scattered jack pines (Pinus banksiana), scrub oaks (Quercus ellipsoidalis), and shrubs, was passed over once with a spring-toothed harrow which was reported to tear up the soil but left intact many of the existing trees
and shrubs. Beal described the land and preparation as "land once harrowed with spring tooth harrow. No grubbing. Jack pines numerous in places. The piece is about 40 rods long, about 5 rods wide at the east end and 14 rods wide at west end and lies north of the trees in the plowed land." The third site received no cultivation. The trees were planted in rows spaced 4 feet apart and the trees four feet apart within rows, as in The Arboretum on the MAC campus. The experimental design alternated evergreens, shade-loving trees, and shade-intolerant trees between and within the rows. Eventually, the planting was reported to consist of 76 taxa (Beal 1888b, Anonymous 1913).

Additional plantations were planned for the Experiment Substations at Oscoda, on an upland site south of the Au Sable river near the shore of Lake Huron and on a ten-acre parcel one half mile north of the Village of Harrison which is located approximately 48 miles south of Grayling (Beal 1888b). The Oscoda plantation was established in the spring of 1889 on a ten acre parcel of farmland given to the State Board of Agriculture by James Barlow. This planting consisted of white pine (Pinus strobus), Norway spruce (Picea abies), red pine (Pinus resinosa), box elder, locust and pitch pine (Pinus rigida) (Beal 1889a).
All three Experiment Substation plantations have survived in some form to the present day. The Oscoda plantation was incorporated into the Huron-Manistee National Forests, River Road National Forest Scenic Byway. The plantation was harvested in the early 1980s. However, several mature red pines were left as seed trees, and sapling black locust and pitch pines were found among seedling jack pines and rows of stumps on four foot centers during a site visit in the fall of 1997. The site is adjacent to the parking area and trail head for the Eagle Run Trail System. The Harrison plantation is located on private property just to the north of Budd Lake and to the east of an old railroad grade. It is a one-acre planting consisting of 18 mature red pines planted in rows. This plantation was burned twice early in the 1900s as is evidenced by fire scars at the base of the trees. The Grayling planting has survived in the best condition of the three plantations. The original four-acre plantation is now owned by the State of Michigan (Figure 5). In addition to the native jack pine of the area, red pine, white pine, Scots pine (*Pinus sylvestris*), and Norway spruce are all regenerating among the mature trees planted in 1888.

**PLANTATION EXPERIMENTS ON THE CAMPUS OF M.A.C.**

The fourth experimental plantation was made to the south of The Arboretum on the M.A.C. campus in the spring of 1890. This planting consisted of box el-
ders, eastern white pine, and Norway spruce. Beal intended for the box elders to provide shade to keep weeds and grass under control, minimizing the need for cultivation. Eventually the conifers were supposed to overtop the box elders; however, the box elders grew too fast for the evergreens on this site (Gardner 1903).

Professor Beal decided to experiment with the box elder and white pine combination once again and established a "small model forestry plantation" (Smith 1895) in 1896 on 2.2 acres along the Red Cedar River east of the M.A.C. campus (Figure 6). The original plan was to cultivate the pines in a grid of 10 x 12 feet for a few years and then plant box elders between the wide rows of pines. In addition to the pines, four rows of bitternut hickories (Carya cordiformis) were also planted on this site (Smith 1897). In the fall of 1896, the U.S.D.A. sent a collection of seeds representing trees collected from different regions of the U.S. These were planted in the spring of 1897 in between the rows of pines instead of the box elders. The object of this planting was that of a "common garden experiment", to determine what differences, if any, could be observed in the trees of the same species collected from different regions (Smith 1897, 1898). Two years after the pines were planted, the plantation was maintained free of weeds during the summer and the trees had attained a height of 10 to 16 inches (Smith 1898).

The fate of the common garden experiment is unknown, and Beal reported
that he would go ahead with his original plan to plant box elders in the spring of 1902 (Beal 1901a). A single row of year-old box elders was planted between every other row of pines. An additional planting of hardwoods and conifers was made north of the pine plantation on "a piece of river bottom one hundred and twenty square rods in extent" (Beal 1902). Beal described the planting as being a mixture of trees mostly of silver maple (Acer saccharinum), box elders, and basswoods with a smaller number of arbor-vitae (Thuja occidentalis), balsam fir (Abies balsamea), hemlock (Tsuga canadensis), Norway spruce, white spruce (Picea glauca), red cedar (Juniperus virginiana), larch, and white pine. These trees were planted on a four-foot by four-foot grid and cultivated (Beal 1902). Today, the plantation of eastern white pines and mixed planting to its north are known as the Beal Pinetum.

In 1911, the state foresters of Michigan placed a bronze plaque in the northwest corner of the pinetum in honor of Dr. Beal and in recognition of his contributions to forestry, declaring him "The Father of Michigan Forestry" (Figure 7). One hundred years after their planting, the pines stand over 100 feet tall (Figure 8). A second growth of hardwoods forms a dense understory about two-thirds of the height of the pine canopy. Many of the pines have been infected by root rot fungi; however, rows of trees on a ten-foot by twelve-foot grid can still be observed. Just to the north of the pinetum can be found rows of silver maples and basswoods with an occasional white pine representing the 1902 addition.

**PUBLICATIONS AND PRESENTATIONS**

Most of Dr. Beal's research was recorded in his Annual Reports to the State Board of Agriculture or as bulletins of the Michigan Agricultural College or Forestry Commission, in which he reported on the growth of trees in The Arboretum and encouraged his readers to plant trees. In one of his bulletins from 1889 (Beal 1889b) entitled "Why Not Plant a Grove?", Professor Beal closes by asking; "Reader, if not already done, will you not plant a grove this year, or do something to induce some of your friends to plant one? The writer will be glad to give any further instructions in his power on this subject, and would consider it a favor to receive a postal card from any who contemplates a grove" (Beal 1889b). He also lectured extensively on the subject of growing trees at national meetings and Farmers' Institute meetings around the state, encouraging farmers and land owners to plant trees and create wood lots. Convincing people to plant trees at the end of the 19th century was no easy task. At one of his lectures presented in a northern Michigan schoolhouse entitled "Our Forests", Beal was introduced by the chairman of the meeting as "the man who has come to tell us what to do with these woods of ours, how to get rid of the nuisances so we can plant corn." Obviously, this was not at all the message of the presentation. The chairman left halfway through the talk (Kuhn 1955).

The first progress report on tree growth in The Arboretum was published in 1876 in the Michigan State Board of Agriculture Annual Reports, recording the
FIGURE 7. The "1911 Foresters" of Michigan placed this bronze plaque in the northwest corner of the Beal Pinetum on the campus of Michigan State University in honor of Dr. Beal and declared him 'The Father of Michigan Forestry'. (Photo credit: Bruce A. Fox)
FIGURE 8. Standing tall after 100 years, the white pines of the Beal Pinetum continue to grow. (Photo credit: Bruce A. Fox)
first two to three years’ growth of seedlings (Beal 1876). By 1879, Beal published a more detailed description of growth of thirteen species, including swamp white oak, white ash, basswood, sugar maple, butternut, chestnut, black walnut, shagbark hickory, catalpa, red elm, silver maple, and Tree-of-heaven (Ailanthus altissima) (Table 1). Of the Tree-of-heaven, he wrote: “This is tender, diseased, and will very likely soon die down to the ground” (Beal 1879a). The fact that five of these original trees have survived for over 100 years, and are in excess of two feet in diameter proves his assumption of this potentially weedy species to be wrong. The report included a table of height and diameter growth for the different species. Michigan Agricultural College Bulletin No. 21, entitled “Lessons on growing forest trees”, was published by Professor Beal in 1886. Within this bulletin, Beal stated with regard to his Arboretum experiment:

“Till a person begins to plant and cultivate trees and shrubs, as here attempted, he does not realize how little any one in this country knows about the best sorts to select and how to treat them from the seeds to mature trees. For want of information mistakes have been made, but even these mistakes often teach as much as the successes. Whether Michigan men ever grow forest trees for profit or not, the information acquired in growing an arboretum has already been the means of helping to answer many inquiries, and is likely to help in answering many more” (Beal 1886).

The report identified some of the factors influencing species hardness in Michigan, methods of seed collecting and times of sowing, effects of cultivation, and the influence of stocking densities on lower leaf retention and tree form. The influence of stocking densities and leaf retention on weed growth and a reduced need to cultivate led Beal to consider “nurse” trees. Later experimental plantings using box elders and white pines were conducted to test the possibility of using an alternate tree species to reduce the need for weed removal (Beal 1886).

Seed viability was another area of interest of Beal’s. The viability and longevity of tree seeds was relatively unknown, prompting him to experiment (Beal 1895) and report on the viability of black oak acorns and other species. Additionally, he included observations on seed dispersal by wind or birds. He also presented another summary table reporting on height and diameter growth of 16 forest tree species after 10 years of growth (Table 1) (Beal 1886).

In 1893, Professor Beal published two papers related to forestry. The first, published in the journal The Engineering Magazine, was entitled “Conditions of forestry as a business.” In this article, he defined forestry, reviewed forestry practices and regulations in Europe, asked what could or should be accomplished in the United States, called for more research on tree growth and the conditions that influence growth, and endorsed more forestry programs at agricultural colleges to achieve effective state and national forestry programs. He also called for use of the various state Farmers’ Institute programs as a vehicle for increasing awareness of the need to plant forests. Beal was a supporter of state and federal legislation regarding implementation of forest policy and clearly stated his position in this article (Beal 1893a). However, feeling the sting of the demise

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7 Among the many contributions of Professor Beal is his long-term seed viability study. Started in 1879, it is now the longest continuously running seed viability study (Beal 1879b).
of Michigan’s first forestry commission in 1892, Beal wrote; “Something may be done by forestry commissions, but too much is likely to be expected of them, and, to save expenses, somebody will advocate their abolition—and somebody will sooner or later usually succeed. The value of forestry commissions consists largely in giving advice and in educating the people” (Beal 1893a). The second paper, “A forestry fortune: Our wealth of commercial woods” was a popular account of the trees of Michigan and their uses (Beal 1893b).

A paper presented at the Farmers’ Institutes in 1895 entitled “Some needs of forestry” addressed Beal’s concerns regarding the state of forestry in Michigan, drawing on many themes developed in earlier papers (Beal 1895). In this presentation, later published in the Michigan State Board of Agriculture Annual Reports in 1895, Beal defined forestry, outlined the need within the state, and continued to encourage the audience to plant trees and manage woodlots. It was also during this presentation that Beal called for and received a resolution to create a new state forestry commission (Beal 1895).

In 1899, the first Forestry Bulletin was produced by M.A.C. (Smith 1899). Beal contributed a paper on the methods of regenerating pine stump lands (Beal 1899b). Within this article he acknowledged that natural regeneration could occur in many instances, but stated that the natural process was slow and ‘often imperfect’. Beal identified “seven problems” which needed to be addressed in order to facilitate proper forest management and perfect regeneration:

1. What kinds of trees shall we plant; shall they be native or foreigners?
2. How many shall we plant to the acre?
3. What preparations shall we give the land?
4. How shall we care for the trees, from seedlings to maturity?
5. How shall we plant to best advantage, and at what season of the year?
6. How large shall the trees be when planted, or shall we rely on sowing and planting seeds?
7. Shall we plant one kind of tree on an acre, or shall we plant several kinds?

To address the first question, Beal drew from his experiments on growing trees on the M.A.C. campus and from the experiences of Professor C.S. Sargent, Director of the Arnold Arboretum and long-time contributor to Beal’s forestry experiments. Beal quotes Sargent as initially being very supportive of growing exotic timber species in the 1870s, but retracting support for exotics in favor of species native to Massachusetts by the mid 1880s. A similar recommendation was made for reforestation in Michigan by Beal. He also acknowledged the early success in planting a grove of chestnuts, butternuts, and black walnuts achieved by Professor James Satterlee in Greenville, Montcalm County in 1863. In addition, Beal recommended the planting of “… aspens and other poplars, with a view of using the timber for paper pulp.” Site evaluation and selection were also noted for influencing the selection of species to be planted. The easiest selection criterion was to plant species that formerly grew on the site.

Stocking densities and planting strategies were recommended as “… four to the square rod, 640 to the acre, and among these and near them, should be other cheap and quick growing trees or shrubs to shade the ground and help keep out
grasses, herbaceous plants and weeds. For cheap nurse trees, to start quickly and shade the ground, there appears nothing better than box elder. On the light sand, jack pine started from seed is first rate."

Site preparation was acknowledged as being highly variable and dependent on prevailing conditions of vegetation cover and debris left from previous logging. Examples were presented for different scenarios. Protection of the young trees from grazing animals and fire was emphasized. The use of nurse trees to reduce weed and grass growth was suggested. If nurse trees exceeded the height of the stock trees, pruning was recommended. Beal recommended both clearcutting mature timber and selective harvesting of the maturing stand with the intent of encouraging natural regeneration. He strongly supported selective harvesting on slopes.

Regarding the planting of trees, Beal wrote "Evergreens are best planted just as the buds are pushing in the spring; other trees may be planted in the spring or fall, while they are destitute of leaves." Details were given to facilitate planting of the seedlings. Special care of bare root seedlings to prevent drying was stressed: "An experienced gardener knows that the roots of a young tree when exposed to dry air will live just about as long as a trout or a black bass in the same situation; the inexperienced or thoughtless person might lose most of his labor in tree planting by not knowing this fact." The planting of nuts was recommended in the spring and at a depth of two inches. Beal was aware of recalcitrant seeds and emphasized the need to plant the seeds of elm, birch, maple, and ash shortly after collection. Instruction on developing a tree nursery for seedling production was also presented (Beal 1899b).

After spending thirty years growing and experimenting with trees on and off the campus of M.A.C., Beal published a list of trees and shrubs planted on campus. The list, published in 1901, evaluated 619 taxa. Those he found to be hardy and "otherwise desirable for planting" were marked with an asterisk (Beal 1901b). Referring to an original list of woody plants printed in 1887 by Professor L.H. Bailey, Beal commented that one thousand copies of Bailey's list were distributed over a period of ten years, and that this new updated list would replace the original. By today's standards, a thousand copies of a publication may appear small, but given the population of Michigan in the latter half of the 19th century, this figure represents a sizable interest in trees.

**AN INFLUENCE ON PRESENT DAY FORESTRY**

Dr. Beal realized the economic and social value of forests and the timber they produced. He worked to ensure that a future supply of forests and forest products would be available with a minimal impact on the environment through his efforts in reforestation and conservation. These actions clearly established the future direction of forestry and silviculture in the state of Michigan. Known as the "Father of Michigan Forestry", Dr. Beal pioneered methods of silviculture including site preparation; planting, transplanting and cultivation of forest trees; development of forest nurseries; evaluation testing for performance of both native and
introduced timber tree species under the variable climatic and soil conditions of Michigan; and tree seed storage and viability. His early suggestions as to the best trees to plant and where to plant them had an early impact on reforestation of Michigan, as did his advocacy toward forestry, conservation, and forest legislation. He was one of the founding directors of the original 1887 State Forestry Commission, and an advocate for the formation of, and participant in, the second State Forestry Commission. Today's Forest Management Division of the Michigan Department of Natural Resources can be traced back to the second State Forestry Commission. The 70,000 acres first reserved by the state in 1903 has grown to nearly 4 million acres of dedicated state forest land. Timber revenues from these lands now are sufficient to pay costs of management and part of the costs associated with fire control and wildlife management.

One of the most significant long-term contributions to the fields of silviculture and forestry is the importance of Beal's plantings to education and demonstration. All of his original forest tree plantings have survived, to some extent, into the present. The best preserved plantations, the Beal Pinetum and Arboretum, are on the MSU campus. These campus plantations continue to function as educational tools for thousands of students at Michigan State University in the fields of forestry and the plant sciences.

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8 Statistics and information regarding the Michigan Department of Natural Resources were supplied by Mr. William B. Botti, Timber Management Unit Leader, State Forest Operations Section, Forest Management Division, Michigan Department of Natural Resources.
in the arborium. 18th Annual Report of the Secretary of the Board of Agriculture of the State of Michigan for the year 1879, pp. 188–191.


1880. Experiments and other works of the Horticultural Department: Notes of some timber trees in the arborium. 18th Annual Report of the Secretary of the Board of Agriculture of the State of Michigan for the year 1879, p. 188–191.


1895. Some needs of forestry. 34th Annual Report of the Secretary of the Board of Agriculture of the State of Michigan for the year 1895, pp. 818–820.


Abies sp.
Abies balsamea (L.) Mill.
Abies grandis (D. Don ex Lamb.) Lindl.
Abies nordmanniana (Steven) Spach.
Acer campestre L.
Acer colchicum rubrum (?)
Acer negundo L. (Negundo aceroides)
Acer platanoides L.
Acer pseudoplatanus L.
Acer rubrum L.
Acer saccharinum L. (A. dasycarpos J.F. Ehrh.)
Acer saccharum L.
Acer spicatum Lam.
Acer tataricum L. (A. tatarica)
Aesculus glabra Willd.
Aesculus hippocastanum L.
Ailanthus altissima (Mill.) Swingle
Alnus sp.
Alnus glutinosa (L.) Gaertner
Alnus maritima (Marsh.) Nutt.
Amorpha fruticosa L.
Betula allegheniensis Britt. (Betula lutea)
Betula lenta L.
Betula nigra L.
Betula nigra L. (B. rubra Michx.f.)
Betula nigra var. Marsh.
Betula pendula Roth (B. alba L.)
Betula pendula var. (?) (B. alba var. castanea)
Betula populifolia Marsh.
Carragana pigmeyae DC
Carpinus orientalis Mill. (Carpinus doureiensis Scop.)
Carya aquatica (Michx.f.) Nutt.
Carya glabra (Mill.) Sweet (Carya microcarpa Nutt.)
Carya glabra (Mill.) Sweet (Carya parvula (Michx.f.) Nutt. mis-specified as C. pereirae?)
Carya luciniosa (Michx.f.) Loud. (Hicoria incinera)
Carya ovata (Mill.) C. Koch (Carya alba Nutt.)
Carya tomentosa (Poirier) Nutt.
Castanea pumila (L.) Mill.
Castanea dentata (Marsh.) Borkh. (Castanea versa var. americana)
Catalpa bignonioides Walt.
Catalpa ovata G. Don (C. kempferi Siebold & Zucc.)
Catalpa nana (?)
Catalpa speciosa (Warde) Engelm.
Catalpa hybrid (Teas Japan Hybrid)
 Celtis sp.
Celtis occidentalis L.
Celtis occidentalis L. (C. pumila Pursh)
Cercis canadensis L.
Clethra alnifolia L.
Corns racemosus Lam. (C. paniculata L’Her.)
Cotoneaster sp.
Cytisus sp.
Cytisus scopinonis (L.) Link (C. laburnum)
Diospyros virginiana L.
Fagus grandifolia J.F. Ehrh. (F. americana Sweet)
Fagus sylvatica L.
Fraxinus americana L.
Fraxinus nigra Marsh.
Fraxinus ornus L.
Fraxinus pennsylvanica Marsh. (F. pubescens Lam.)
Fraxinus pennsylvanica Marsh. (F. viridis Michx.)
Fraxinus quadrangulata Michx.
Gleditsia aquatica Marsh. (G. monosperma Weker)
Grevillea lalianthus (L.) Ellis.
Gymnocladus dioica (L.) K. Koch (G. dicidious)
Juglans cinerea L.
Juglans nigra L.
Juglans nigra L. x Juglans cinerea L. (?)
Juniperus virginiana L.
Larix decidua Mill. (Larix europaea DC.)
Ligustrum vulgare L.
Livistona chinensis L.
Lonicera parviflora (?)
Malus pumila (Raft) Schneid. (Toxylon pumila)
Magnolia acuminata L.
Magnolia acuminata var. cordata (Michx.)
Surg. (M. cordata Michx.)
Magnolia virginiana L. (M. glauca L.)
Malus coronaria (L.) Mill. (Pyrus coronaria L.)
Malus floribunda Siebold ex Van Houtte (Pyrus floribunda Siebold ex Kirch.)
Malus sylvestris Mill. (Pyrus malus L.)
Morus alba L.
Morus rubra L.
Nyssa sylvatica Marsh. (N. multiflora Wangen.)
Philadelpis coronarius L. (P. coronaria) Link
Picea abies (L.) Karst. (Picea excelsa (Lam.) Link)
Picea glauca (Moench) Voss (Picea alba (Ait.) Link)
Pinus cembra L.
Pinus nigra Arnold
Pinus strobus L.
Pinus sylvestris L.
Platanes occidentalis L.
Platanus orientalis L.
Populus balsamifera L.
Populus deltoides Marsh.
Populus nigra L. (var. dilatata?)
Prunus verticillata (?)
Prunus sp.
Prunus americana Marsh.
Prunus (c.v. 'Basset')?
Prunus persica (L.) Batsch. (Multiple varieties)
Prunus serotina J.F. Ehrh.
Prunus virginiana var. demissa (Nutt.) Surg. (Prunus demissa (Nutt.) Walp.)
Pshea trifoliata L.
Quercus alba L.
Quercus bicolor Willd.
Quercus cerris L.
Quercus cocinea Muench. (Q. cocinea tinctoria, could be Q. velutina?)
Quercus imbricaria Michx.
Quercus ilicifolia Wangenh. (Q. naua)
Quercus laevis Walt. (Q. catesbeiana Michx.)
Quercus lyrata Walt.
Quercus macrocarpa Fisch. & C.A. Mey. (Q. macrocarpa)
Quercus macrocarpa Michx. (Q. oliviformis Michx.?
Quercus nigra L.
Quercus obtusifolia (?)
Quercus palustris Muenchh.
Quercus palustris compacta (?)
Quercus prinus L.
Quercus rubra L.
Quercus velutina Lam. (Q. tinctoria Bartr.)
Rhamnus lancerolata Pursh. (R. lancerolata)
Rhododendron sp. (Azalea sp.)
Ribes sp. (Utah currants)
Robinia pseudoacacia L.
Salix alba L.
Salix humilis Marsh.
Salix nigra Marsh.
Spiraea sp.
Spiraea latifolia (Ait.) Borkh. (S. carpinifolia Wiltd.)
Spiraea media Schmidt. (S. confusa Reg. Körn.)
Staphylea trifolia L. (S. trifolia)
Symphoricarpos orbiculatus Moench (S. vulgaris Michx.)
Tilia americana L.
Tilia americana var. pubescens (?)
Tilia × europaea L. (T. europea)
Tilia platyphyllos Scop.
Tsuga canadensis (L.) Carrière
Ulmus americana L.
Ulmus rubra Muhlenb. (U. fulva Michx.)
Ulmus laifolia (?)
Ulmus thomasii Surg. (U. racemosa D. Thomas)
Ulmus pumila L. (U. siberica)
Vitis vulpina L. (V. cordifolia Michx.)