

The Harvard Forest as a Demonstration Tract

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THE HARVARD FOREST
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By R. T. FISHER, Director of the Harvard Forest.

The Harvard Forest has belonged to the University for twenty-three years. In 1908 it represented merely what a hundred and fifty years of ups and downs in rural colonization had done to the virgin wilderness. In 1931 it represents what twenty-three years of intensive management have done to organize and improve the natural forest. In the long perspectives of forestry this period is trifling; but in a country where the average citizen has so recently exchanged the family axe for a niblick, it is sufficient to make the Harvard Forest the oldest institution of its kind in America and perhaps to make pertinent the query as to how it has functioned as a means of education.

In the use of the property by the Forestry Department of the University, there have been three objectives: a model forest to demonstrate the practice of forestry; a laboratory for the training of professional students; and an experiment station for research. But although the Forest has provided a field for countless exercises by students and the material for many bulletins and papers, it is not these but the forest itself which has translated the developing technique of management into realizable and convincing terms. It speaks in the only language which can be understood both by the wise and the simple—visible results.

The forest consists of 2,100 acres of varied woodland situated in the town of Petersham, in northern Worcester

In view of the interest which is being aroused in the subject of demonstration forests in England it is thought that this article which has been written by Professor Fisher, of Harvard University, is particularly opportune.—Ed.

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County, Massachusetts, where from earliest times wood-working industries have been an important item in the livelihood of the people. Well timbered almost all over, it contains a greater variety of the different stages of forest represented in New England history than can be found on an equal area anywhere else in the region. Besides authentic fragments of the original primeval stands, it has phases of second growth and forest types characteristic both of the northern and of the central forests.

Conditions at the outset were peculiarly favourable not only to significant developments in silviculture but even more to the creation of a successful business enterprise in forestry. There being already on hand in the existing growing stock a merchantable volume of ten million board feet (1,430,000 cu. ft.), it was possible to meet the stipulation of the governing board of the University that the forest must be self-supporting. This condition, as can readily be seen, has been a powerful influence for economy and efficiency in management. In the matter of markets, nearby industries have furnished an outlet for almost every species on the property, and there has been also a fair demand for fuel wood. By a happy accident of history and previous ownership there was also a fair distribution of age groups so that it was possible from the beginning to set up a working plan on the basis of a sustained yield. The forest has had its own sawmill, a couple of motor trucks for hauling and delivery, and a small year-around crew of woods workers under a resident superintendent. Aside from special projects of research, both biological and economic, the management has been directed toward the improvement of the growing stock in volume, increment, and age distribution, and the evolution of effective silvicultural methods for reproduction and the maintenance of growth and quality.

The progress in these directions has been tangibly reflected in the forest itself. In twenty-three years five million board feet (710,000 cu. ft.) have been harvested from the forest; yet in consequence of the maturing of younger stands and the increasing increment of the period, the present merchantable volume is approximately twelve million (1,710,000 cu. ft.). The annual increment, originally estimated at

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Fig. 1. Old Field White Pine (control area) eighty years old. Decomposition in the humus layers is slow and there is a tendency to podsolization in the soil. This is an uncut portion of the stand which preceded the hardwood shown in Fig. 2.



Fig. 2. Sapling stand of White Ash, Red Oak, Yellow Birch, etc., eighteen years old. Result of weeding advance growth which originated under the pine (note stumps). Here organic decomposition has been rapid, and the soil has changed to a mull type of active fertility.

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two hundred and fifty thousand board feet (36,000 cu. ft.) is now about four hundred thousand (60,000 cu. ft.), and the uniform distribution of age classes required for continuous production has been substantially approached. There has been a net income, available for improvements and equipment, of \$1,000 to \$2,000 a year equivalent to 50 cents to \$1 per acre.

Under the existing scheme of management it has been necessary to control the business and economic phases of operation as carefully as the silvicultural. In the system of records and accounts which has been developed, both these phases of work are dealt with. All labour costs, operating expenses, and the various forms of overhead, including interest on the capital invested, are currently posted and periodically summarized. Form sheets are provided for annual statements according to block, compartment, and type of the amounts cut in timber and other products. The status of the growing stock as regards volume, composition, age, and growth is kept track of in a card file in which each card carries the data on a single uniform stand, a number of which may occur in a single compartment. Such a file, in which annual changes due to cutting or planting are currently recorded, makes it easy to summarize the general condition of the growing stock at any time. In the matter of the silvicultural and biological aspects of the management, the records are even more comprehensive. In addition to the stand cards, notes and observations upon the cutting or experimental areas are filed by compartments. Permanent sample plots and other areas set apart for special studies are given an additional form of record. Finally, and applying to all forms of forest operation, there is a photographic file for preserving serial views of the same spot and a full set of large scale compartment maps on which all significant changes in the forest are plotted.

The task of maintaining such a system of records is difficult, and quite naturally becomes more so as the areas under treatment or experiment increase. Nevertheless, experience has proved that the forest is valuable as a demonstration almost exactly in proportion to the completeness and accuracy of its records. As time goes on new



Fig. 3. Virgin stand of Hemlock, Yellow Birch, Beech, and Sugar Maple.



Fig. 4. Selection cutting in stand of Mixed White Pine and Hemlock.

and unforeseen problems arise for solution. With a forest whose history is accurately known in both economic and silvical terms, it is often possible to make a significant study which would have been impossible on unmanaged areas. Thus, adequate records may furnish in the end not only what they were originally planned for, but quite unexpected by-products of knowledge.

Through its continuing experience as a demonstration area the forest has been able to establish certain concepts of silvicultural policy which have influenced not only the point of view of professional foresters, but also the public propaganda which takes its cue from that source. For the past thirty years, which is about the life-time of the profession in America, various public and semi-public agencies in the north-east—federal and state forestry departments and private associations—have built up an immense campaign designed to educate the landowners to the production of timber. From the beginning this took the form of advocating coniferous plantations, generally white pine; and so thoroughly has this policy been advertised that forestry in the public mind of New England has been generally thought to begin and end with re-forestation by planting. In consequence, after thirty years we have some hundred thousand acres of pine plantations so poor in quality that few of them will ever repay their cost.

By a curious irony of economic history there were several apparently good reasons for emphasizing the planting of pine. It was about 1900 that the extraordinary accidental production of enormous volumes of white pine on the farms and pasture lands abandoned in the middle of the last century began to be widely used in a great many local industries, particularly for the manufacture of wooden boxes. Originating on areas especially adapted to white pine reproduction, and at a time when in the existing remnants of original forest, seed trees of inferior species were relatively scarce, these so-called pine woodlots, generally in pure stands, showed remarkable productiveness. At the usual cutting age of from fifty to sixty years, volumes per acre ranged from twenty to fifty thousand board feet (three to seven thousand cubic feet), which in the prosperous pre-

war days of the woodworking industries meant a stumpage value of from \$300 to \$500 an acre. How much this purely gratuitous reward of nature for the failures of man has meant to the struggling farms of upland New England may be gathered from the fact that between 1895 and 1925, fifteen billion board feet (over two billion cubic feet) of second growth pine have been cut in central New England, with a manufactured value of over \$400,000,000, more than half of which has gone to the owners of the land and the local population which took part in the logging and milling. If one considers also how simple and understandable to the layman is the planting of trees as compared to the handling of established forests, it can be seen that there were obvious reasons for believing that pine plantations were a good thing to advocate. Unfortunately the use and value of old field pine have seriously declined, and the stands of recent origin are inferior in quality.

On the Harvard Forest almost at the outset of management it was decided not to attempt to maintain the pure pine type but rather to convert it into mixtures, either hardwoods alone or hardwoods with pine. This decision was based in part on the theoretical value of mixed stands, and in part on the belief that the old field pine was a transition type, not in the long run so suitable for the soils and climate as certain simplified forms of the original mixed types of the virgin forest. Subsequent observations made this policy seem additionally sound. The increment of the old field pine was observed to show an abrupt falling off from forty-five years on; natural pruning, especially in plantations, was notably slow, so that only low grade lumber could be produced; the abundant advance growth generally developing in the later life of the pinewood was always of hardwood species, often of the most valuable kinds, never of pine, which not only indicated a tendency to reversion but made a pine type unduly costly to maintain.

After eighteen years of converting pine stands to varying mixtures, there began to be observed a contrasting condition of soil profiles, which conclusively showed why, for the region and forests under consideration, the mixed stand was the better objective (see figs. 1 and 2). Under the

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pure pine cover decomposition in the humus layers became progressively slower, leaf litter in a more or less felted form accumulated to considerable depths, with the formation of but little true humus and accompanied by a gradual reduction in the depth and tilth of the top soil. This condition was apparently coincident with the falling off in growth. On the other hand, under the hardwood or mixed types which had followed the cutting of pine, the reverse of this process had set in promptly: a rapid decomposition both of the organic layers previously accumulated and also of the current fall of leaves, accompanied by improvement in the depth and tilth of the top soil or enriched horizon. In this case also there was immediate response in the growth of the trees. It was apparent, too, that the prospective quality of the timber, as indicated by straightness of stem and rapidity of pruning, was notably better than with the pure pine. The outcome of this experience, which could only be achieved on a forest deliberately and efficiently devoted to the continuing observation and recording of silvicultural experience, has been quickly disseminated into the general professional consciousness not only by the men who have taken their professional training at the forest but by large numbers of practising foresters who are continually visiting the tract.

Still another instance in which the Harvard Forest has been of service in defining a useful principle of regional forest management has been to demonstrate the economic and silvicultural possibilities of improved productiveness in natural stands. It has been a consequence of the propaganda for the planting of pine that little or no attention has been paid, even by forest owners who have undertaken planting, to the cut-over lands already forested by nature, which have been vaguely supposed to be "devastated." But the large natural regeneration in New England has been uncommonly abundant, notwithstanding the almost complete lack of any conscious measures on the part of timberland operators to secure it. But although some sort of tree crop usually follows the logging operation, a hundred and fifty years of cutting, clearing for farms, natural reforestation of old fields followed by more cuttings and perhaps repeated fires, have profoundly altered the regional distribution

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of species. What is locally known as the weed tree, that is, small short-lived species such as grey birch, poplar, pin cherry, etc., together with immense areas of degenerate coppice have probably increased in the last century at least a thousand per cent. This means that more valuable species such as white ash, red oak, white birch, and pine have been correspondingly reduced, not because they are generally absent in the young growth which follows logging, but because they are progressively suppressed by the faster growing weeds and coppice. Indeed this regional degeneration in composition has gone so far that the weed element and its correction constitute the first and greatest problem in New England silviculture. Twenty-three years of dealing with this difficulty on and about the Harvard Forest have shown proofs in the form of highly valuable stands, first, that there are very large areas of cut-over land which, if taken in time, can be converted through the process of weeding or cleaning from potential worthlessness to excellent stands, often in almost ideal mixture; and second, that the cost of this work per acre is generally far less than that of planting. This demonstration has very materially helped to influence the general realization that much of New England's twenty-five million acres of existing forest land has a realizable productiveness out of all proportion to the planting of new land.

The ways in which such lessons as these become available have multiplied through the years. Probably first in importance, if one considers the long view, would be the knowledge and grasp of fundamentals absorbed by the professional students who come to the forest for graduate training and research. Such men naturally transmit and apply their philosophy more and more widely as time goes on. The results of all research projects as well as maturing reports on various phases of silviculture and management are published from time to time as bulletins of the Forest or articles in technical journals. To a considerable extent also local newspapers publish stories about phases of work that may be useful to the general public. There has been maintained also at Petersham a sort of unofficial service bureau. Through the Forest staff there is offered free to residents of the town, and at cost to other land owners in the vicinity,

advice in forest management. This takes the form of estimates and valuation of timber, marking for cuttings, planting plans, etc. In many cases the actual work of logging and milling, planting, or weeding may be carried out for the owner by the woods crew of the Forest in combination with its own work. The Town Forest of Peter-sham is managed in this way. Through these kinds of direct service the Forest has contributed to the development, improvement, or re-forestation of nearly fifty thousand acres in the surrounding region.

Last of all, and perhaps most important, are the outward and visible effects of applied silviculture, which may be seen in the forest itself and which with the written and other records embodying results and progress are shown to large numbers of visitors, sometimes as many as two hundred and fifty to three hundred in a year. Most of these visitors are foresters from federal or state departments or from forestry schools. Many also are men interested in the biological sciences, and the remainder, a very considerable number, are forest owners or lumbermen. It is difficult to estimate the total effect of all these forms of contact between the Forest laboratory and the public and professional consciousness; but to one who has seen the process going on for over twenty years, it is obvious that there has been an ever widening diffusion of knowledge about the handling of forests which is coming to be reflected in the policies and methods of the region. It is not far from the truth to say that, for all around usefulness, no other means of education can equal a highly developed demonstration forest.

In the Harvard experience there has been more than a hint that forestry depends as much upon a state of mind as a state of markets. There has been little in the economic history of the United States to induce foresight or deliberate provision for the future. "America, the land of the free," has been more than a slogan of patriotism; it has been almost a promise of material plenty. There has been free timber—two-thirds of a continent covered with the most varied and valuable reservoir of wood that the world has known, and with no cost of production. There has been free land—first the allotments to settlers in the thirteen

colonies and then the immense disposals of public domain by the federal government. Along with free land went the implication of free use and access, not only on areas still publicly owned but also on private lands which still bore the aspect of wilderness. In some cases these traditions have acquired the force of rights, as in the early grazing on our public domain in the West and the policy established in all our states, that fish and game belong to the public and not to the owner of the land. In some regions, notably New England and the South, the idea that nature will provide has been still further strengthened by the immense replacement of usable second growth timber on abandoned farms, another free gift of raw material to a people already used to plenty.

A history like this has not conduced to the habit of taking thought, still less to any interest in, or comprehension of, the technical or economic processes of forestry. On the contrary it has given rise to some widespread fallacies that have helped prevent even such forms of forestry as existing economic conditions would have made profitable. There is the idea that investments in forests should yield a very high return, at least six per cent. There is the assumption, clearly reflected in the practice of New England town assessors, that only mature trees are timber and that sapling and seedling stages are worthless brush. There is the habit in the woods of cutting always the nearest and best trees, whether or not the poorer ones, whose removal would benefit the stand, are equally satisfactory. There is the conviction, still widely held among lumbermen, that since nature always has produced our timber, it is necessary only to control fires and nature will do it again. Finally, less clearly definable but no less definitely an obstacle to successful forestry, is the obliviousness of the general public to the productive values of forest land, an attitude which is responsible for most of our forest fires and for much damage to trees and plants.

In the face of such a general state of mind as this, the most favourable economic conditions might well be slow in stimulating forestry. On the other hand, it is clear that where there is a reasonable understanding of the technique

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of silviculture, it is possible, even in the midst of destruction, to make a success of forestry. There are a number of ownerships in New England where the same land in the hands of a small wood-using industry has produced timber and a moderate income for several generations. These properties, like the Harvard Forest, have done their bit to spread the realization of how forests are actually managed and of how very far the proper knowledge and purpose will go toward making them profitable. In the words of Mr. Ward Shepard, who for several years has been helping to guide the public relations of the Forest Service, "The solution of the forest problem depends far more on intelligence, will, and good workmanship than on economic predestination."
