5

PLEASE CIRCULATE.

PRIZES FOR ARBORICULTURE

OFFERED BY THE

TRUSTEES

OF THE

MASSACHUSETTS SOCIETY

FOR

PROMOTING AGRICULTURE.

BOSTON:
ALFRED MUDGE & SON, PRINTERS,
34 SCHOOL STREET.
1876.

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PRIZES FOR ARBORICULTURE.

WITH a view of stimulating this important branch of agriculture, the following prizes, open to all land-owners in Massachusetts, are offered for Tree Planting by the Trustees of the Massachusetts Society for Promoting Agriculture.

FIRST:—

For the best plantation of not less than five acres	$1,000
For the next best	600
For the next best	400

Plantations intended to compete for these prizes must be made of the European larch in every part of the State, except in Barnstable, Dukes, and Nantucket Counties, where the Scotch pine or the Corsican pine, or the two mixed, must be used.

Plantations originally of less than 2,700 trees to the acre cannot compete for these prizes.

Only plantations made on poor, worn-out land, or that which is unfit for agricultural purposes, can compete for these prizes.

SECOND:—

For the best plantation of American White Ash, of not less than five acres in extent	$600
For the next best	400

Plantations originally of less than 5,000 trees to the acre cannot compete for these prizes.

GENERAL CONDITIONS OF COMPETITION.

Competing plantations must be made during the spring of 1877. The prizes will be awarded during the summer of 1887.

All persons intending to compete for these prizes must notify in writing the Secretary of the Society, E. N. Perkins, Jamaica Plain, Mass., of such intention, before Dec. 1, 1876, stating the prize entered for, the variety of tree to be planted, and the nature and description of the ground to be used.

All competing plantations must at all times be open to the inspection of a committee of the Board of Trustees, who will award the prizes.

The Board of Trustees reserve the right to withhold any or all of these prizes if, in the opinion of the judges, none of the competing plantations are of sufficient merit to warrant the award.

DIRECTIONS FOR PLANTING.

LARCH AND PINE.

When the nature of the soil will permit, shallow furrows four feet apart should be run one way across the field to be planted. This is best done during the autumn previous to planting. Then by planting in the furrows, and inserting the plants four feet apart in the rows, the whole land will be covered with plants standing four feet apart each way. Planted at this distance 2,720 plants will be required to the acre. On hilly, rocky land, which is especially recommended for the cultivation of the European larch, and where it is impossible to run furrows, it will be only necessary to open with a spade holes large enough to admit the roots of the plants, care being taken to set them as near four feet apart each way as the nature of the ground will admit. In very exposed situations on the sea-coast, it is recommended to plant as many as 5,000 trees to the acre, the plants being inserted more thickly on the outsides of the plantations in order that the young trees may furnish shelter to each other.

It is imperative to plant the Larch as early in the season as the ground can be worked. No other tree begins to grow so early, and if the operation of transplanting it is delayed until the new shoots have pushed, it is generally followed by the destruction of the plant.

The Scotch and Corsican pines can be planted up to the 1st of May.

ASH.

Land in condition to grow corn or an average hay-crop is suited to produce a profitable crop of white ash. Deep, moist land, rather than that which is light and gravelly, should be selected for this tree. The land should be ploughed, harrowed, and made as mellow as possible during the autumn previous, that the trees may be planted as soon as the ground can be worked in the spring.

As soon as the frost is out mark out the field with furrows four feet apart, and insert the trees two feet apart in the rows. This will give 5,445 plants to the acre, which, at the end of ten years, must be thinned one half. These thinnings are valuable for barrel-hoops, etc.

It is recommended to cultivate between the rows for two or three years to keep down the weeds and prevent the soil from baking. At the end of that time the ground will probably be entirely shaded by the trees, and further cultivation will not be necessary.

GENERAL DIRECTIONS FOR TREE-PLANTING.

Be careful not to expose the roots of trees to the wind and sun more than is necessary during the operation of transplanting. More failures in

tree-planting arise from carelessness in this particular than from any other cause.

To prevent this, carry the trees to the field to be planted in bundles covered with mats; lay them down, and cover the roots with *wet* loam, and only remove them from the bundles as they are actually required for planting.

In planting, the roots should be carefully spread out and the soil worked among them with the hand.

When the roots are covered press the earth firmly about the plant with the foot.

Insert the plant to the depth at which it stood before being transplanted.

Select, if possible, for tree-planting a cloudy or a rainy day. It is better to plant after the middle of the day than before it.

All young plantations *must be protected* from cattle and other browsing animals,— the greatest enemies, next to man, to young trees, and the spread of forest growth.

DIRECTIONS FOR PROCURING YOUNG TREES.

Selected plants of the European larch and the Scotch pine, about one foot high and very thrifty, can be imported from England, and delivered at the railroads in Boston at from $5 to $6 @ 1,000, the price varying with the price of gold and the rate of exchange and freight. Imported plants of the Corsican pine of the same size will cost at present prices about $10 @ 1,000 delivered in Boston.

All persons, whether competitors for the Society's prizes or not, desiring to import trees of these varieties, can do so by sending their orders to Francis Skinner, Brookline, Mass., before Dec. 1. Mr. Skinner will transmit all orders for not less than 1,000 trees to England, and will see that the trees, on their arrival in Boston, are passed through the Custom House, and forwarded at the least possible expense to the persons ordering them.

As Mr. Skinner undertakes this duty solely from a desire to facilitate tree-planting, in his native State, and not for the purpose of any personal gain, he cannot be held responsible in any way by the persons desiring to order through him.

Mr. Anthony Waterer, Nurseryman, Woking, England, with whom special arrangements have been made to prepare trees for planting in Massachusetts, guarantees their safe arrival in this country, provided his orders are received early enough to permit his shipping the larch, during the months of December and January, and the pines not later than Feb. 15.

The importation of these trees cannot, in safety, be made after these dates. If it is delayed later, the plants are liable to heat in transit, and to make a soft, unnatural growth, which generally causes their death. As the plants will arrive some weeks before they can be planted, importers should provide some accommodation for their reception. The

plants must be unpacked as soon as received, the roots moistened, and then heeled into a frame, cold cellar, or shed, in which the temperature will be at about the freezing point, but where they can be guarded from extreme cold and the sun's rays. As a little soil will be required to put over the roots at this time, importers should lay in a supply in the autumn for this purpose, and keep it away from the frost until needed.

American white ash, one or two years old, and about one foot high, can be procured for from $5 to $10 @ 1000 from the following well-known American nurserymen: Robert Douglas, Waukegan, Illinois; Thomas Meehan, Germantown, Pennsylvania; and the Lawrence Nursery Co., Sturgeon Bay, Wisconsin.

The following paper on Tree-Planting is reprinted from the Report of the Secretary of the Massachusetts State Board of Agriculture, 1875, for general circulation throughout the State, in the hope that its perusal will awaken an interest in this subject among Massachusetts land-owners, and induce them to look on arboriculture as a wise and profitable undertaking.

5 PEMBERTON SQUARE, Boston, April, 1876.

[Reprinted from the Report of the Massachusetts State Board of Agriculture for 1875.]

A FEW SUGGESTIONS ON TREE-PLANTING.

By C. S. Sargent,

Director of the Botanic Garden and Arboretum of Harvard University.

Every year the destruction of the American forests threatens us with new dangers. Every year renders it more imperative to provide some measures to check the evils which our predecessors in their ignorance have left us as a legacy with which to begin the second century of the Republic.

It may not, then, be entirely without interest to examine briefly what the dangers are which follow the destruction of the forests, and the methods of counteracting them, which, so far as Massachusetts is concerned, are fully within our reach.

Our agricultural population is not easily convinced of the necessity of tree-planting. The benefits are too vague, the profits too prospective, to cause them to look with enthusiasm on what seems a doubtful undertaking.

Still, in this respect, public opinion is gradually changing, and already in many of the States of the Union experiments in sylviculture are being made on a sufficient scale to promise the most gratifying results, and it is not improbable that at no distant day, when its benefits are more clearly understood, this branch of agriculture will receive at the hands of our farmers the attention its importance demands.

Proof is wanting that the total average rainfall has been reduced, either in this country or Europe, by cutting off the forests. But examples are often cited in proof that forests play an important part in regulating and attracting summer rains and local showers; and it is not improbable, were more data in the form of carefully conducted observations available, that some theory on this subject might be deduced. Certainly, as Mr. Marsh remarks in his admirable book on physical geography,* "it is impossible to suppose that a dense cloud, a sea of vapor, can pass over miles of surface bristling with good conductors without undergoing and producing some change of electrical condition."

The following interesting illustrations are not without value as vaguely

* The Earth as modified by Human Action. George P. Marsh. New York, 1874.

indicating in what direction we must turn for an explanation of the summer droughts, which, in certain portions of the country, have increased of late to an alarming extent. In Massachusetts, however, some cause outside the destruction of the forests must be sought for; as in the earliest history of the Colony, and long before land enough had been cleared to induce any climatic change, the country was nearly devastated by severe summer droughts, which, if less frequent, were no less violent than those of the present day.

Mr. Calvin Chamberlain, in an able memorial on the subject of forests* presented to the House of Representatives of the State of Maine in 1869, says, "There is a portion of Hancock County (Maine), along the coast, that is now nearly denuded of trees. During the heat of summer the radiation from the parched surface affects the atmosphere to excessive dryness. The electrical and rain-bearing clouds that approach from the westward, as they come within this dry atmosphere, are absorbed and dissipated before their watery contents can reach the earth; while the clouds just north of them float on over a better wooded district and yield a copious rainfall; and, on the other hand, the showers continue abundant in the more humid atmosphere of the contiguous bays and ocean."

Dr. Lapham† observes that "in the hot and dry plains of our southwestern territories we often see clouds passing overhead that reserve their contents until they have passed from these almost desert regions. These clouds frequently present all the actual appearance of rain in the higher region of the atmosphere, and the fertile-giving drops are seen to fall far down towards the earth, only to be dissolved and dissipated in the lower strata of air, heated by the reflection from the parched earth, which these raindrops do not reach."

As moderators of the extremes of heat and cold, the benefits derived from extensive forests are undoubted, and that our climate is gradually changing through their destruction is apparent to the most casual observer. Our springs are later; our summers are drier, and every year becoming more so; our autumns are carried forward into winter, while our winter climate is subject to far greater changes of temperature than formerly. The total average snowfall is, perhaps, as great as ever, but it is certainly less regular, and covers the ground for a shorter period than formerly. It is interesting to note in this connection the conclusion which Noah Webster‡ drew three quarters of a century ago, showing that, even at that time, before the cutting-off the forests had assumed the importance which it does to-day, similar climatic changes were at work. "From a careful comparison of these facts," he says, "it appears that the weather in modern winters in the United States is more inconstant than when the earth was covered with woods, at the first settlement of Europeans in this country; that the

* Agriculture of Maine. Second Series. 1869.

† Report of the Disastrous Effects of the Destruction of Forest Trees now going on so rapidly in the State of Wisconsin. 1867.

‡ A Collection of Papers on Political, Literary, and Moral Subjects. New York. 1843.

warm weather of autumn extends further into the winter months, and the cold weather of winter and spring encroaches upon the summer; that the wind being more variable, snow is less permanent; and perhaps the same remark may be applicable to the ice of the rivers." Mr. Marsh arrives at nearly the same conclusion. "So far as we are able to sum up the results," he says, "it would appear that in countries in the temperate zone, still chiefly covered with woods, the summers would be cooler, shorter; the winters milder, drier, longer than in the same regions after the removal of the forests, and the condensation and precipitation of atmospheric moisture would be, if not greater in total quantity, more frequent and less violent in discharge."

Such changes of climate are everywhere noticed in countries from which the forests have been extensively removed; and if they are not more apparent in Massachusetts, it is owing to its propinquity to the ocean, which exerts an important, and, of course, perpetual control over the temperature of all regions within its influence, preventing the excessive and sudden changes which often mark an inland climate. But even here there are certain changed conditions which can only find a solution in climatic deterioration traceable to the destruction of the forests.

Twenty years ago peaches were a profitable crop; now we must depend on New Jersey and Delaware for our supply; and our apples and other orchard fruits now come from beyond the limits of New England. The failure of these and other crops in the older States is generally ascribed to exhaustion of the soil; but with greater reason it can be referred to the destruction of the forests which sheltered us from the cold winds of the north and west, and which, keeping the soil under their shade cool in summer and warm in winter, acted at once as material barriers and reservoirs of moisture. It is not necessary to go beyond the limits of the United States for examples of the climatic changes which follow the destruction of the forests. Mr. Chamberlain, in the memorial to which I have already referred, says, "A decline in fruit products in Maine has been apparent for a considerable time; other farm crops are seemingly in a decline also. Potatoes, oats, and wheat now rarely give such crops as they did thirty or forty years ago. Fruit-trees take on disease, apples become scabbed and distorted; pears knotty, cracked, and extremely perverse; plum and cherry trees forget former habits and old friendships; blight and rust and insect-destroyers are everywhere. The farmer's crops are invaded from all sides. The cry of local exhaustion of the elements of the soil, negligent culture, and a long chapter of local complaints, fail to account for any portion of the difficulty." According to Lapham, the winter in the State of Michigan has greatly increased in severity during the last twenty years, and this severity seems to keep pace with the cutting-off of the forests. "Thirty years ago," he says, "the peach was one of the most abundant fruits of that State; at that time frost injurious to corn, at any time from May to October, was a thing unknown. Now the peach is an uncertain crop, and frost often injures the corn." It has been estimated that the same State has lost, during four years, $20,000,000 from the failure of the winter wheat, a crop which, in the early history of the State, was never injured.

Forests, by preventing the escape of moisture by rapid superficial flow and evaporation, ensure, it is now generally acknowledged, the permanence of springs, which, in their turn, supply the rivulets from which the great water-courses draw their supply. The water falling on a tract of land stripped of its covering of woods is rapidly evaporated by the summer sun, or in winter rushes off over the surface of the frozen ground to the nearest water-course, converting this for the time being into a roaring torrent. In a country properly wooded the result would be exactly opposite. The summer rain, falling on the ground, protected by the forest from evaporation, is held as in a sponge, slowly but surely finding its way to the water-courses, while the melting snows and winter rains gradually soak into the soil, which in the forests is never so deeply frozen as in the open ground. This is no mere theory, but a fact of which the proof is, alas! too easily found, and too convincing. It is a subject of common remark in the country, that brooks which formerly ran throughout the year are now dry, save after the autumn rains or the melting of the snows in spring, when they become raging torrents, carrying off to the sea in a few days the water which formerly supplied them with a moderate but constant flow throughout the summer. Unfortunately, no observations of the flow of the great rivers in the United States have been made, covering a period of time of sufficient length to enable us to draw any conclusions in regard to it. But in Europe this subject has received more careful investigation. Herr Wex, at the recent yearly meeting of the Geographical Society of Vienna, demonstrated that the average level of the river Elbe had fallen seventeen inches; that of the Rhine, over twenty-four inches; that of the Vistula, twenty-six inches; and that of the Danube, at Orsova, as much as fifty-five inches during the past fifty years. Accompanying this fall in level, there was also shown to be a constantly increasing diminution of the discharge from springs. Instances, though of less general importance, are not wanting near home. "There * is a good illustration of the effects of the destruction and reproduction of forests in drying up and restoring ponds in my immediate neighborhood. Within about one half mile of my residence there is a pond upon which mills have been standing for a long time, dating back I believe, to the first settlement of the town. These have been kept in constant operation until within about twenty or thirty years, when the supply of water began to fail. The pond owes its existence to a stream which has its source in the hills which stretch some miles to the south. Within the time mentioned these hills, which were clothed with a dense forest, have been almost entirely stripped of trees; and to the wonder and loss of the mill-owners, the water in the pond has failed, except in the season of freshets, and, what was never heard of before, the stream itself has been entirely dry. Within the last ten years a new growth of wood has sprung up on most of the land formerly occupied by the old forest; and now the water runs through the year, notwithstanding the great droughts of the last few years, going back from 1856."

Lapham mentions that "such has been the changes in the flow of the

* Trees of America. R. U. Piper, Boston, 1855.

Milwaukee River, even while the area from which it receives its supply is but partially cleared, that the proprietors of most of the mills and factories have found it necessary to resort to the use of steam, at a largely increased yearly cost, to supply the deficiency of water-power in dry seasons of the year. The floods of spring are increased until they are sufficient to carry away bridges and dams before deemed secure against their ravages. What has happened to the Milwaukee River has happened to all other water-courses in the State from whose banks the forests have been removed, and many farmers who selected land upon which there was a living brook of clear, pure water, now find the brooks dried up during a considerable portion of the year."

Many such examples might be instanced to prove that cutting off the forests has a direct influence in diminishing the flow of springs, but I will confine myself to one other.

Marschand, as quoted by Mr. Marsh, cites the following: "The Wolf Spring, in the commune of Soubey (France), furnishes a remarkable example of the influence of woods upon fountains. A few years ago this spring did not exist. At the place where it now rises a small thread of water was observed after very long rains, but the stream disappeared with the rain. The spot is in the middle of a very steep pasture, inclining to the south. Eighty years ago the owner of the land, perceiving that young firs were shooting up in the upper part of it, determined to let them grow, and they soon formed a flourishing growth.

"As soon as they were well grown, a fine spring appeared in place of the occasional rill, and furnished abundant water in the longest droughts. For forty or fifty years the spring was considered the best in the Clos du Doubs. A few years since the grove was felled, and the ground turned again to a pasture. The spring disappeared with the wood and is now as dry as it was ninety years ago."

The influence of belts of trees, especially of spiked-leaved species, on local climate is important. Such plantations serve as a material check to the natural force of the cold winds from the north, which rapidly lower the temperature, hasten evaporation, and blow into drifts the snow which would otherwise protect the ground with an even covering. There is probably no way in which the farmers of this State could more easily or more rapidly increase its agricultural product than by planting such screens from the northeast to the northwest of their farms; and their attention is particularly directed to the importance of this subject. Such plantations would be too limited in extent and too widely scattered to have any general influence on our climate, or the flow of our water-courses; but, as a means of direct profit, it does not seem unreasonable to predict that such protection to our fields would increase the profits of their cultivation fully twenty per cent.

Orchards thus protected are still productive, and all gardeners know that plants generally supposed too tender to support our climate will thrive when planted under the protection of a garden wall, or among evergreen trees. What garden walls are to the horticulturist, these broad evergreen plantations should be to the farmer.

Mr. J. J. Thomas, as quoted by Lapham, says, "Isaac Pullen, a well-known nurseryman at Hightown, N. J., showed me last summer (1864) several belts of evergreen trees which had sprung up from his nursery rows to a height of twenty-five or thirty feet in ten years, and he stated that within the shelter of these screens his nursery-trees, as well as farm crops, averaged fifty per cent more than in blank or exposed places."

Becquerel, as quoted by Mr. Marsh, says, "In the valley of the Rhone a simple hedge two metres in height is sufficient protection for a distance of twenty-two metres." "The mechanical shelter," says Mr. Marsh, "acts, no doubt, chiefly as a defence against the mechanical force of the wind; but its uses are by no means limited to that effect. If the current of air which it resists moves horizontally, it would prevent the access of cold or parching blasts to the ground for a great distance." "Becquerel's views," says the same author, "have been amply confirmed by recent extensive experiments on the bleak, stony, and desolate plain of the Crau in the department of the Bouches du Rhone, which had remained a naked waste from the earliest ages of history. Belts of trees prove a secure protection even against the piercing and chilly blasts of the Mistral, and in their shelter plantations of fruit-trees and vegetables thrive with the greatest luxuriance." Experiments of a similar nature, and on a large scale, have been made in Holland, and lands which were formerly considered unimprovable, such was the force of the winds blowing from the North Sea, have been rendered almost the most productive in Europe simply by sheltering them with rows of trees placed at regular intervals, and at right angles to the direction of the wind.

It appears, then, that in a country in which a due proportion of forest was maintained, it might be expected that local summer showers would probably be attracted; that extremes of temperature both in summer and winter would be prevented to such an extent that additional crops would be made possible; and that the annual rainfall, instead of being rapidly wasted by evaporation, or still more rapidly poured into the sea, would be held in the forest-clad ground, from which it would gradually find its way to the water-courses, which would flow regularly throughout the year, bringing summer verdure to pastures, and assured power to the manufactories along their banks.

But these are national questions, and can only be treated in a broad, comprehensive manner. Let us consider, however, whether Massachusetts is furnishing her quota to the national forest system which would return to our country much of its lost fertility. It has been estimated, and, I think, with correctness, that forests, in order to maintain normal physical conditions, and to supply the material so essential to every branch of human industry, should occupy about twenty-five per cent of the area of the country to be influenced and supplied by them.

By the census of 1870, of the 4,992,000 acres which constitute the State of Massachusetts, only 766,714 were reported as woodlands, or nearly 550,000 acres less than the proper amount. A comparison of Mr. Bigelow's Report on the Industry of Massachusetts for 1837 with the United

States census of 1870, shows a decrease in the amount of Massachusetts woodlands of some 23,000 acres. The methods used, however, in preparing the statistics of these two reports were so widely different, that I am inclined to doubt the value of such a comparison, and to coincide with the opinion of many intelligent observers, that the Massachusetts woodlands are at least holding their own in extent; and if we consider the very encouraging attention which has been been, for some years, paid to tree-planting for ornamental purposes, it must be conceded, I think, that there is now as large a proportion of Massachusetts covered with arborial growth as at any time during the past fifty years.

As compared with most of the other States of the Union, this condition of things would be extremely gratifying were it due to a desire on the part of our people to maintain a proper proportion of forest within the limits of the State, and not to the forced abandonment of much improved land; the result in no small measure of the folly of those who stripped the land of its protection, and subjected their descendants to the evils I have tried to point out.

Granting that the area covered with forest growth in Massachusetts has not diminished during the last fifty years, we are still short, by over half a million acres, of the amount supposed essential to maintain proper physical conditions; while, if we examine the actual state of the woodlands, it will be found that they are very far from being able to supply sufficient forest products for the requirements of the inhabitants of the State.

The abandoned lands have generally grown up with trees, comparatively worthless for employment in the arts, and which only supply, after years of struggling growth, an inferior fuel.

The most valuable trees have always been cut, often before they reached maturity, and as no steps have been taken to replace them, it is not astonishing that the poverty of our woodlands has reached a point which compels the inhabitants of the State to draw nearly their whole supply of lumber from portions of the country more recently settled. This is attended with so much expense and inconvenience that many valuable industries have already moved from Massachusetts, and it is not improbable that at no distant day many others depending on the forests for their existence will be compelled to do likewise. By the census of 1870, there were in Massachusetts, besides the woodlands, nearly two million (1,988,164) acres of unimproved land. Of these, at least 1,200,000 are admirably suited for forest growth, and, if planted with trees adapted to the various soils and situations, they would produce at the end of fifty years a crop, the actual value of which in dollars can only be reckoned by hundreds of millions.

It is impossible to estimate the indirect profit of such plantations in improved climate and water-power; but that it would equal or excel the actual value of the timber produced seems not improbable, while the benefits arising from so large an additional area of forest would be felt far beyond the limits of the State. There are in Massachusetts, according to the last returns, 26,500 farms (a falling off of 7,500 since 1850), which

average one hundred and three acres in extent. There is not a farm of this size in the State which could not be rendered more valuable if a strip of land, equal to at least one tenth of its whole area and on its northern boundary, was devoted to a belt of trees, which would serve to protect the remainder from the cold winds of winter, and render its cultivation more profitable and its occupation more agreeable. Such timber-belts would, in the aggregate, give the State 340,000 additional acres covered with trees.

It is true that if the existing woodlands were increased to the extent I suggest, their area would cover not twenty-five, but nearly fifty per cent of the whole State. But it must be remembered that the poverty of the soil and the severity of the climate preclude profitable agriculture from a large portion of Massachusetts, and that the waste lands at least can only be made profitable through sylviculture.

Any fears that the production of such plantations will be greater than the demand, are groundless, as Massachusetts, from her geographical position, can always secure a market for any excess of lumber she can produce beyond the wants of her inhabitants. There is no soil within the State too poor or too exposed, it must be remembered also, to resist the fertilizing effects of fifty years of forest covering; and the fact that properly managed forests, especially when formed of certain trees, have so great an influence in enriching the soil beneath them, should always enter largely into any consideration of the expediency of forest culture.

But few experiments in arboriculture, except on the most limited scale, have been attempted in Massachusetts, but I will briefly describe the two most important, which are of special interest as showing what our unimproved lands are capable of, if judiciously managed. Mr. Richard S. Fay commenced, in 1846, planting on his estate near Lynn, in Essex County and in that and the two succeeding years, planted two hundred thousand imported trees, to which were afterwards added nearly as many more raised directly from the seed, nearly two hundred acres being covered in all. The sites of these plantations were stony hillsides, fully exposed to the wind, destitute of loam, their only covering a few struggling barberry bushes and junipers, with an abundant undergrowth of woad-wax (*Genista tinctoria*, *L.*), always a certain indication in Essex County of sterile soil. He employed in his plantations, oaks, ashes, maples, the Norway spruce, Scotch and Austrian pines; but the principal tree planted was the European larch. No labor was expended on the land previous to planting, the trees, about one foot high, being simply inserted with a spade, and no protection has at any time been given them, save against fire and browsing animals. I recently visited these plantations, twenty-nine years after their formation, and took occasion to measure several of the trees, but more especially the larches. Some of these are now over fifty feet in height, and fifteen inches in diameter three feet from the ground, and the average of many trees examined is over forty feet in height and twelve inches in diameter. The broad-leaved trees have also made a most satisfactory growth, and many of them, on the margins of the plan-

tations, are fully forty feet high. During the past ten years, about seven hundred cords of firewood have been cut from these plantations, besides all the fencing required for a large estate. Firewood, fence-posts, and railroad sleepers, to the value of thousands of dollars, could be cut to-day, to the great advantage of the remaining trees. The profit of such an operation is apparent, especially when we consider that the land used for these plantations did not cost more than ten dollars an acre, and probably not half that amount.

The second experiment was made by Mr. J. S. Fay, a brother of Mr. Fay of Essex County, on his estate at Wood's Holl, in Barnstable County, on the extreme southwestern point of Cape Cod. A tract of land, one hundred and twenty-five acres in extent, which is now densely covered with Mr. Fay's plantations, was, in 1853, seemingly as little fitted for the purpose of tree-culture as can well be imagined. It was fully exposed to the cold northwest winds of winter sweeping down across Buzzard's Bay, and to the no less baneful southwest winds of summer, which come from the Atlantic loaded with saline moisture.

In answer to an inquiry as to the nature of the soil on which his plantations are made, Mr. Fay writes me: "My land is made up mainly of abrupt hills and deep hollows, sprinkled over with bowlders of granite. The soil is dry and worn out, and what there is of it, is a gravelly loam. The larger part consisted of old pastures, and on the one hundred and twenty-five acres not a tree of any kind, unless an oak, that sprang out of the huckleberry bushes here and there, barely lifting its head above them for the wind, and when attempting to grow, browsed down by the cattle ranging in winter, could be called a tree."

Thirty-five thousand trees were imported and set out, besides a large number of native trees procured in this country; but fully three fourths of the whole plantation was made by sowing the seed directly on the ground where the trees were to stand. A large variety of trees, both native and foreign, were employed, and while few have failed entirely, the foreign species, as was to be expected from the situation, have been the most successful. The Scotch pine has made the most rapid growth, and then the European larch.

The Corsican pine (*Pinus Laricio, Poir.*), although not planted as early as the others, promises to be a valuable and fast-growing tree for planting under such circumstances.

Larch and Scotch pine, transplanted from the nursery in 1853, are now forty feet high, and from ten to twelve inches in diameter at one foot from the ground. Trees of the Scotch pine, raised from seed planted in 1861, where the trees have grown, but in favorable situations, and which have been properly thinned, have been cut this winter, and measured thirty feet in height and ten inches in diameter one foot from the ground, while the average of the trees in a large plantation of Scotch pine, made in the same manner in 1862, and which has received no special care, is twenty feet high and six inches in diameter. Plants of the Corsican pine are now eight feet high in only eight years from seed, the growth of the last three years being over five feet.

When we consider the success which has attended the experiments of these gentlemen in reclothing their property with forest growth, under circumstances, too, as disadvantageous as it is possible for Massachusetts to offer, it must be acknowledged that the attempt to replant our unimproved lands is a perfectly feasible one, and the only wonder is that the inhabitants of Essex and Barnstable Counties, with such examples before them, have not already planted their worthless, worn-out lands with a crop which would yield a larger profit than any they have produced since the first clearing of the forest.

Enormously as the price of all forest products has advanced during the last twenty-five years, their future increase in value must be more rapid as the supply becomes more and more inadequate to the demand. The great timber districts of the northern hemisphere have now all been called on to supply the always increasing wants of the civilized world, while no provision has as yet been made, except in limited areas, and on an entirely insufficient scale, to provide artificially the wood on which our descendants must depend.

In Europe, Norway and Sweden, Russia, Germany, and possibly Belgium, are the only countries which yield more forest products than they consume; while the other European countries, especially Great Britain and the extreme southern nations, are enormous consumers of imported wood. In the United States, according to Mr. Marsh's estimate, Oregon is the only State in which there is an excess of forest. New York and Maine, which were formerly the chief lumber-producing States of the East, now do not cut enough for the use of their own inhabitants, and depend on Canada for a large portion of their supply. And this seems to be true of all the States of the Union, with the exception of Pennsylvania, Colorado, Oregon, Florida, Michigan, Wisconsin, and Minnesota.

The annual forest destruction in the three last States is enormous, and they must soon depend on extraneous sources for their domestic supply. According to an article in the "St. Louis Republican," quoted by Mr. Marsh, 3,311,372,225 feet of lumber were cut in 1869 in these three States, from 883,132 acres; and the same article estimated that there were only about 15,500,000 acres of forest left in these States to be cut off, or only fifteen or twenty years' supply. When this is gone, the world will be deprived of one of its richest stores of lumber.

How long the supply in the British Possessions in North America will last, it is impossible to estimate. Heavy drains are already being made on it. During the three years ending June 30, 1871, the Dominion of Canada exported lumber to the value of $63,131,608, *gold;* the trade increasing during that time about $1,000,000 each year.

In spite of the substitution in many parts of the country of coal as fuel, both for domestic purposes and for the generation of steam; in spite of the increasing employment of other material, both in the construction of buildings and various implements, and for ship-building, the demand for wood in the United States has stimulated the supply until the figures which mark its increase seem almost incredible.

The railroads are enormous consumers, both in fuel, in the construc-

tion of cars and buildings, and for sleepers. "The Monthly Report of the Bureau of Agriculture" for November and December, 1869, estimated that the annual expenditure of the railroads at that time for wood for buildings, repairs, and cars, was $38,000,000, and that the locomotives of the United States consumed $56,000,000 worth for fuel annually. Supposing this is correct, and that the wood is worth $4 a cord (a large estimate), this yearly consumption of fuel by the railroads would represent twenty-five years' growth on 350,000 acres.

By the last returns there are in the United States 72,633 miles of railroad in operation, and the addition of double tracks and sidings will probably increase this amount to 85,000 miles.

Supposing the life of a sleeper is seven years, the 85,000 miles of track consume annually 34,000,000 sleepers, or thirty years' growth on 68,000 acres of the best natural woodlands; or if the sleepers are raised artificially, some 700,000 acres would be required, planted with trees best adapted for the purpose, regularly cropped and scientifically managed, to supply the railroads already constructed. At least 125,000 miles of fencing are required to enclose the railroads of the country, which could not have cost on an average less than $700 a mile. One half of this would barely represent the cost of the wood employed, or $43,000,000; while it must take annually lumber to the value of not less than $4,000,000 to keep these fences in repair.

By the last return I have seen (1872), there were in operation in the United States 65,000 miles of telegraph, which destroyed in their construction 2,600,000 trees for poles, while the annual repairs must call for some 250,000 more.

The 20,000,000,000 matches manufactured in the United States annually require, according to Mr. Marsh, 230,000 cubic feet of the best pine lumber.

At least 1,450,000 cords of wood, principally pine, were required to bake the 2,899,382 thousand bricks which the census of 1870 gives as the number made in that year, requiring the cutting off the trees from 36,000 acres.

The manufacture of shoe-pegs (a Massachusetts industry, but now carried on beyond the limits of the State for want of material here) consumes annually 100,000 cords of white birch worth $1,000,000.

In 1850 the value of the pine packing-boxes made in the United States was $1,000,000; in 1870 they were valued at $8,200,000. The value of the material made into wooden ware in the United States increased from $436,000 in 1850, to $1,600,000 in 1870. The value of the material converted into agricultural implements in the United States in 1850 was only $8,000,000, while in 1870 it had reached the enormous sum of $73,000,000, of which the forests must have furnished twenty millions' worth. The enormous consumption of wood in this country will, however, be sufficiently shown by the following figures.

In 1860, the value of logs sawed into lumber was $43,000,000; in 1870, it was over $103,000,000, — an increase which neither the growth of population or the general advance in all prices can account for, and which can only be explained by the supposition that the uses to which forest products

are applied are being rapidly extended, and that the foreign demands on American forests are increasing. But the statistics of the lumber trade do not show the entire destruction which is going on in our forests. Mr. Frederic Starr, Jr.,* in an interesting paper on the American forests, estimated that during the ten years between 1850 and 1860, 30,000,000 acres of forest-covered land were cleared in the United States for agricultural purposes, or ten thousand a day for each working day during that time. Of the trees thus cut, probably the largest portion never found their way to market, but were destroyed by fire for the sake of getting them off the land as rapidly as possible; and although lumber is now too valuable to justify any such mode of clearing, it is not improbable that trees capable of producing millions of feet are annually sacrificed in this manner.

These facts and figures prove, whatever other objections there may be to re-covering a portion of this State with forest growth, that the farmers will not want a market for all the lumber they can produce, and at prices far above those of the present time.

In order that any system of arboriculture may be successfully carried out, it is necessary to consider what trees, both native and foreign, can be grown in this State to the greatest advantage; and the profits of such an undertaking as I advocate will be immensely increased, if suitable selections for the various situations of soil and climate are made.

The sugar-maple, the white elm, and the white ash reach their greatest perfection in this and the neighboring States, and should be generally planted wherever the soil will permit. The product of the white oak and the hickories is of such value that they should also be generally planted, although they require a more genial climate and deeper soil than Massachusetts can now offer to develop their best qualities.

The white cedar (*Cupressus thyoides, L.*), although we are here on its northern limit, where it only attains a moderate size, should be planted on account of the value of its wood for fencing and other rural purposes, boat-building, shingle-making, etc., but more especially on account of its natural place of growth, which is always in deep, cold swamps, often near the sea, and overflowed by high tides, a situation in which no other tree of an equal commercial value could possibly thrive.

The value of the white pine is so thoroughly understood, and this beautiful tree grows so rapidly wherever it finds a certain amount of shelter and protection, that it is needless to advance its claims on the planter.

In consideration of its market value at all ages, the rapidity of its growth, and the length of time it continues to throw up suckers, the white ash (*Fraxinus Americana, L.*) is the most valuable of all our native trees for planting in this State. Valuable as Massachusetts-grown white oak is, it can never compete with that produced in other sections of the country for purposes which call out its highest qualities; while the slowness of its growth, and the difficulties which attend the early years of its cultivation, seem still further to reduce its value for the general planter as compared with the ash. Already there is a rapidly increasing export

* Report of Department of Agriculture, 1865: American Forests; their Destruction and Preservation. By the Rev. Frederic Starr, Jr., St. Louis.

trade of ash lumber to Europe, Australia, and the Pacific coast, from Boston and New York, and the possibilities of this business can only be limited by the supply. The American is generally acknowledged to be superior to the European ash in the qualities for which it is specially valued, toughness and elasticity, and in which no other wood can equal it. Australia possesses no tree which is at all its equal for carriage-building, while west of the Rocky Mountains there is but a single one which can supply its place — an ash (*Fraxinus Oregana, Nutt.*) which, developing into a large and valuable timber tree in Oregon, is less frequent and less valuable south of the California line. Of the economic value of several species of ash which grow on the Eastern Asiatic seaboard, nothing is as yet known. It seems, then, that the New England States could command the markets of the world for one of the most useful and valuable of all woods, had they but a sufficient supply to offer.

According to Mr. Thomas Laslett,* Timber Inspector to the British Admiralty, the specific gravity of American ash is 480, while that of the European is 736. The former is, therefore, on account of its greater lightness, far more valuable for the handles of shovels, spades, hoes, rakes, and other hand implements.

According to the United States census of 1870, the number of spades, shovels, rakes, hoes, and hay-forks made in that year was 8,347,478, and as our exportation of such implements is rapidly increasing, although still in its infancy, it is evident that the value of ash will be greatly enhanced at no distant day. It is also used in making ships' blocks, in turnery, and for making the oars of boats. In speaking of the white ash, Laslett says, "It stands well after seasoning, and hence we get from this tree the best material for oars for boats that can be produced. They are much and eagerly sought after by foreign governments as well as our own, and also by the great private steamship companies and the mercantile marine of this country; consequently there is often a very keen competition for the possession of them." The manufactory of oars (surely a seaboard industry), in pursuit of material, moved from Massachusetts first to Maine, and then to Ohio and other western States.

Ash is coming into extensive use for expensive furniture and for the interior finish of houses, while an immense number of the young saplings are annually consumed in the coopers' trade. Its value for firewood, according to Bull,† is 77, the standard hickory being 100, while only four other American woods are its superior in heat-giving qualities.

In view of its many uses for purposes for which no other wood can supply its place, it is not astonishing that the value of ash lumber has largely increased of late years. The present price in the Boston market of the best New England ash is $85 the 1,000 feet, or about $15 higher than that grown in the West.

To develop its best qualities, the white ash should be planted in a cool,

* Timber and Timber Trees, Native and Foreign. By Thomas Laslett, Timber Inspector to the Admiralty. London, 1875.

† Experiments to determine the Comparative Value of the principal Varieties of Fuel. T. Bull. Philadelphia.

deep, moist, but well-drained soil, where it will make a rapid growth. That the plantation may be as early profitable as possible, the young trees should be inserted in rows three feet apart, the plants being two feet apart in the rows. This would give 7,260 plants to the acre, which should be gradually thinned until 108 trees are left standing, twenty feet apart each way. The first thinning, which might be made at the end of ten years, would give 4,000 hoop-poles, which at present price would be worth $400.

The remaining thinnings, made at different periods up to twenty-five or thirty years, would produce some three thousand trees more, worth at least three times as much as the first thinnings. Such cuttings would pay all the expenses of planting, the care of the plantation and the interest on the capital invested, and would leave the land covered with trees capable of being turned into money at a moment's notice, or whose value would increase for a hundred years, making no mean inheritance for the descendants of a Massachusetts farmer. The planting of the white ash as a shade and roadside tree is especially recommended, and for that purpose it ranks, among our native trees, next to the sugar-maple.

The finest hickories are not produced in Massachusetts, although in the western part of the State, especially in the valley of the Connecticut, and in other favorable situations, the natural growth of this tree is fine enough to warrant its extensive cultivation. The hickories should be cultivated in the same manner as recommended for the ash, the young plants being equally valuable for hoop-poles, walking-sticks, and similar purposes; while the lumber cut from the large trees brings a higher price than any other produced in the northern States. It is used extensively in carriage-building and for axe handles, in which form it is carried all over the world. Hickory makes better fuel than any other wood with which we are acquainted, and is always the standard by which the value of other woods for this purpose is estimated. The best hickory is worth, in the Boston market at the present time, $100 the 1,000 feet. In the form of firewood it now seldom comes to the Boston market, where it readily commands, however, $16 the cord, and in nearly every part of the State it is worth from $8 to $10 a cord for curing hams and bacon, for which purpose no other wood supplies its place. The shagbark hickory (*Carya alba, Nutt.*), which also produces the finest fruit, and the pignut hickory (*Carya porcina, Nutt.*), are the most valuable species for cultivation in Massachusetts.

In the valley of the Connecticut the American elm develops its noblest proportions, and there possibly earns the title of the "most magnificent vegetable of the temperate zone," bestowed on it by the younger Michaux. Except, however, in very favorable situations, where its roots can find their way in deep, cool soil, supplied with abundant moisture, the American elm is far from a beautiful tree. In the situations I have described as being favorable to it, the American elm should be largely planted, not only on account of its beauty, rapid growth, and long life, but for the value of its wood, which has many uses, the most important being its employment for the hubs of carriage-wheels.

The sugar-maple (*Acer saccharinum, Wang.*) nowhere becomes a finer tree than in the western portions of Massachusetts; and when we consider the value of its wood in the arts, and for fuel, the value of its sap when converted into sugar, its rapid growth, long life, immunity from the attacks of insects, and its beauty and fitness for street and ornamental planting, it must be acknowledged that no tree deserves more general cultivation in this State. The wood of the sugar-maple, which is hard, close-grained, and smooth, is largely used in furniture-making, cooperage, and in making shoe-lasts, for which it is preferred to that of any other tree. Two million five hundred thousand pairs of lasts are consumed annually in Massachusetts alone; and if we can judge of the future of this business by its past history, it will, before many years, consume all the sugar-maple lumber the country can produce. For fuel, the wood of this tree is generally considered superior to that of any other, with the exception of the hickory. Mr. Bull estimates its value, however, at only 60, hickory being 100, and places before it, in heat-giving qualities, no less than twenty-two species of North American trees and shrubs.

The destruction of the sugar-maple has been so general in this State, that sugar making, which formerly held an important place in Massachusetts industry, has, during the last thirty years, diminished fully one half, and that, too, in the face of an enormously increased national production, and of prices which have considerably more than doubled during the last forty years.

There are, especially in the western part of the State, many unproductive pastures, now almost worthless, which would, if converted into sugar-orchards, yield in a few years a handsome income.

In regard to the age at which it is profitable to commence drawing the sap for sugar, authorities differ; but a tree twenty-five years old will yield, on the average, ten pounds of sugar, and will continue to be productive to this extent for fifty or sixty years longer. One hundred and sixty trees being allowed to the acre, the sugar crop, from an orchard of that size, would yield, at present prices, $273 annually; and it must be remembered that, owing to the season of the year at which sugar is made, no operation of the farm can be carried on with so small an outlay for labor. The trees, uninjured by the drawing off of the sap, would increase in value for a hundred years, and at any age find a ready sale either for fuel or for use in the arts. Its adaptability to all soils, except where stagnant water stands, the rapidity of its growth, its general thriftiness and undoubted beauty at all seasons of the year, render the sugar-maple the most valuable of all the North American trees for street and roadside planting, and it should be more generally used instead of the American elm, which has been planted for this purpose in Massachusetts almost to the exclusion of other trees, although rarely thriving in such dry, dusty situations.

As I have before remarked, the value of the white oak (*Quercus alba, L.*), for all purposes requiring durability, toughness, and hardness, is so great that it must always be in demand, no other North American wood equalling it in these qualities. And although I do not believe that its

cultivation in Massachusetts can ever be as profitable as that of the ash or the hickory, it should always form a part of mixed plantations, and should be spared in thinning woodlands in preference to all other trees, on account of the slow growth of its early years and its value at maturity. The value of the white oak for fuel is very great, being, according to Bull, 81 to hickory's 100, the hickories and the swamp white oak alone surpassing it in this quality.

There are a few European trees which have now been sufficiently tested here to show that they are suited to the soil and climate of Massachusetts, and that the qualities for which they are held in high esteem in other countries would make their cultivation equally valuable here.

The common European elm (*Ulmus campestris, L.*) was introduced into Massachusetts more than a century ago. According to Dr. Shurtleff,* Maj. Paddock, a carriage-builder by trade, and therefore probably fully aware of the economic value of the tree, planted the row of English elms in front of the Granary Burying-ground in Boston about the year 1762, and as the trees had been grown in a nursery at Milton for some time previous to their being planted in Boston, it is not improbable that they were imported fully a hundred and twenty-five years ago. In spite of the hard treatment which seems the destiny of all trees intrusted to the care of our city fathers, one of the row had in 1860 reached, according to Dr. Shurtleff's measurement, the respectable size of twelve feet eight inches in circumference at three feet from the sidewalk. Other trees of this importation were doubtless planted in the neighborhood of Boston, and I have recently measured two growing in Jamaica Plain which could not have been planted much later. One of these, at four feet from the ground, measures seventeen feet two inches in circumference, and the other sixteen feet ten inches at three feet.

Several trees in Brookline, which were planted in 1805, when they might have been ten years old, are now eighty feet high, and average from eight feet to eight feet six inches in circumference at three feet from the ground. It would, from these examples, seem that the European elm not only grows rapidly in the eastern part of the State, but promises to attain its largest dimensions and full span of life. I have been unable to compare satisfactorily the rapidity of its growth with that of the American elm, but probably in its best condition the latter is of far more rapid growth, although in the ordinary situations where the elm is planted, and where it generally suffers from insufficiency of root-moisture, the European elm is immeasurably its superior in rapidity of growth, length of life, and general thriftiness. The fact that the European is fully a month longer in leaf than the American elm, that its tougher leaves would seem to offer a less appetizing food to the canker-worm, the greatest enemy of the American elm in New England, and its adaptability to all situations, are strong arguments in favor of giving the preference to the former for general cultivation.

Its thriftiness in smoky situations makes the European elm the most

* Topographical and Historical Description of Boston. Nathaniel B. Shurtleff. Boston, 1872.

valuable tree our climate will allow for city street and square planting, and as a shade-tree by roadsides, no American tree is its equal.

The economic value of the wood of the European, which is hard and fine, has always been generally acknowledged to be superior to that of the American elm, and in Europe it is devoted to many important uses. For the hubs of carriage-wheels, it is used almost to the exclusion of all other wood. If employed in situations where it is constantly under water, or kept perfectly dry, it excels almost every other wood in durability. It is considered the best timber for ships' keels. It is largely used for ships' blocks, and for pumps, piles, and water-pipes, and by the turner and cabinet-maker; and by the coffin-maker it is preferred to all other woods. The general cultivation of the European elm would add a valuable timber-tree to the products of Massachusetts.

As timber-trees, some of the willows deserve more attention than they have hitherto received in this country, for, although the white willow (*Salix alba, L.*) has for many years been planted in Massachusetts for ornamental purposes, its economic value has been entirely overlooked. It grows rapidly here, reaching its largest size and developing its best qualities. By the side of the highway leading from Stockbridge to Great Barrington, in Berkshire County, there is a willow which, at four feet from the ground, girts twenty-one feet eight inches, and which, according to a popular tradition of the neighborhood, was brought in the form of a riding-switch by a person travelling from Connecticut, and planted where it now stands, in the year 1807. According to Newlands,* *Salix fragillis, L.*, or as it was more commonly known, *Salix Russelliana, Smith* (the Duke of Bedford's willow), produces the most valuable timber of any of the family, the common white willow coming next. I am not aware that the Duke of Bedford's willow has ever been introduced into this State; but as the two species have the same geographical range, and grow naturally under precisely similar conditions, there is no doubt that it can be successfully cultivated in any part of Massachusetts. Few trees grow more rapidly than the willow, or adapt themselves to a greater variety of soil. It has been general in this State to select low, undrained situations, beside streams or stagnant ditches, for planting this tree, but it is equally suited to high, exposed places, and poor soil, where, however, its growth will be naturally less rapid. In Europe, the timber of the willow I have referred to is used for many purposes. Newlands says it is "sawn into boards for flooring, and into scantlings for rafters; and in the latter capacity, when kept dry and ventilated, it has been known to last one hundred years. But the purposes more peculiarly its own are such as require lightness, pliancy, elasticity, and toughness, all of which qualities it possesses in an eminent degree. It also endures long in water, and therefore is in request for paddle-wheel floats, and for the shrouding of water-wheels. It is used in lining carts for conveying stones or other heavy material, as it does not splinter; and the same quality renders it fit for guard posts or fenders." Turners and tray-makers find many uses for willow-wood, and it is employed in making shoe-lasts, light ladders, and

* Carpenter's and Joiner's Assistant. James Newlands. London, 1867.

the handles of light agricultural implements. Its incombustibility is so great that it is peculiarly suited for the flooring of buildings intended to be fire-proof, and attention has been recently called to its value for such purposes. As willow timber could be produced far more cheaply than that of any of our native trees, it would soon come into general use here for the purposes for which it seems particularly fitted, and for which more valuable woods are now employed.

Less than one third of the willow used in the United States in basket-making is produced here, the remainder being imported from Great Britain, France, and Belgium, at an annual cost of $5,000,000.

The osier proper, the product of *Salix viminalis, L.*, and its allies, can be grown without trouble in any wet, undrained soil, capable of producing little else of value; but the better sorts of basket-willow are only successfully produced with careful cultivation on rich, well-drained soil. Under such conditions it is a profitable crop, capable of netting at least $150 a year to the acre, and well worth the attention of our farmers. Further experiments, which might be made under the auspices of the county societies, are, however, required to determine which of the many basket-willows is best adapted to our climate, and to devise some method for protecting this crop against the attacks of many insects which have of late years seriously interfered with its cultivation in various parts of the United States.

In spite of the beauty and great economic value of the white pine, there are many situations in this State where its cultivation is almost impossible, and where it should be replaced by its relative the Scotch pine (*Pinus sylvestris, L.*) of the north of Europe. It is many years since this tree was first introduced for ornamental purposes in Massachusetts, where it finds itself perfectly at home, and grows rapidly, soon becoming a large tree on poor soil and in exposed situations. Under such conditions, we usually find the ground covered with a spontaneous growth of the pitch pine, and wherever this tree grows naturally, it is certain that the infinitely more valuable and beautiful Scotch pine will flourish. If Mr. Fay's success with this tree can be taken as a criterion, the whole of Cape Cod, to its eastern extremities, could be covered with sufficiently large tracts of the Scotch pine to render the remaining portions better suited for agricultural purposes; while the product of such plantations in Barnstable and the other eastern counties in the shape of fuel for brick-baking would always find a ready market, taking the place of the imported firewood from the shores of the Bay of Fundy, already nearly stripped of its forest growth to supply the increasing demands of Boston and the other New England seaports.

But fuel is the least valuable use to which the wood of the Scotch pine can be turned. In Europe the lumber from this pine is considered more valuable than that of any other coniferous tree, the larch excepted, and for all economic purposes it is rated far above American white pine.

The nature of these two woods, and the uses to which they are each specially adapted, are so dissimilar that any comparison between them is not particularly interesting. A number of experiments * made at the

* Timber and Timber Trees. Laslett. London, 1875.

Royal Woolwich Dockyard have shown that the wood of the Scotch pine will resist a transverse strain .11 greater than that of the white pine; that its resistance to a tensile strain is about twice as great, and its resistance to a vertical strain is .56 greater; while its specific gravity is 541 to 513 for the white pine. All European writers on timber, from Duhamel to Laslett, agree that the wood of the Scotch pine is the most durable of all pine woods.

Newlands says "the lightness and stiffness of the Scotch pine render it superior to any other kinds of timber for beams, girders, joists, rafters, and, indeed, for framing in general."

From its greater strength, spars, top-masts, and the masts of small vessels which are often subjected to violent and sudden shocks, are made from the Scotch pine, in preference to any other wood, although, on account of its greater lightness, the white pine is preferred for heavy masts and large spars. Since the supply of larch has become entirely inadequate to the demand, the Scotch pine is used in Europe for railroad sleepers more generally than any other tree, enormous quantities even being shipped from the northern ports to India for this purpose.

Although the wood of the white pine is undoubtedly superior to the Scotch for all purposes where a soft, light, easily worked, clear wood is demanded, the latter has qualities so desirable that its cultivation for economic purposes would be of great value in this State, especially when it is remembered, as I have before remarked, that it will grow rapidly in situations where the white pine cannot flourish.

The rapidity of its growth in all situations and its economic value make the Scotch pine the most valuable tree farmers can plant for screens and wind-breaks about their fields and buildings, and for this purpose it is recommended in place of the more generally planted Norway spruce, which, although of rapid growth in its young state, does not promise, in our climate, at least, to fulfil the hopes which were formed in regard to it. The Scotch pine is being so extensively planted in Europe that it is propagated in immense quantities and at low rates. Plants one foot high can be delivered in any part of this State for from $50 to $60 the ten thousand.

There is no tree capable of producing so large an amount of such valuable timber in so short a time as the European larch (*Larix Europea D. C.*) in countries where its cultivation is possible. A native of high elevations in Northern and Central Europe, and always growing on poor, gravelly, and well-drained soil, it is not surprising that when planted under exactly opposite conditions, as is often the case, it does not become a valuable tree. The rocky, well-drained hillsides so common in Massachusetts are admirably suited to the cultivation of the larch; and there is but little land within the limits of the State too poor or too exposed to produce a valuable crop of timber, if planted with this tree.

The European larch has always been a favorite for ornamental planting here, and has shown itself well adapted to our climate. I cannot discover when this tree was first planted in Massachusetts, but in the eastern part of the State specimens, in open situations, are abundant, sixty feet high and five feet in girth three feet from the ground. The largest specimen

of the European larch in Bartram's Botanic Garden, near Philadelphia, probably the first ever sent to America, when examined by Mr. Meehan,* over twenty years ago, measured 108 feet high and 5 feet 4 inches in circumference.

The economic uses of the larch are numerous and important. According to Newlands, the strength of larch timber is to that of British oak as 103 to 100; its stiffness as 79 to 100, while its toughness is as 134 to 100. In the most trying circumstances in which timber can be employed, where it is alternately subjected to the influence of air and water, it is the most durable wood known. Laslett states, on what he considers good authority, that "many of the houses in Venice are built on larch piles, particularly those of which the supports are alternately exposed to wet and dry, and that many of these piles, after being in place for ages, are said not to have the least appearance of decay."

At the request of the Duke of Athol, experiments with a view of testing the durability of the larch were made many years ago in the River Thames. The result of these experiments is found in Sir Thomas Dick Lauder's † edition of Gilpin. "Posts," he says, "of equal thickness and strength, one of larch and the other of oak, were driven down facing the river wall, where they were alternately covered by water by the flow of the tide, and left dry by its fall. This species of alternation is the most trying of all circumstances for the endurance of timber, and accordingly the oaken posts were decayed, and were twice replaced in the course of a very few years, while those that were made of larch remained altogether uninjured."

In Europe, larch is preferred to all other woods for railroad sleepers, and it is probably superior for this purpose to the wood of any North American tree. Larch fence-posts are also in great demand at high prices, and instances are abundant of its great durability when thus employed. A practical forester, ‡ speaking of this tree, says, "For out-door work it is considered the most durable of all descriptions of wood. The lengthened period that some larch posts have stood is quite surprising, some of which are known to the writer to have stood nearly fifty years, than which there can be no better proof of its durability." For posts, it will probably equal in durability our red cedar, while in the power to hold nails it is greatly its superior.

The European must not be confounded with the American larch, which, although a valuable tree for many purposes, does not make durable fence-posts.

Timber of the European larch is admirably adapted for rafters, joists, and the main timbers in large buildings. When sawn into boards, however, it has the serious drawback of excessive shrinkage, and a tendency to warp in seasoning, and is therefore rarely used in this form. Its principal uses in this country would be for railroad sleepers, fence-posts, tele-

* The American Hand-book of Ornamental Trees. Thomas Meehan.

† Gilpin's Forest Scenery. Edinburgh, 1834.

‡ Christopher Young Michie, in Transactions of the Scottish Arboricultural Society. Vol. V, part II. Edinburgh.

graph posts, hop and bean poles, and other rustic work, and for piles in bridges, wharves, and similar structures, where the rising and falling of the tide require the employment of the most durable timber possible. White oak is generally thus employed, but it is probably less durable than larch, and far too expensive. The fertilizing effects of a plantation of larch on poor, almost barren ground, is remarkable, and now universally acknowledged.

According to a writer in the Highland Society's Transactions, quoted by Loudon, the pasturage under a plantation of larches thirty years old, and which had been thinned to four hundred trees to the acre, produced in Scotland an annual rental of eight or ten shillings the acre, while the same land, previous to the introduction of the larch, was let for one shilling the acre. Grigor* calls attention to the same good result of planting the larch. "No tree," he says, "is so valuable as the larch in its fertilizing effects, arising from the richness of the foliage which it sheds annually. In a healthy wood the yearly deposit is very great; the leaves remain, and are consumed on the spot where they drop, and when the influence of the air is admitted, the space becomes clothed in a vivid green, with many of the finest kinds of natural grasses, the pasture of which is highly reputed in dairy management. And in cases where woodland has been brought under grain crops, the roots have been found less difficult to remove than those of other trees, and the soil has been rendered more fertile than that which follows any other description of timber. Already in some of the Western States great interest is taken in the cultivation of the European larch, owing principally, I believe, to the efforts of Mr. Robert Douglas, of Waukegan, Illinois, and large numbers are planted annually, with every prospect of success. In his wholesale catalogue for 1876, Mr. Douglas calls attention to the fact, that the president of the Illinois Central Railroad, after an examination of the larch forests of Europe, and the growth and quality of this timber produced in Illinois, has without solicitation offered to transport European larch free of charge to any point on his lines in Illinois and Iowa, provided they are to be planted in the vicinity of the road.

Judging from the growth made by the larches in Mr. Fay's plantation, which are the only ones I know in this State offering any valuable statistics in regard to the rapidity of growth of this tree, I think we can feel confident that on the ordinary soil suited to their culture, larch, planted when about one foot high and three years old, will in twenty years average twenty-two feet in height, and seven inches in diameter, three feet from the ground; and that in thirty years they will be from thirty-five to forty feet high, and twelve inches in diameter; and if the plantations are thinned to four hundred trees to the acre, that at the end of twenty years more, or fifty years from the time of planting, the trees will reach from sixty to seventy feet in height, and at least twenty inches in diameter. This is also the average growth of this tree in the Highlands of Scotland, under nearly similar conditions.

Let us consider what profits a plantation of larch, ten acres in extent,

* Arboriculture. John Grigor. Edinburgh, 1868.

and intended to stand for fifty years, would give. The labor of cutting the trees will be more than paid for by the sale at different periods of a large amount of small wood suited to many rustic purposes, but for which no credit is made. It must also be remarked that the following account is charged with a permanent wire fence, although it is more than probable that any land suited to this purpose, is already surrounded by stone walls, which would require but little subsequent care. Present prices for forest products are taken, without allowance being made for their probable future increase in value.

ESTIMATED PROFITS OF A PLANTATION OF EUROPEAN LARCH OF TEN ACRES, TO LAST FIFTY YEARS.

DR.		
Ten acres of land, at $20		$200 00
Wire fence		1,600 00
Plants, 27,200, at $5		136 25
Labor of planting		500 00
		$1,836 25
Interest on investment, as above, 50 years, at 6 per cent		5,499 00
Taxes, 50 years, at 1.5 per cent		150 00
Interest on taxes equal 25 years, at 6 per cent		225 00
		$7,710 25
CR.		
Product of first cutting at the end of 20 years: 13,000 trees, less 20 per cent for casualties; 10,400 trees, or 20,800 fence-posts, at 20 cents		$4,160 00
Product of second cutting at the end of 30 years: 10,200 trees, less 10 per cent for casualties; 9,180 trees, or 18,360 sleepers, at 50 cents	$9,180 00	
And 9,180 fence-posts, at 25 cents	2,295 00	
		$11,475 00
Product of third cutting at the end of 50 years: 4,000 trees, less 5 per cent for casualties; 3,800 piles, worth $5.00 each	$19,000 00	
And 7,600 sleepers, worth 50 cents	3,800 00	
		$22,800 00
Land at cost		200 00
		$38,635 00
Thirty years' interest on $4,160, at 6 per cent	$7,488 00	
Twenty years' interest on $11,475, at 6 per cent	13,770 00	
		$21,258 00
		$59,993 00
Profit		52,282 75*

There are within the limits of the State fully 200,000 acres of unimproved land which could with advantage be at once covered with larch plantations.

For the sake of keeping these estimates within reasonable bounds let us suppose that these 200,000 acres will, in the natural course of events,

* Equal to about 13 per cent per annum for the entire fifty years, after returning the original capital invested.

produce during the next fifty years one hundred cords of firewood to the acre, worth $6 a cord. This would make their total yield for the fifty years $120,000,000. If they were planted with larch, their net yield, according to my estimate, during the same time, would be $1,045,000,000; but that we may judge how much such an operation would add to the wealth of the community, we must deduct from this amount the value of the wood which we suppose would be produced naturally, or $120,000,000. That sum being subtracted, we have left as created wealth the respectable sum of $925,000,000.

There is no branch of agriculture at once so pleasant and so productive of possible gains, as farming *on paper*. It is a dangerous pastime, however, and often leads into grave errors, and great dangers, as the agricultural population has learned to its cost. In this case it will be well to be on the safe side. The larch, in common with other plants, is liable to disease; it is preyed on by many insects, and our plantations may be often injured by fire, bad management, and other dangers now unforeseen.

In view of such chances, let us reduce the total yield of our ten acres of larch a little more than one half, and be content with a profit of only six per cent per annum on the capital invested.

Such a diminution of yield would reduce the amount I suppose would spring, in the course of fifty years, from the 200,000 acres of larch, to $462,830,000.

If we can add $8,000,000 annually to the net product of the agriculture of Massachusetts by replanting a small portion of our nearly worthless lands with trees, the mere material gain to our wealth is worth striving for But when we consider that this is an operation which will bring benefits to the State far beyond any direct material gain, it becomes the moral duty of every citizen to continue his efforts in this direction until every landowner shall be convinced that tree-planting is a patriotic act, and that we owe it to our descendants to leave the land at least as productive and pleasant as we received it. It is within the power of many to give direct assistance to such an undertaking. The wealthy and powerful corporations depending on a supply of water for their existence will do well to reflect on the dangers which threaten them through the destruction of the forests, and consider what steps they can take to avert them.

The railroads, the most dependent of all our corporations on a supply of wood for their daily consumption and increased traffic, must soon, in self-defence, turn their attention to arboriculture. But, in this community, we must look to individual enterprise and individual intelligence if we expect to see any considerable portion of this State re-covered with forest growth; and to the farmers, more than to any other class, must be left the solution of the difficulties and dangers, which the forest question presents.

To-day, I can offer them no better advice than that of the dying old Scotchman to his son,—"Ye may be aye sticking in a tree, Jock; it will be growin' when ye're sleepin'."