The Economic Uses of Massachusetts Forests

NANCY M. GORDON

SINCE TIME immemorial, man has used the forest in a variety of ways to support his existence. When Europeans realized that there was a whole new world, on the other side of the Atlantic, for them to explore and exploit, they had reached a point where their own forests had become a scarce resource. But the forest in the new world seemed limitless, and those who moved to the new world to live set about immediately to utilize the forest and its products to improve their living standard.

At first, the forest was seen primarily as a source of furs, the next best thing to the gold and silver the Spaniards had staked out for themselves far to the south. But once Europeans, especially Englishmen, determined to move permanently to the new world, they found that the forests there supplied a wide variety of needs. These needs changed over time, but to this day the forest supplies products without which modern man could not live.

THE SEVENTEENTH CENTURY: CREATING A MARKET

When the Pilgrims first set foot on Massachusetts soil, in November of 1620, a bleak scene met their eyes. There was very little vegetation on the sandy shore, and where trees grew, inland, they were often interspersed with dense thickets. Even though the Pilgrims chanced on some abandoned Indian larders and corn fields, the next few years would be hard ones for the seekers of a religious haven.[1]

Not so the Puritans who followed and, under the leadership of John Winthrop, staked out a place on Massachusetts Bay. To be sure, the immediate coast, with its salt marshes and sand flats, was almost as bleak as that around Plymouth. But not far inland the forest began, and

the settlers of Massachusetts Bay, driven as much by a desire for new economic opportunities as for religious security, made haste to take advantage of the adjacent forest.[2]

The flood of settlers that poured into Massachusetts Bay in the decade between 1630 and 1640, often called the Great Migration, were convinced believers in Calvinist theology but were also, most of them, men of some means as well; nowadays we would call them middle class. They had owned property, some personal, some real estate in England; and they had sold off their possessions before they left to provide themselves with the funds they would need to create a new existence in the new world.

The first need was houses for protection against the harsh New England winter. House building went on apace in the new settlements on Massachusetts Bay, the settlers adapting the styles that had been familiar to them in old England to the resources available in New England. They built timber frame houses, felling the numerous oaks in the woods adjacent to the new settlements, hauling them by ox teams to the chosen site, and erecting modest dwellings. They filled in the spaces between the beams with mud and straw, but they sheathed the outside, and later the inside, with clapboards. These were not made by sawmills or even by pit-saws, the conventional method of sawing boards in the England of their day, but were, as the settlers would have said, "riven." Bolts of wood were chopped from a log and then split into thin layers with a frow, a wedge-shaped tool that was hit with a hammer. If the wood was straight-grained, a relatively smooth piece was the product, but those who were meticulous could make it smoother with a draw knife. In place of the masonry-clad houses the immigrants had known in England, these wooden, clapboard-sheathed houses became the norm in New England. This was without doubt the first use of the forest by the new immigrants to New England.[3]

The first houses were generally roofed with thatch — the marshes along the coast could provide ready material for thatched roofs — but before long the settlers adopted a practice of the Dutch traders in New Netherlands to the south, the shingle. These too could be riven, and where cedar was available a good, sound roof could be made. Shingles were also made from pine. Moreover, shingles were slightly less liable to catch fire than the thatched roofs they replaced, which was an important consideration, since the new residents of New England built huge

fires in their houses to keep themselves warm during the long winter. The forests, that then seemed unlimited, provided fuel in abundance. After the deprivation in England, where fuelwood had become scarce and expensive, the New Englanders could afford to indulge in generous fires on the hearth.[4]

Although the settlers in Massachusetts Bay proved adept at making use of the wood they found available to them, many of the goods they needed could not be hand made in the new environment. These goods, notably glass and metal products, had to be imported from England. During the first decade, the resources (English currency and letters of credit) most immigrants brought with them from England paid for these necessities, and as long as new immigrants kept pouring in, the money to buy such goods came with them. But in 1640, for reasons both political and economic, immigration almost ceased, and with that cessation came the end of the financial resources of the new immigrants. What happened then has often been described as a depression, which lasted for most of the next two decades. But there was still a need for British products. How to pay for them was the burning question of the day.[5]

This need for foreign exchange led to a pressing search for products that could be traded elsewhere, either in exchange for other products that could be sold for English currency or credit, or that could be shipped directly in Europe and sold there. Some of the earliest settlers had had visions of great wealth gained from the fur trade; but except for the new settlement created by John Pynchon on the Connecticut River at the present site of Springfield, the settlers had little opportunity to interact with Indians who, in turn, could bring in the number of furs that would generate good European credit. And even the Pynchons found that, after a decade or so, the fur trade was petering out. The Dutch, located on the upper Hudson River, had built better ties with the Indians who had access to the vast trapping grounds in the interior of the continent.

But the new settlers were determined men, and they were driven by necessity. Necessity soon produced an answer: the many white oaks in the forests adjoining the Massachusetts Bay settlements could be cut up to make barrel staves. In the seventeenth century barrel staves, especially white oak barrel staves that could be made into water-tight (or, more accurately, wine-tight) barrels were in rapidly rising demand.

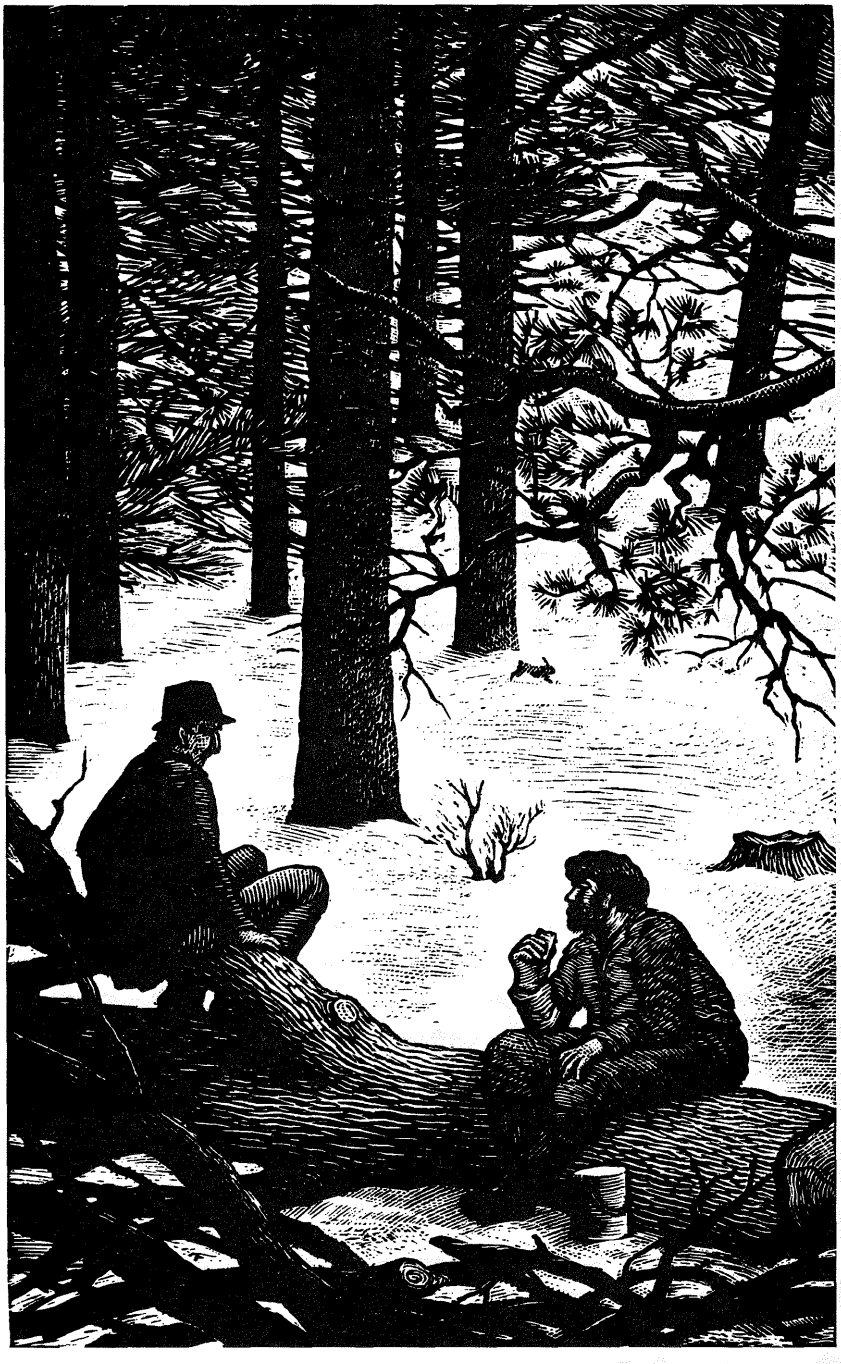


Figure 1. Woodcutters at work in a nineteenth-century woodlot. Illustration for Walden, *by Henry David Thoreau, (New York: The Heritage Press, 1939). Boston Public Library, Print Department, by permission of the estate of Thomas Nason.*

White oak barrel staves, crudely manufactured by hand with frow and draw-knife, began to earn that vital foreign exchange that Massachusetts so desperately needed. The market was not in England, but in Spain, and, especially, in the so-called "wine islands," the Azores, the Canaries and Madeira, where recent Spanish immigrants had created a thriving industry in the mild climate raising grapes that were quickly turned into wine. Wine was in high demand in England especially among the upper and growing middle classes. So staves went to the islands, wine went from there to England, and the New England shippers were paid off in commercial credit in England.[6]

At the same time that Massachusetts was being settled by Puritans, the British West Indies islands, especially Barbados, were being settled by other Englishmen. These men soon discovered a market niche that supports the Caribbean islands to this day: sugar cane, made into sugar and molasses. So great was the profit that the West Indies soon became devoted almost entirely to the raising and processing of sugar. The local forest was soon exhausted, and the continued need for wood fuel and building materials created a market that the New Englanders were eager to fill. New England sent livestock, timber and fish to the islands, where they were exchanged for sugar and molasses, some of which were brought back to Massachusetts Bay, but most of which went to England. There they were sold and earned for the New Englanders the desperately needed credit with which to buy manufactured products.[7]

But before the New Englanders could reap the rewards of this triangular trade, they had to get the barrel staves, the fish and livestock to the wine islands and to the Caribbean. That meant ships. Once the settlers in Massachusetts Bay had satisfied their need for housing, they began building ships. A large portion of the ships' frame was hewn from local white oak, which had many of the same qualities as the English oak. New England's white oak, however, proved most useful when built into a ship in Massachusetts. Attempts were made to sell white oak logs in England, where the shortage of oak was acute, but were not very successful, because the oak was shipped immediately after being felled, rather than being allowed first to dry. (Time was money then as it is today.) The holds of the ships of that time tended to be dank (few ships were totally water-tight) and filled with decay organisms. These infected the wood cargo, so that logs shipped to British shipyards had already begun to decay before they could be used. For constructing

ships in Massachusetts, however, they were highly satisfactory; and in shipbuilding the settlers of Massachusetts Bay and their descendants found a niche in world trade that lasted two centuries.[8]

The first ship built in Massachusetts Bay colony was the *Blessing of the Bay,* launched in 1631 in Malden. It was followed in 1633 by the *Rebecca,* built in Medford. Both were relatively small ships, intended for the coastal trade. But by 1636 the ocean-going vessel *Desire* slid down the ways in Marblehead. The *Desire* was followed by many others, for building ships in New England, despite the shortage of skilled shipwrights, was far cheaper than in England, because wood was so readily available. By 1660 shipbuilding was a major industry in the Bay Colony; all the places with access to the rivers that flowed into Massachusetts Bay became busy shipyards, though Boston supplied the financing. Throughout the colonial period New England continued to enjoy a great advantage in the shipbuilding industry, for its costs were below European costs.[9]

One major advantage of the New England shipyards, besides the availability of oak ship timbers, was access to pine masts. For several centuries British shipyards had had to rely on Baltic sources for masts, produced from Scotch pine. But as ships grew steadily larger, and carried more sail, larger and taller masts were needed. But large masts made of Scotch pine had to be pieced together. However in New England's old growth forests were many white pines, a yard and more in diameter. A single tree could furnish the mainmast of a British man-of-war. The rule of thumb was that a mast tree would have the same height in yards as it had in inches of diameter, so that a 36-inch-diameter tree would yield a 36-yard mast — over 100 feet tall. Many of these trees were significantly larger. White pine masts such as these were available no place else in the world, and the men of Massachusetts Bay, skilled traders, soon learned to capitalize on this fact.[10]

The first mast was shipped from New England to England as early as 1634. But it was contemporary European politics that opened up real opportunity. The Dutch and the English were lively trading competitors in the seventeenth century, and in the 1650s the Dutch acquired control of the sea lanes to the Baltic. This victory effectively shut off England from her traditional mast supply. At that point the New England masts came into their own. By 1670 Portsmouth, in what is

now New Hampshire but was then part of Massachusetts Bay colony, was regularly sending ten mast ships a year to England.[11]

The late seventeenth century saw a substantial restructuring of the political landscape in northern New England, where most of the great pines were located. In 1680 New Hampshire was struck off from Massachusetts Bay Colony, and made a separate royal colony. By contrast, Maine, which had hitherto been the preserve of private royal grantees such as Sir Ferdinando Gorges, in 1677 became part of Massachusetts. The Bay Colony bought out the rights of the Gorges heirs for the sum of 1,250 British pounds, and Maine became the District of Maine within Massachusetts. The reconstruction of the Bay Colony's government as a royal colony in 1691 included both Maine and Plymouth within its boundaries. Plymouth and the islands remained permanently part of Massachusetts, but in 1820 Maine became a separate state.

Harvesting the pine masts, located mostly in New Hampshire and southern Maine, became a separate industry. To fell the great trees without splintering them when they hit the earth required great skill. Generally, a "bed" of smaller trees was dropped first, to create a cushion for the mast tree when it came down. Then it had to be limbed and skidded to a navigable river, mostly the Merrimac, which drains much of New Hampshire but flows into the Atlantic at Newburyport, in Massachusetts, and the Piscataqua, which drains southern Maine and flows into the ocean at Portsmouth. At one of these two ports the felled tree was loaded into specially designed ships that carried only masts. These ships had a loading port in the rear, and they were of exceptional size — at least 500 tons, some as much as 1000 tons. They could carry anywhere from 40 to 100 large masts, with some smaller masts and spars as well; such a cargo of masts would be worth many thousands of pounds.[12]

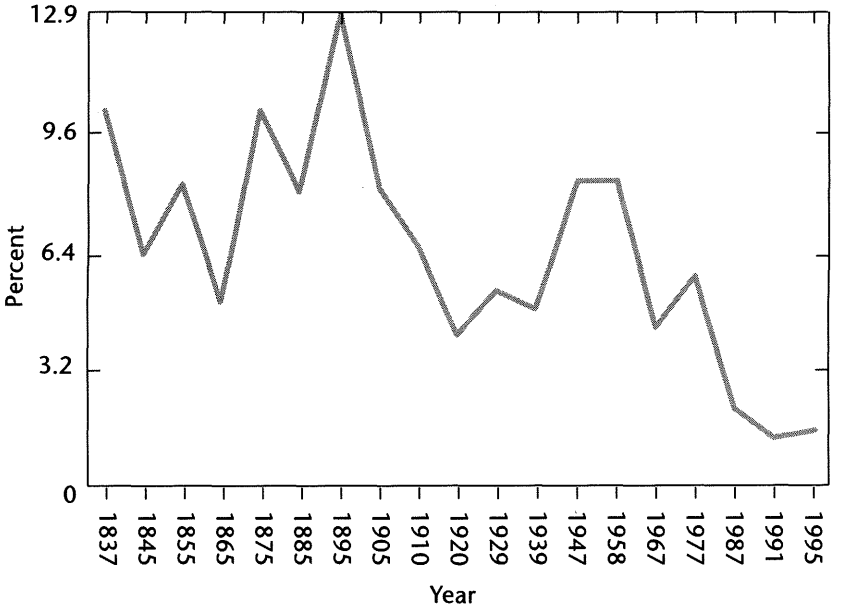
By the end of the seventeenth century, as Britain was about to embark on a series of wars for control of the sea lanes that proved to be the foundation stone of the British Empire, the British Navy came to require a steady supply of pine masts from New England. This need led the British Government to attempt to reserve all large pine trees — in time this came to mean all more than two feet in diameter — for the use of the navy. Timber inspectors were appointed whose task it was to roam the woods of New Hampshire and Maine to stamp the famous symbol, the "King's Broad Arrow," on the trunks of trees that were to be

kept for the British Navy. The colonists resented deeply this attempt to restrict what they believed was their right to fell any tree for which they had a market, either as a single piece or cut up into boards. The conflict festered throughout the eighteenth century until resolved by the American Revolution. Meanwhile the mast business became a highly organized affair, involving American firms generally headquartered in Boston doing the felling and the shipping, and British merchants securing the contracts with the navy.[13]

When the Pilgrims set forth for New England, there were no sawmills in Old England. Boards were hand hewn or else were laboriously produced by two men pushing and pulling a large saw through a log located over a pit. The man in the pit was known as the pitman, and when machinery took over his role, the connecting rods to the lower end of the saw became known as pitmans. But labor, though abundant in old England, was in very short supply in New England, and the old method was quickly abandoned in favor of water-powered sawmills. Moving a single blade up and down through a log does not require a vast amount of power, and many of the streams that criss-cross the New England countryside generally afforded enough power for a sawmill. Because of the great need of the colonists for lumber to build houses, sawmills were one of the first enterprises, often linked to a grist mill, to be established in the colonies. The early history of New England sawmills is obscure, but by the 1630s a number of them are known to have existed in Massachusetts. As the settlers spread out over eastern Massachusetts, just about every new town commissioned one of its new inhabitants to erect a sawmill, and in return provided certain advantages, among them water privileges, a stream-side lot on which to erect the mill, and early tax exemption. Still, it took capital to set up a sawmill: estimates are between 400 and 750 British pounds. Such costs often meant that sawmills were started by several men. Visitors can view examples of early sawmills at Sturbridge Village, or at Henry Ford's Greenfield Village outside Detroit, Michigan. That mill came from Georgetown, Massachusetts. It was bought by Ford, dismantled and re-assembled in Michigan.[14]

Most of the lumber produced by these early mills was used locally, but commercial operations were not long in coming. Numerous mills on the Merrimac and the Piscataqua sawed out lumber for sale abroad, especially in the West Indies. In the seventeenth century, very little was

Wood Products as Percent of All Massachusetts Products, 1837–1995



exported to England, because the cost of transportation prevented it from being competitive with Baltic lumber. Only in years of war, when foreign navies were able to control access to the Baltic, did significant amounts of American lumber go directly to England.

As the seventeenth century wore on, some minor products of the Massachusetts forest came to market. Aware that the need for iron and iron products was a heavy drain on the foreign exchange earned by Massachusetts traders, the General Court encouraged the development of local iron manufacture. The necessary ingredients were at hand on the North Shore in the vicinity of Lynn. An attempt was made to set up an early iron works in Saugus, making use of the readily available bog ore, the gabbro rock containing lime for flux to be found on Cape Ann, and the vast supply of wood for fuel. The wood, of course, first had to be turned into charcoal, and the proprietors of the Saugus Iron Works were granted timber rights, along with water rights and tax exemptions, by the General Court in 1645. Though the Saugus Iron Works was not commercially successful, it did lay the basis for a charcoal iron industry in Massachusetts that lasted until the twentieth century.[15]

Early settlements in Massachusetts were along the coast and in the

Connecticut River valley, for the obvious reason that water transport was the only economical way to travel. Roads were virtually nonexistent. For this reason, central Massachusetts, especially Worcester County, remained a wilderness until the eighteenth century. But even in the seventeenth century, new settlements had to be hacked out of the forest, for the supply of Indian clearings for agriculture was quickly exhausted. It was time consuming and expensive to clear land for agriculture, but the colonists were rewarded for their effort in the production of potash, and its more refined cousin, pearlash. When the trees for a new farm had been cut down and burned, the ash was collected and boiled down to make potash, needed in the manufacture of glass (at first all imported from England), soap and gunpowder. In the seventeenth century, most of the potash produced in the colonies was used locally, but by the eighteenth century, when Worcester County began to be settled by the sons and daughters of the large families in eastern Massachusetts, potash became a commercial product. It was relatively light in weight in relation to its value, so it was worth transporting, even overland. It was to become a major earner of foreign exchange in the eighteenth century.[16]

Once the colonial towns had become well settled and their inhabitants well established on the farms that supported most of them, there was a need for better communication. The rivers were immensely useful for transport, but sometimes there was a need to travel overland to reach areas not accessible by navigable rivers. Crossing rivers became a real headache, so many towns moved as quickly as they could from ferries to bridges; thus was born the timber bridge. The first such bridges were built in the Boston area, notably the Cradock bridge over the Mystic River at Medford. Another early bridge crossed the Charles River between Cambridge and Boston. To build these bridges, stone-filled cribs were established at intervals in the river, and wood stringers connected them. The deck was planked. The Cambridge-Boston bridge that was built in 1662 lasted till the end of the eighteenth century.[17]

THE EIGHTEENTH CENTURY: EXPLOITING THE ATLANTIC MARKET

During the English Civil War (1642–48) immigration into New England virtually ceased, but with the restoration of the Stuart monarchy

in 1660, immigration resumed, though at a slower pace. The religious fervor that had driven the Great Migration was replaced by a quest for greater economic opportunities. Combined with the large natural increase of families long settled in New England, the new migrants put acute pressure on the land supply in the older settlements. This land shortage had two consequences: it drove younger sons to create new settlements in the parts of Massachusetts not already settled, those parts not close to a navigable river, and it increased the proportion of the population deriving its living from efforts other than farming.

The most important alternative to farming was trade. The trade with the West Indies, initiated and developed in the seventeenth century, blossomed in the eighteenth. Although precise figures exist only for a four-year period between 1768 and 1772, many inferences can be drawn from those data. Staves and completed barrels continued to occupy a central position, though many more completed barrels were exported than in the prior century. Approximately half of all timber-related exports from Boston were staves and barrels.[18]

Although the British government attempted through legislation to organize the trade of the empire according to self-sufficiency principles popular at that time — the concept called mercantilism — American traders were practitioners of freedom of the seas. The Navigation Acts, passed in the mid-seventeenth century to counteract the Dutch success in global trade and restrict intercolonial traffic to British ships, were now enforced with greater vigor. But canny Yankee shipowners either found ways to get around the rules or they simply ignored them, trading with only a minimum of precautions not just with the British West Indies but with the Caribbean islands of other European nations as well. Not just staves but boards as well were in high demand in the West Indies, and the New Englanders, with Boston the focus of the financing if not the management of the trade itself, took full advantage of the continuous Caribbean market for wood products. Some five-sixths of the boards and half the staves exported from New England ports went to the West Indies.[19]

British mercantilist doctrine was employed not just to direct trade into channels that benefited the Empire, but also to protect the markets of British manufacturers against upstart colonial enterprises. But despite all attempts to ban the production of iron ore, colonial entrepreneurs managed to evade the efforts of the British to control their

activities. As a result, manufacture of pig iron and cast iron products grew in the colonies, and these products actually became an important item of trade between the colonies and Britain itself. Such manufacture required ample supplies of charcoal that had to be supplied by the local, that is, the Massachusetts forest.

Among the permitted items of trade between the colonies and Great Britain was lumber. The shortage of native-grown timber in England was acute, and although a steady import of Baltic timber helped alleviate the shortage, New England pine found a niche market of some significance in Britain. Oak and pine from New England were evidently used for house construction in Britain, especially in the latter part of the century when the population began to increase as industrial growth created new livelihoods. Even though English houses continued to be substantially of masonry construction, they needed oak timbers for their frames, and they needed pine to finish the interiors. By the 1770s American lumber imported into Britain exceeded that brought from the Baltic.[20]

The most valuable of American wood products continued to be ships. Here New England, and especially Boston, reigned supreme. Forty percent of the tonnage built in the American colonies was built in or around Boston in 1769. That percentage had dropped to 35 in 1770, and to 32 percent in 1771, but Boston still outran other shipbuilding colonies by a wide margin. New Hampshire was second, Rhode Island third. The value of the wood used in constructing the hull of a ship, combined with the cost of the labor in assembling it, equaled half the cost of the entire ship. Next to Boston in shipbuilding activity in Massachusetts were Charlestown, Salem and Scituate. Shipbuilding, like many enterprises in the eighteenth century, was often a family business. Notable among the shipbuilding families were the Barstows and the Briggs, building ships on the North River near Salem for more than a century. Other important shipbuilding families were the Beckets in Salem, and the Hoods and Hallowells in Boston.[21]

White oak continued to be the preferred material for construction of the hulls, and these oak trees continued to be the foundation of Massachusetts' shipbuilding dominance. Some shipbuilders, however, became adventuresome: in 1719 a shipbuilder in Duxbury built a ship of "wild cherry wood."[22]

New England shipbuilders' main advantage, however, was their

access to large white pine masts. With Maine part of Massachusetts since 1677, the producers of masts from the "virgin" forests of Maine along the Piscataqua, Kennebec and Penobscot rivers that made the interior of the state accessible were formally as well as financially Massachusetts businesses. They were run largely from the financial center of the colony, Boston.[23]

The new Massachusetts charter of 1691 incorporated a provision that reserved for the use of the British Navy all pine trees above a specified size that were not growing on land already granted to an individual — essentially, that is, the public lands as they later came to be known. Legislation soon followed to confirm this reservation. In 1711 the British Parliament passed the first of a series of acts, called "An Act for the Preservation of White and other Pine trees growing in Her Majesty's Colonies . . . for the Masting of Her Majesty's Navy." This Act applied the reservation contained in the Massachusetts charter of 1691 to all pine trees growing between Maine and New Jersey. In 1721 the reservation was enlarged to include all pine trees of any size not growing in an established township, and requiring a license if anyone wished to cut a pine. The removal of the earlier size limit (a minimum of two feet in diameter) was intended to ensure future supply.[24]

Concern about future supply also underlay a system of bounties or special premiums on American masts and "naval stores" instituted in 1704 and paid by the British government to the naval contractor. Except for a brief lapse, between 1725 and 1729, this system of bounties or premiums continued until the Revolution. During this time the navy paid out almost 1.5 million British pounds in bounties to the contractors who supplied these items to the navy, though a significant part was for "naval stores." (After a brief attempt in the late seventeenth century to develop the production of "naval stores" — tar and pitch essential for making ships watertight — in Massachusetts, the business shifted to the southern colonies, where it remained.)[25]

Perhaps partly because the felling and processing of mast trees was largely controlled by capitalists, either in Boston or in London, the average settler deeply resented the "king's broad arrow" policy. Most settlers felt that on land not clearly owned by an individual, the logs belonged to whomever took the trouble to fell the trees. Moreover, as the number of sawmills grew and the market for lumber expanded, there was an alternative use for the large pines.

In the late seventeenth century the office of Surveyor-General of the Forest had been created for the colonies to enforce the mast reservation, but until the mid-eighteenth century the whole process was riddled with corruption. One Surveyor-General accused the Massachusetts General Court of creating paper townships so that the pine trees within such townships would not be subject to reservation for the navy. Besides, most of the large pines still standing were well up the rivers, and policing the timber cutters was simply not possible with the minimal staff the Surveyor-General had. His staff was paid, anyway, out of his own salary, so the incentive for him was to employ as few as possible. The resentment against British restrictions on American enterprise that began in the early years of the century escalated in the 1770s until it played a part in triggering the explosion called the American Revolution.[26]

Notwithstanding all the difficulties, some 4,500 American masts actually made it to the British Navy in the eighteenth century, though one authority estimates that these constituted less than one percent of the trees that would have been eligible had the policy been strictly enforced. Those trees that did not make it intact to the navy generally found their way to the numerous sawmills dotting nearly every stream in Massachusetts and heavily concentrated along the major rivers. Even when the Surveyor-General or his minions succeeded in confiscating a group of logs that they thought should be reserved for masts, the logs often found no buyer when auctioned in the colonies. Or sometimes they mysteriously disappeared and were lost to the authorities because they were promptly sawn into boards. No successful condemnation sales were recorded.[27]

THE WATERSHED YEARS, 1775–1825: TRANSITION TO A NATIONAL MARKET

The years between 1775 and 1825 were years of profound change in American society, in its economic underpinnings, and in the role government played in shaping those underpinnings. Prior to the Revolution, the 13 colonies had been an integral part of the old British colonial system, based on the notion that the colonies should supply raw materials to the mother country, which then made them into usable products. The New England colonies never fitted well into that

system, yet New Englanders had managed to adapt reasonably well to it. Their efforts were devoted to economic activities that supplied niches in the mercantilist system: staves for the variety of packaging materials needed before many raw materials could be transported, notably sugar, molasses and alcoholic beverages; ships to move the staves to where the raw materials were; ships to move the packaged raw materials to market in England. Even potash and pearlash, products of new settlement, temporarily filled a niche in the British market. In the four years of the colonial period for which records have survived, 1768–1772, Massachusetts exported more potash and pearlash than any other colony.[28]

But the Revolution changed all that. The mainstay of the New England economy was the trade with the West Indies, and the Revolution virtually wiped that out. American vessels were refused permission to bring goods directly to the West Indies. Under the Navigation Acts this trade was reserved for British vessels. Moreover, during the War the British navy had captured so many American merchantmen, many operating as privateers, that few American merchantmen were available to pick up trade after the signing of the peace agreement in 1783. Though subsequent negotiation between the U.S. and Great Britain reopened part of the trade between New England and the British West Indies to American vessels, the trade never recovered the dominance of American foreign trade it had had before the Revolution.

The cessation of hostilities ushered in a severe depression in New England, especially devastating in such overwhelmingly agricultural areas as western Massachusetts. Repayment on debts owed Boston financiers, postponed during the Revolution, now fell due. Deferred taxes also had to be paid. The resulting foreclosures led directly to Shay's Rebellion; its failure served to convince many that, as soon as the western lands opened up, they should move there. That is why the population of such western Massachusetts hilltowns as Shutesbury fell from 1,000 in 1800 to 250 in 1900. Western Massachusetts recovered only slowly in the early decades of the nineteenth century. Indeed, until 1840 and the advent of railroads it was largely (though not wholly) a self-sufficient world that existed on its own agricultural output and on barter exchanges among the inhabitants.[29]

The eastern part of the state recovered much faster. In this recovery it was helped by the beginnings of industrialization, first in Rhode Island under Samuel Slater, then in the environs of Boston. To be sure,

the industrialization took place first in the manufacture of textiles but since the early textile machines were largely made of wood this new industry created a great opportunity for the craftsmen who worked in wood.

Industrialization made other demands on the state's wood supply. Early industry was still water-powered, and continued to be so at least till 1850. The small dams that created the mill ponds that assured a steady flow of water over the water wheel were primarily made of large timbers. The water wheels themselves were made of wood. Earlier, the water-driven mills had operated intermittently, usually in the spring and summer when the flow of water was greatest. Now, however, there was an incentive to keep them going all year round. This in turn meant greater wear on the parts of the water wheel, requiring more frequent replacement.

Heating the barnlike structures that housed the new industry made ever greater demands on the fuelwood supplied by the Massachusetts forest. The concentration of population in industrial centers meant that supplying fuelwood was no longer just a household effort, but rather a business. Massive quantities of fuelwood were burned in Massachusetts' early industrial centers; no one knows exactly how much, but one estimate is that every winter from one to four and a half cords per capita were burned in the northern states. The quantity probably exceeded that cut for sawing into lumber by a wide margin, and this at a time when most Massachusetts land had already been cleared for farmland.[30]

Massachusetts' premier industry of the eighteenth century, shipbuilding, recovered between 1790 and 1810. Before the Revolution, Massachusetts customarily launched about 125 vessels each year; in 1784 only 45 were built. But that situation quickly improved, and until 1812 Massachusetts led the nation in tonnage built. Wood was still available in coastal areas, but its price was rising, causing some shipbuilders to move their operations upriver. Between 1790 and 1810 the total tonnage of vessels whose home port was in Massachusetts doubled. This was the heyday of Salem as a port, and the vessels that called Salem home were built either in Salem itself or on the nearby North River or the Merrimac. The lower Merrimac between Haverhill and Newburyport bristled with shipyards; in 1810 alone, some 12,000 tons of shipping were built and launched on the Merrimac.[31]

The new American government in many respects simply adopted for itself the economic thinking that had earlier guided the British government. For example, Massachusetts passed a law in 1783, reserving for itself all pines over two feet in diameter. The legislation required permits to cut such trees; the fine for cutting without a permit was a hefty 30 pounds, and even lesser white pine trees cut without a permit could bring a fine of three pounds. Other regulations were added. Every town in the Commonwealth had to have a surveyor of wood and shingles, whose responsibility it was to inspect and attest to the quality of the product. Any vessel shipping wood products, especially staves, out of Massachusetts had to have a certificate showing that the product had been inspected in the town in which it had been produced. A penalty of 12 shillings per thousand board feet was imposed on anyone attempting to ship wood products that had not been inspected. The same legislation also set quality standards, specifying, for example, the width and length of clapboards and shingles.[32]

On the national scene, too, some leaders believed that the future of the United States could only be guaranteed if the country developed its own industry through active intervention by government in the market. Initially, these leaders had little influence over policy, as long as southerners with their tobacco and cotton to export and their desire for cheap imports dominated the government. But as the nineteenth century wore on, the notion of national self-sufficiency gained ground. This was to be the dominating outlook in the years that followed.

THE NINETEENTH CENTURY: THE FLOWERING OF THE NATIONAL MARKET

The nineteenth century was a time of profound change for the forests and people of Massachusetts. A Rip Van Winkle who went to sleep in 1700 and woke again in 1800 would have been, no doubt, surprised at the density of the population, but not at the way they lived and worked. By contrast, one starting a long sleep in 1800 and awakening in 1900 would have been totally confounded. The difference was largely due to technological change. In 1800 activities were hand- or animal-powered, at best water-powered, whereas in 1900 the steam engine had taken over. Candles and oil lamps were being rapidly replaced, first by gas lights, then by electric lights. Goods that had moved by ships powered

by wind in the sails now were moved by ships powered by steam engines or by railroads using the same source of power. Men who were overwhelmingly farmers in 1800 were overwhelmingly industrial workers in 1900, and most lived in towns and cities, not down on the farm. Where, in 1800, many exchanges were still barter exchanges, by 1900 there were only cash or credit transactions.

These changes profoundly altered the use of Massachusetts forests. Earlier, wood products had been made primarily of local wood, because the cost of transporting the wood any appreciable distance was so high. Now wood from around the world was available. Moreover, Massachusetts residents had increasingly come to be workers in manufacturing, because the supply of productive (and profitable) farmland had long been exhausted. So wood products from Massachusetts came increasingly to be secondary wood products — made from boards already sawn. The high value-added product came to dominate Massachusetts' trade in wood prducts.

The businesses that handled wood products changed, too, in the nineteenth century. Before, wood that was sold either in raw form or partially worked up was nearly always the work of a single individual or of one with a partner and perhaps half a dozen laborers. But gradually wood products, secondary wood products, came to be produced by industrial processes that required substantial investment in machinery and a significant labor force. This shift, in turn, required capital to be invested in the plants and the machinery; in the latter part of the century this capital was usually assembled by corporate organizations.

These changes are visible in the many ways in which wood, still one of nature's cheapest and most available raw materials, was put to use in nineteenth-century Massachusetts. Since the arrival of the Pilgrims, one of the most important uses of Massachusetts wood had been for the construction of houses. This remained true even in the nineteenth century, for the rapidly growing industrial towns needed dwellings for the hordes of industrial workers that flocked there for employment. These houses continued to be built overwhelmingly of wood, but the technique was profoundly altered by the development of the balloon-frame house in Chicago in the 1830s. Henceforth, house framing was no longer of post and beam, hewn from native oak, but of 2-by-4-inch sticks sawn, as often as not, from trees growing in parts of the United States far distant from Massachusetts. Though dwellings remain a high

value-added product, much of the wood in them is no longer from the Massachusetts forest. One exception to that generalization remains true, at least for the nineteenth and the early twentieth centuries: the trim moldings with which the Victorians embellished their houses often began as a Massachusetts pine.[33]

The profound technological shift of the nineteenth century also had a major influence on how these houses were heated. Throughout the nineteenth century and well into the twentieth, farmhouses continued to be heated by fuelwood cut on the farm. In towns and cities, however, by the end of the century the houses were overwhelmingly heated by coal. Cheap railroad transportation made the switch from wood to coal possible, as did the availability of furnaces able to provide central heating in place of the stoves and fireplaces that had formerly done the job.[34]

Though changes in the standard of living are often hard to document, some of these can be detected in the type of household devices used. Early in the century woodenware — bowls, buckets and basins — was extremely common; by the end of the century these items had largely been replaced by sheet metal products. The coal scuttle had to be made of metal; the bathtub came to replace the wooden tub in the kitchen where the weekly bath took place.[35]

But if metal replaced some items of everyday use, others remained made of wood. Even in the eighteenth century, local cabinet-makers had supplied increasingly well-off householders with furniture that served both to show that they had "arrived," as well as to provide greater comfort. The nineteenth century built on this base, but added immense improvement in the system of manufacturing, copying the concept of "interchangeable parts" devised at the Springfield Armory. Furniture parts no longer need be cut out by hand — they could be machined on power lathes and even cut to exactly duplicated dimensions on power saws controlled by jigs.

Two centers for furniture making developed, one in Boston, the other in Gardner, in Worcester County. Gardner, which came to be known as the "Chair City," produced chairs and tables particularly, and not just for the well-off, but for the average family at prices the average family could afford. In time, Gardner had some twelve companies making chairs, with a total annual output of some two million a year. The effects of large numbers of tables, chairs, chests of drawers,

bedsteads, vanities and the like at modest prices can be seen in pictures of Victorian houses stuffed with furniture.[36]

Boston developed another secondary wood specialty, musical instruments. Without television to entertain, families had to create their own entertainment, and they did so with the piano and the parlor organ. Grand pianos were still made in the Boston area in the twentieth century, utilizing sugar maple veneer glued into the traditional shape of the grand piano body. The sounding board probably came from somewhere else — spruce is the preferred species for sounding boards, especially spruce with tight annual rings — but at least some of the maple veneer probably came from Massachusetts forests.

Down on the farm, too, manufactured wood was still the norm. Hay had become the principal crop of Massachusetts farms since the West had taken over the cultivation of grain. First the Erie Canal, then the railroad could bring in grain at prices with which Massachusetts farmers could not compete, but hay to feed local horses was still overwhelmingly grown locally. By the middle of the century hay began to be harvested and processed with implements made largely or wholly of wood. Horse-drawn rakes, for example, were generally of local design and manufacture. The first reaper, that invented by Obed Hussey of Nantucket in 1833, used numerous wooden parts. Most agricultural

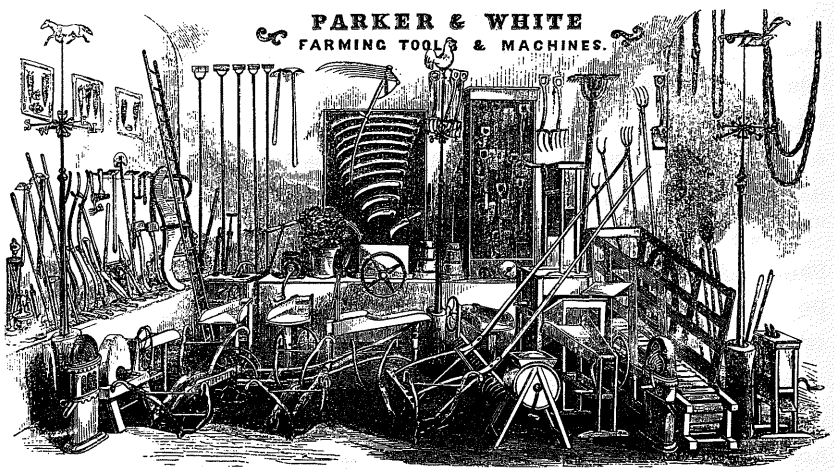


Figure 2. Hand tools made from wood, displayed at a fair held in Boston in 1853. FROM Gleason's Pictorial Drawing Room Companion, *volume 5 (1853). Courtesy of Widener Library, Harvard University.*

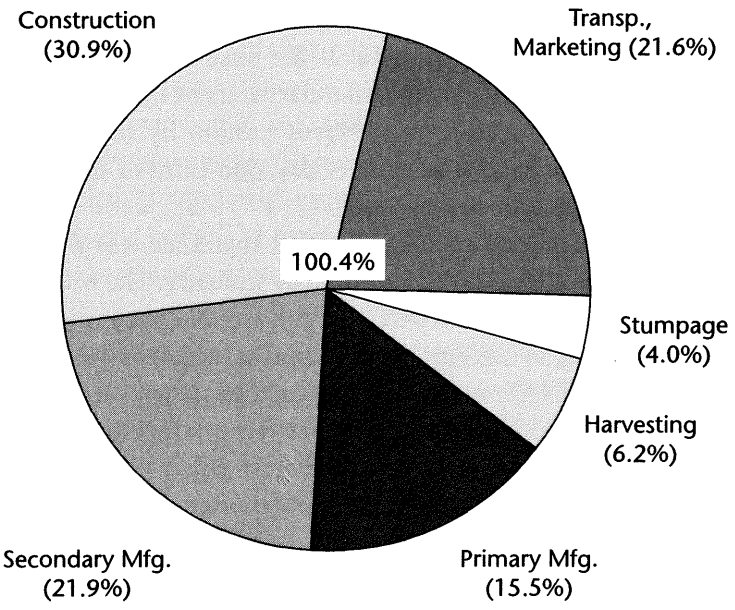
equipment of the nineteenth century combined both wood and steel. Scythes, still widely used for mowing, had a steel blade but a wooden handle. Shovels and hoes had metal at the business end, but wooden handles. One of the most notable manufacturers of hand tools used in agriculture was the Ames firm of North Easton. By 1857, Ames was making 2,400 shovels and spades every day, one-third of all the shovels and spades made in the United States.[37]

Though the shift from wood to other materials was slow, it did impact the way in which wood was used by industry. The mill dams of the turn of the century had all been made of wood. But by mid-century, they were tending to become either hybrids, using both wood and masonry, or wholly of masonry construction. The dam across the Connecticut River built at Holyoke in 1848, for example, was first made of wood, but no sooner was it tested than it failed — it went, as the famous telegram to its Boston financiers reported, "to hell by way of Willimansett." But it was immediately rebuilt, and this time it was anchored to bed rock with metal bolts; the dam itself was a mixture of timber and rubble. It was replaced in 1900 with a masonry dam. However, at Lawrence the initial dam built in the 1840's was of masonry, and from mid-century onward, dams created to hold back water, at least on major rivers, were almost invariably masonry. Water wheels gave way to turbines, made after mid-century of metal. Later in the century water power itself itself, with its uncertainties, was replaced by steam power.[38]

Although wooden-hulled ships were now powered by steam as well as by sail, the shift to steam power heralded another, more fundamental change that decimated the Massachusetts shipbuilding industry: the shift to metal hulls. The growth of the American iron and steel industry in distant Pittsburgh made this change possible. By the end of the century the era of sailing ships, except for recreation, was definitely over.[39]

Notwithstanding, Massachusetts continued to have a small iron industry of its own, smelting with charcoal. Not until the twentieth century did the iron and steel industry learn how to control the chemical composition of its product. Until then, charcoal-smelted iron had advantages, particularly when used to produce wrought iron, then worked into horseshoes. As long as local transportation was powered by the horse, which remained true until after World War I, there was a

Distribution of Wood Products Dollar, 1995



market for charcoal-smelted iron. But the replacement of the horse-drawn carriage by the internal combustion engine killed the small Massachusetts iron industry.

Despite these changes new uses for wood helped to sustain the wood market. From early in the nineteenth century Massachusetts had had a large shoe industry, supplying much of the nation. Initially the industry had used local hides, but later it began importing them from the West Coast and from South America. In the early years, these hides required tanning after arrival, for which first the bark of oaks and later of hemlocks proved of great value. Only the development of synthetic chemicals late in the nineteenth century freed the tanners from dependence on the bark of trees.[40]

The transportation revolution made possible by the development of the railroads provided a vast new use for the products of Massachusetts forests. One of the earliest railroads in the United States was the Beacon Hill Railroad, built early in the nineteenth century to haul earth dug off Beacon Hill to the harbor to fill in the marshy areas along the shore. The impetus for this enterprise was the drastic shortage of house lots in Boston at the turn of the century. The loaded cars going downhill were attached by pulleys to the empty cars, and pulled the

latter uphill. For everything except power source, however, this road served as a prototype, clearly revealing the advantages of rail for the movement of heavy, low-value materials.[41]

The first true railroad in the Commonwealth was the Boston and Worcester, which opened for traffic in 1835. Linking Worcester with Boston and subsequently directly with the harbor opened up vast new commercial opportunities for central Massachusetts. Seven years later, the construction of the Western Railroad forged rail ties between Boston and Albany, where for the first time western agricultural products barged in on the Eric Canal could be loaded onto cars heading for Boston. When rail lines were completed across the nation, such agricultural products were moved entirely by rail. This connection spelled the death of tillage farming in Massachusetts, except in a few specially favored localities such as the alluvial plains of the Connecticut River valley.

The Boston and Worcester and the Western Railroad became the Boston and Albany in 1867. The road was financed by canny Boston investors, was well run, and throughout the nineteenth century was prosperous and profitable. The construction of a series of very local lines in central and western Massachusetts opened up those parts of the Commonwealth to the national economy, enabling producers of goods in that region to sell their products nationwide.[42]

Each mile of new railroad required 2,640 railroad ties. The most desired material for the ties was white oak, the same white oak that had earlier supplied ships' timbers and barrel staves. Even after the railroad was built, ties continued to be needed: the normal life span of a white oak tie was seven to eight years. Generally, some 350 ties per mile were renewed each year. In 1882, the cost of white oak ties in Massachusetts was 50 cents each, but by the end of the century the price had begun to rise, even though the development of creosoting had, by that time, lengthened the life of ties. The first creosoting facility in Massachusetts was built by the Old Colony Railroad in 1865 in Somerset. Creosoting proved to prolong the life not just of ties, but of bridge timbers as well, an important consideration, since all early railroad trestles were built of wood.[43]

Wood provided a major part of the materials used in the construction of early railroads, not just for the ties. Initially, the rails were also made of wood, with iron straps laid on the top surface to retard wear.

Only the rapid development of the iron industry in Pittsburgh and vicinity made possible the substitution of iron rails for wooden ones, soon themselves to be replaced by steel rails with the introduction of the Bessemer converter in the last quarter of the century. Besides the rails, the cars of the early railroads were largely made of wood well into the twentieth century. Last but by no means least, all the early railroad engines generated their steam power with wood fires. All the early railroads had piles of firewood at strategic points along the route, as did the early steamships. Wood-fired engines used a vast amount of firewood until they were replaced by coal burners late in the century.

Perhaps the most important technological innovation of the nineteenth century, especially when viewed from the perspective of the late twentieth century, was the adaptation of wood to the making of paper pulp. From the early years of the nineteenth century there had been a paper industry in Berkshire County, using first rags collected from individuals, later scraps from the rapidly growing textile industry. The first paper mill in the county was established in 1801. Wood was important in the manufacture of rag-based paper because the tubs and the beaters used to reduce the rags to fiber were made of wood. Their heavy use required frequent replacement. The leader in Berkshire papermaking was Zenas Crane, who moved from eastern Massachusetts to Berkshire County in the early years of the nineteenth century. He had learned the trade in his brother's paper mill in Newton Lower Falls.[44]

Crane saw the advantages of Berkshire County for paper-making: access to a new supply of rags, the presence of several turning mills that could produce wood elements for the early machinery, and an ample supply of firewood to heat the buildings and the vats that cooked up some of the ingredients, notably size. Made from animal wastes; size gave the paper its smoothness and stiffness. The beating machines, known as Hollanders, were largely made of wood and had to be frequently replaced.[45]

People began thinking about substituting wood for rags as the basic raw material for paper early in the nineteenth century. That thinking intensified as a world-wide shortage of rags developed by the middle of the century. The key invention that made possible the use of wood pulp was the Keller-Voelter machine devised in 1847 in Germany. This ma-

chine duplicated the work of the Hollander but with wood, reducing it to fiber. In the 1860s a group of Americans led by Frederick Steinway, the piano manufacturer, organized a company to import Keller-Voelter machines, and shortly thereafter began manufacturing the machines themselves. Their firm was located in Curtisville, in the Berkshires, and in 1867 they sold one of their machines to the Smith Paper Company of Lee. That year Smith Paper produced the first wood-based paper pulp in America.[46]

The new technology spread rapidly in the 1870s. The wood, from spruce or fir trees, was drawn from the forests of the Berkshires, and by 1885 the Smith Paper Company alone was using 30–40 cords a week. A number of textile mills in the Berkshires were converted to paper mills, and some new mills were built to take advantage of this new technology. By 1890, however, the Berkshire County forests were denuded of usable wood for pulp, and one of the Smith mills was shut down in 1891 for lack of raw material. Meanwhile, mills had sprung up in Holyoke, using pulpwood floated down the Connecticut River, not just from Massachusetts but from Vermont and New Hampshire as well. Paper production became such a central activity in Holyoke in the last two decades of the nineteenth century that the city earned the title, "the paper city."[47]

Meanwhile, as American industry turned out more and more products that had to be shipped to reach their ultimate market, the packaging industry, once based almost exclusively on barrels of various sizes made from staves and hoops, now shifted to wooden boxes. The barrel was fine for bulk products and even served satisfactorily for the thousands of apples shipped from Massachusetts to the West Indies in the nineteenth century. By late in the century, however, shippers needed smaller containers that were better adapted for shipping fragile manufactured products, as well as batches of items already packaged in small containers such as metal cans that were then sold directly to the consumer. Meanwhile, too, the abandoned Massachusetts farms had produced a fine crop of pasture pines, that could be used to make boxboard that could, in turn, be assembled into small crates. This industry lasted through the rest of the nineteenth century and well into the twentieth, with firms in the business persisting until after World War II.

THE TWENTIETH CENTURY: JOINING THE GLOBAL MARKET

The trends initiated in the latter half of the nineteenth century continued in the twentieth, largely driven by technology. Wood products became ever more concentrated in secondary manufacture, their higher value reflecting both the capital investment in the processing machinery and the high cost of skilled labor. Both these factors had played an important role in Massachusetts' economic development from an early period, and continued to do so.

Ships offer an outstanding example of these trends. The wooden vessels that had played such a part in the success of Massachusetts, first as a trading colony, then as a major participant in world-wide trade, were replaced in bulk shipping by iron, then steel vessels. But Massachusetts continued to build ships of wood. Some of these were for the fishing fleet whose market expanded with the growth of population, but others were luxury vessels for recreational use.[48]

Massachusetts forests not only contributed the material for the construction of small boats for recreation, but they themselves offered recreation directly. Massachusetts state forests saw a steadily rising number of visitors until about the eighth decade. Although the amount of income generated by "gate receipts" for daily visits, seasonal passes, and the use of campsites remained relatively small compared to the very large value of all the products turned out by Massachusetts manufacturers, the state forests provided recreational opportunities for those who could not afford to own their own private recreational land. Growing numbers of residents of the state (and of other states) chose to "own their own," as the increasing fragmentation of ownerships in Massachusetts reveals. People who first acquired a taste for forest recreation from public forests wanted their own private forest, and went out and bought one. Though no figures are available on the dollar value of the recreation pursued on privately owned woodland, it surely constitutes a very important use of the Massachusetts forest.[49]

Secondary processing of wood continued to be the place where money was to be made. By the last decade of the twentieth century over half the returns from wood processing were concentrated in the manufacture of mirrors and picture frames (6.1 percent in 1992), wooden boxes and crates (36.6 percent), millwork — windows, doors and inte-

Figure 3. Pine plantation thinnings being received at the yard of a local sawmill (location unknown), typical of the scale of the Massachusetts wood-processing industry during the first quarter of the twentieth century. Lantern slide collection, Massachusetts Department of Environmental Management.

rior trim (16.7 percent) and wooden kitchen cabinets (15.6 percent). Although there are anecdotal reports of large quantities of Massachusetts logs being exported, in value they account for only .4 percent of all Massachusetts wood products. Rough sawn hardwood lumber comes in at 2.1 percent, rough sawn softwood lumber at .3 percent, measured by value, the only way in which these very different products can be compared.[50]

Technology had a profound effect on the market for railroad ties, important in the previous century. The advantages of using creosote preservatives — the greater longevity of ties in place and the reduced need for replacements — had been fully demonstrated by the beginning of the twentieth century. But the railroads themselves suffered a

deep decline with the vast expansion of the national highway system after World War II, when a lot of freight and an overwhelming proportion of passengers switched to trucks and cars. Now, railroad ties are only a niche market, and the nationwide system of rail lines can find the ties where they are least costly. The Massachusetts white oak ties that commanded premium prices in the late nineteenth century are effectively priced out of the market.[51]

Late in the century a new market opened in Massachusetts for forest products: the use of wood chips as a fuel to generate electricity. Political events played a role when the OPEC oil crises of the 1970s with their tremendous price spikes led to a search for alternatives to oil-fired generators. The simultaneous price inflation of oil and the various disasters that overtook the nuclear power industry led industry leaders to look around for a low-cost way of firing up steam generators. While burning wood chips for fuel has its own technological drawbacks, it has become a use for the low quality wood that abounds in all New England forests. Massachusetts currently has one wood chip power generator located in Westminster.[52]

The paper industry, in the late nineteenth century a major user of wood from the Massachusetts forests, has undergone a total transformation. Present-day paper manufacture enjoys genuine economies of scale. By the late twentieth century, only paper mills that could produce on a vast scale could be profitable in what had become a global industry. As the cost of a new basic paper plant approaches $1 billion, new plants are generally sited near a large resource base. That is why Maine is still a major producer of bulk paper, while in Massachusetts the "paper city," Holyoke, has become essentially a paper-converter city. Its plants buy bulk paper produced elsewhere and turn it into products for the ultimate consumer. The only true paper plant still in Holyoke produces only rag-based paper.[53]

Perhaps the most important new use of the products of the Massachusetts forest is one that its residents once took for granted: water, water that is pure because it is filtered through forested watersheds. Massachusetts is one of the most densely populated states in the United States, and civilized society requires a substantial quantity of water to maintain health standards, and that water needs to be pure. The more technologically advanced industries also consume water for their manufacturing processes: about 35 percent of the water produced by the

Metropolitan District Commission (which supplies water to a large part of eastern Massachusetts) is process water — water used in manufacturing processes. Once water became a public utility and no longer came from backyard wells, it was first priced by the municipal authorities who delivered it to each household at the cost of distribution. Cost of distribution is still an important factor in the pricing of water, but now scarcity is also part of the equation. The wholesale price of MDC water went from $120 per million gallons (the price established by the legislature) in 1962 to $200 per million gallons in 1974 and $240 in 1975. Since then its price has risen dramatically, to $875.95 per million gallons in 1995, reflecting the limits on supply. It is projected to rise even more rapidly in the years ahead, to between $2212 and $2506 per million gallons by the year 2002. Considering that MDC water supplies all or most of the water needs of about 40 percent of the population of the state, the water produced by Massachusetts forests is worth about $200 million annually. Even though this is less than one percent of the gross state product, it is a product no one in the state can do without.[54]

CONCLUSION

Urban Americans of the late twentieth and early twenty-first centuries take the forest products that surround them for granted. They shouldn't. Wood saved the early settlers from freezing in the harsh New England winter, because it supplied the material to make the wooden houses that are still the hallmark of New England. Wood heated those houses. Wood supplied the packaging material that enabled the products of the new world-wide economy to be traded globally. Without barrels of New England white and red oak it would have been difficult, if not impossible, to send Caribbean sugar and molasses to European consumers. Equally indispensable to this trade were the wooden ships that slid down the ways of Massachusetts shipyards in increasing numbers from the first days of settlement.

Wood contributed fundamentally to the manufacture of other products as well. Wood ashes boiled down by new settlers clearing a forest for farming supplied the potash needed to manufacture glass, soap and gunpowder. Wood converted to charcoal made possible the processing of the bog iron ore of Massachusetts into bar iron that in turn was converted into usable iron products: plows and guns and horseshoes.

After America gained national independence and began to build a national economy, wood, nature's most abundant raw material, provided the parts for the machines that made industrial production possible. The dams and the millponds that made water power a usable resource, the textile and paper-making machines that supplied an ever-enlarging consumer market as the population of the United States grew, all contributed essential items to the economic advance of the country.

As the engine of technology moved ahead, uses of the Massachusetts forest changed. The wood that heated houses, factories and stores was replaced by coal, made available by railroads that depended heavily on wood for their initial construction and that still rely on the wooden tie. While the railroads brought wood from other places to Massachusetts for the construction of houses, the millwork of modern houses comes in part from the trees of Massachusetts. Massachusetts wood was used, not directly as lumber (though the state still produces some $50 million worth of lumber annually) but rather as the raw material to be turned into furniture, musical instruments, and kitchen cabinets. Though the cardboard carton has replaced many boxes as the shipping container of choice, wooden boxes are still preferred for some products, and Massachusetts still produces a lot of boxes — over $200 million worth in 1992.

Civilization has come to depend on two products of Massachusetts forests that figure largely in the life styles of Massachusetts residents at the end of the twentieth century: recreation and water. As the machine has released men and women from the drudgery necessary to survival in earlier centuries, the residents of Massachusetts have come to need the outdoor experience to refresh their lives. Forests are the setting for a significant part of the recreational activities of the state's residents — and of residents of other states who come to Massachusetts because of the quality of her forests. Both residents and tourists rely on the water that flows out of that forest in pure form to maintain a standard of cleanliness that was once unheard of but is now the basis of civilized living. Without the human-forest interaction of more than three centuries, Massachusetts would still be that "hideous and desolate wilderness" William Bradford first observed as the Pilgrims landed on Cape Cod in November of 1620. The Massachusetts forest has played an indispensable part in the long passage from then to now.

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41. Frederock L. Gamst, "The Context and Significance of America's First Railroad, on Boston's Beacon Hill," *Technology and Culture* 33 (January, 1992), 66–100.
42. George P. Baker, *The Formation of the New England Railroad System.* (New York: Greenwood Press, 1968), 3, 7–9, 23; Sherry H. Olson, *The Depletion Myth: A History of Railroad Use of Timber* (Cambridge, Mass.: Harvard University Press, 1971), 12–15, 17.
43. Ibid., 63.
44. Judith A. McGaw, *Most Wonderful Machine: Mechanization and Social Change in Berkshire Paper Making,* 1801–1885 (Princeton: Princeton University Press, 1987), 15, 20.
45. Ibid., 41, 178, 206.
46. Ibid., 201–03.
47. Ibid., 162, 204–05.
48. Morison, *Maritime History,* 318.
49. Muriel More, *Massachusetts Forest Resources: A Working Guide to Action* (Amherst Mass.: Department of Environmental Management, 1985), 40–41.

50. United States Department of Commerce, 1992 Census of Manufactures: Forest Products (Washington, DC: Government Printing Office, 1995), passim.
51. Olson, *Depletion Myth,* 63.
52. Senator Robert D. Wetmore, personal communication.
53. Nancy M. Gordon, "Parsons Paper: High Quality Is Their Specialty," Holyoke *Transcript-Telegram,* March 18, 1975, 24; Nancy M. Gordon, "Parsons: First in Paper City," Holyoke *Transcript-Telegram,* January 20, 1979, 40. This may change as recycled paper gains wider use. There is still a business, in Massachusetts, of gathering up used newspapers and selling them to facilities that reconvert them to pulp that, in turn, can be re-processed into paper. As more de-inking plants come into being, more of this may occur in Massachusetts, which does have a large resource base in used paper.
54. Metropolitan District Commission, "A History of the Development of the Metropolitan District Commission Water Supply System," pamphlet ([Boston]: Wallace, Floyd Associates, 1984); Massachusetts Water Resources Authority, "MWRA Wholesale Water Charges." pamphlet ([Boston]: MWRA Rates and Budget Department, 1996).