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A Forest Journey, Section Summaries

A FOREST JOURNEY

The Role of Trees in the Fate of Civilization

John Perlin

Introduction

Throughout history, wood has supported the development of human societies, sparked large population movements, and catalyzed major technological changes. The new edition of *A Forest Journey* uses wood as a lens to explore the movement of civilization while underscoring the need to break the cycle of deforestation and ecological degradation that could cause the end of nature and humanity.

Cover photo: A western red cedar stump with lance tooth crosscut saw, Cortes Island, British Columbia, Canada. (David Ellingsen)

Above: A lumberyard full of Douglas fir outside of Clarkston, Washington. (Garrett Grove)

ONE How Trees Have Changed the World

Archaeopteris: The Earliest Modern Tree 385 Million Years Ago

The earliest modern tree, Archaeopteris, emerged 385 million years ago. In addition to playing a pivotal role in carbon dioxide sequestration, the growth of Archaeopteris and its successors helped establish microclimates that enabled the spread of other plants, invertebrates, and vertebrates on land.

The End-Permian Extinction 251 Million Years Ago

During the end-Permian Extinction, more than 90 percent of animals in the sea and 70 percent of terrestrial species went extinct. As a result of crippling heat and smoke-filled skies (possibly caused by mass volcanic eruptions), gymnosperms—the Permian ancestors of Archaeopteris—were unable to properly photosynthesize. The subsequent death of most of the planet's trees caused a chain reaction leading to the end of most life on Earth.

Forests and Civilizations; Wood as Society's Principal Fuel and Building Material; Wood Appreciated

Trees have been the main fuel and building material of nearly every society throughout human history. In fact, without wood, the great civilizations of Sumer, Assyria, Egypt, and others would never have existed. Historical documents and languages reveal that members of past civilizations recognized the importance of wood in their lives.

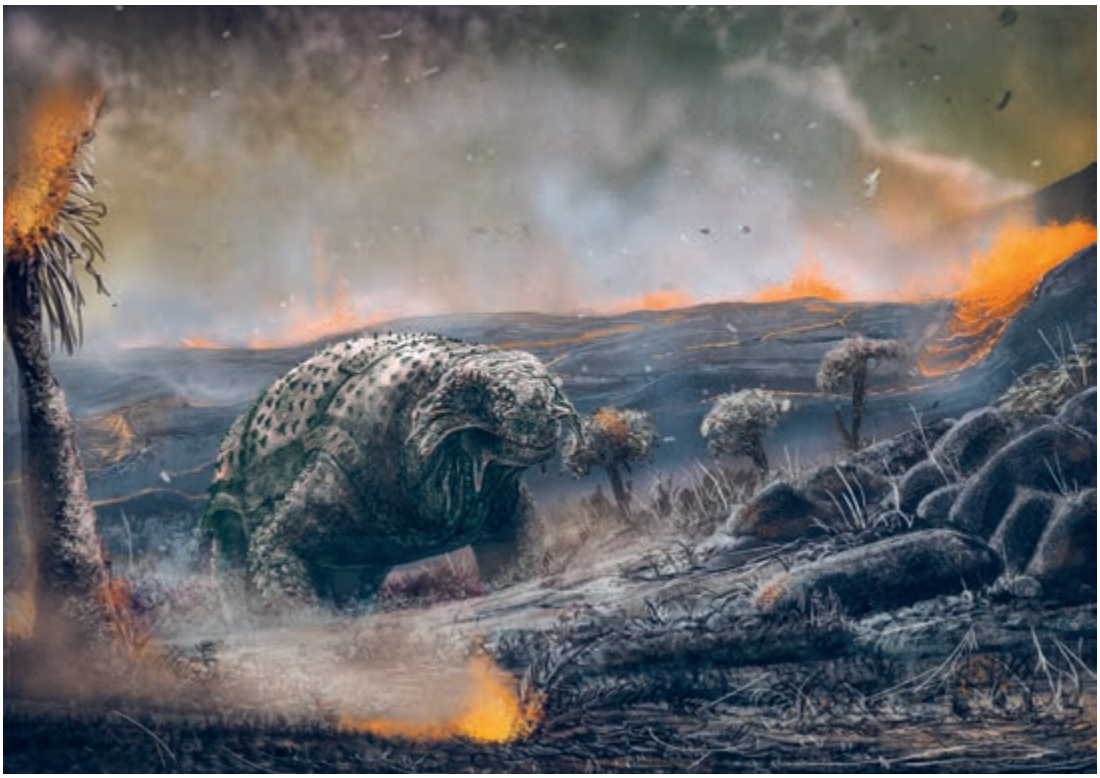


Illustration of the end-Permian extinction event 250 million years ago. Nearly 90 percent of the Earth's marine species and 70 percent of terrestrial species were killed. (Mark P. Witton / Science Source)

THE OLD WORLD

TWO Mesopotamia, China, and India

In the Beginning; Burning of India's Great Khandava Forest

Chinese, Indian, Mesopotamian, and other great civilizations celebrated "taming" nature by eradicating forests and subduing wildness. Emperor Yao, the founder of the Chinese Empire, ordered the destruction of forests, a process that continued as China expanded. While a discovery in 1079 of the power of coal to forge weapons shifted the focus away from wood as a fuel source, much damage to China's forests had already occurred. In India, the *Mahabharata* describes how Agni, assisted by Krishna and Arjuna, burned the massive Khandava forest, killing all of its trees and animals to prepare the land for farming. The Gonds, an aboriginal tribe, also celebrated the destruction of the jungle via divine intervention.

The Cedars of God located in Bsharri are one of the last vestiges of the extensive cedar forests of Lebanon that once thrived across Mount Lebanon. (Marco Ramerini / Alamy)

The Forest Journey of Enkidu and Gilgamesh 1800–1300 BCE; The Legacy of Gilgamesh

The Epic of Gilgamesh, widely considered to be the earliest surviving piece of great literature, originated in the Fertile Crescent. Tablet V, known by many as "The Forest Journey," serves as a blueprint for humanity's never-ending war with the forests as the tablet details Gilgamesh's decimation of the Holy Cedar Forest. Many successors in the Middle East, such as Gudea (ruler of Lagash), followed Gilgamesh's example by eradicating forests throughout this region along with the animals that called them home.

Lagash before Gudea 237 BCE; Third Dynasty of Ur 2200–2000 BCE; The Exploitation of Local Forests; The Importation of Wood; The Increased Value of Wood

Before Gudea, other rulers of Lagash also required large amounts of wood to support their monarchies; Uru-Ka-Gina, for example, acquired wood for his canal builders who used tools with wooden handles. The Third Dynasty of Ur saw Sumeria at its pinnacle, and the abundance of bronze tools created a great need for wood to fuel foundry furnaces; to meet this need, wood was exploited from local forests and several varieties were imported. Due to its immense importance, wood's value became comparable to that of precious metals and stones.

Problems Due to Excessive Silt 2112–2094 BCE; Problems Due to Salinity 1700 BCE; The Decline of Sumerian Civilization 2100 BCE

The mass felling of trees on the banks of the Euphrates, Tigris, and Karun Rivers caused salt, silt, and timber to fill the waters heading south. Deforestation also enabled the erosion of salt-rich sedimentary rocks, which led to the salinization of farmland; in turn, this contributed to the disintegration of agriculture and the decline of the Sumerian civilization.

THREE Bronze Age Crete and Knossos

Wood Shortages in Mesopotamia 2100 BCE

The material culture of the Near East was tied to its workshops, and production levels were dependent on the availability of wood. In Mari and Babylon, wood was an important resource that became scarce, resulting in restrictions on its use and action from government officials.

Near Eastern Interest in Crete 2000 BCE; The Rise of Crete as a Major Civilization 2100 BCE

During Hammurabi's reign, wood stopped coming to Mesopotamia from the East. A high demand for wood remained, though, and rulers looked to other locations to meet it. One of these locations was Crete, an area with extensive woodlands. By trading its timber, Crete became one of the most powerful states in the Mediterranean region.

Knossos: Urban Center of Bronze Age Crete

The development of Crete (Minoa) was felt intensely in urban areas such as Knossos. Wood that was not exported was used in Knossos for constructing palaces and building seafaring vessels, which led to the formation of new industries. Wood, used as fuel, also enabled bronze production to reach its peak during the "Golden Age" of Knossos.

The Decline of Minoan Civilization 1450 BCE; Technological Changes as Evidence of Deforestation 1400–1150 BCE

Many scholars have suggested that the decline of the Minoan civilization was caused by a volcanic eruption on Thera. However, an alternative explanation is that the civilization's decline was caused by wood scarcity due to deforestation. Several technological changes observed during this time support this hypothesis.

Minoan Overseas Trade and the Need for Wood; Knossos Under Mycenaean Rule 1400–1050 BCE; Further Economic Effects of Deforestation 1300 BCE

During the Late Bronze Age, an increased demand for wood and a reduced domestic supply led Minoans to seek it in parts of the Mediterranean mainland. An abundance of wood in Mycenaean Greece and Egypt, coupled with a dwindling supply in Knossos, changed who dominated on the seas and in commerce. The situation also resulted in Mycenaean rulers eventually having dominion over Crete. Ultimately, the loss of timber and associated land deterioration led to the erosion of Minoan power during this period.

FOUR Mycenaean Greece

The Forests 1550 BCE; Conditions for Development; Population and Agricultural Expansion 1300–1200 BCE

When Mycenaean Greece emerged as an important civilization during the Late Bronze Age, forests covered much of its land. Timber was an incredibly valuable commodity for the Mycenaeans, and was used for building palaces and vehicles such as wagons along with serving as an important fuel source for potters and bronzeworkers. As the Mycenaean world became more populated, large tracts of trees were cleared.

Loss of Forests; Accelerated Erosion, Increased Flooding, and Their Consequences 1300–1200 BCE; Wood Scarcities and Their Consequences; Mycenaean Interests at Troy

Initially, the harvesting of forests helped the Mycenaeans meet growing construction, agricultural, and fuel needs; however, deforestation exposed the soil to the elements, which subsequently increased erosion and caused flooding. Natural disasters increased in the Peloponnese during the Late Bronze Age, stripping the soil of important organic matter and harming agricultural production. Deforestation reduced the amount of fuel available for pottery and metallurgical production, and as pottery works closed down in towns such as Berbati and Zygouries, many inhabitants were forced to leave. Because of the shortage of both wood and grain, Mycenae entered into a trading partnership with Troy.

Decline of Mycenaean Civilization 1200 BCE; Resource Deficiencies and Internecine Warfare; Adapting to an Era of Limits; An Ancient Ecology Parable 600 BCE

Mycenae's population in parallel with its forests. The population of Greece dropped by 75 percent by the twelfth and eleventh centuries BCE. Resource deficiencies produced civil unrest and violence, which eventually resulted in a reversion of society to a more primitive, subsistence economy. In Greek legend, the violence and depopulation that occurred during Mycenae's final days are linked to Mycenae's destructive relationship with nature; legend has it that Zeus brought on the Trojan War to rid the Earth of humans and allow the planet to restore itself.

FIVE Cyprus

The Condition of the Mediterranean Rim 1300–1200 BCE; Increase in Cypriot Copper Production; The Copper Industry's Growth and the Wood Supply; Changes in the Flora, Fauna, and Land; Wood Shortages and Technological Change

Cyprus became an important supplier of copper for other Mediterranean states. The heightened production of copper placed a significant burden on Cyprus's wood supply since charcoal was the primary fuel source. Deforestation,

coupled with the production of carbon dioxide in the atmosphere, negatively impacted the ecosystem and society. Wood shortages also drove technological innovation, changes in the types of fuels used, and recycling.

The Copper Industry Peaks 1200 BCE; Decline of Cypriot Copper Production and the International Situation

The Cypriot copper industry peaked and then declined, causing the decline of economic and material culture. Without an adequate supply of copper from Cyprus, bronze production declined in other Mediterranean states, contributing to their demise.

Birth of the Iron Age 1150 BCE

The fuel crisis, caused by a shortage of wood, catalyzed metallurgists to begin working with iron. Since iron ore contained 40 percent iron, metallurgists found that they could obtain more usable iron than copper with the same amount of fuel. This practice established the foundation for the Iron Age (along with continued deforestation) in the Mediterranean and throughout Europe.

SIX Archaic, Classical, and Hellenistic Greece

Asia Minor during the Homeric Age pre-700 BCE

Sometime before 700 BCE, the Homeric poets composed their epics. Both the *Odyssey* and the *Iliad* reflect a focus on the frontier.

Greek Asia Minor after the Homeric Age 700 BCE–200 CE

Due to the growth of both the population and economy, the coastal forests could no longer support the Anatolian Greeks. Moving inland, the Greek settlers transformed river basins into wheatlands. The removal of trees exposed the soil to the elements, accelerating erosion and depositing large amounts of sediment into the rivers. In turn, swampland formed downstream, which negatively impacted trade.

The Greek Mainland during Hesiod's Day 750 BCE

The migration of the Greeks to places such as Asia Minor allowed the Greek mainland to restore itself. Abundant forests existed during this time, which enabled pioneers to flourish on the Greek mainland. Their existence was described by Hesiod in his text, *Works and Days*.

The Athenian Victory over Persia at Salamis 480 BCE

Athens' countryside was reportedly well-wooded. This abundance of timber was likely responsible for saving Greece (and all of Europe) from Persian domination—shipwrights likely used wood from the Athenian forests to build the fleet that defeated Xerxes' navy at Salamis.

The Golden Age of Athens 480–404 BCE; Prelude to the Peloponnesian War

Resulting from its defeat of the Persians with its massive fleet, or "wooden wall," Athens became the leader of the Greek world. Wood was used to maintain the fleet and construct opulent buildings such as the Parthenon; the rapid material growth of Athens drove population growth and caused the deforestation of Attica. Athenians looked to solar energy and forms of conquest to increase wood stores. Also during this time, tensions between Sparta and Athens increased, eventually resulting in the Peloponnesian War.

The First Phase of the Peloponnesian War 431–421 BCE; The War Drags On 422 BCE; The Peace of Nicias 421 BCE

As the war began, wood from Amphipolis enabled Athens to maintain a powerful fleet. Sparta, however, invaded Attica and cut down all of its trees. Large amounts of wood were also used by both sides during sieges. The war dragged on until diplomats signed the Peace of Nicias, which established a fifty-year truce and allowed refugees to return to Attica, where they faced a wood shortage due to Sparta's destruction of the forests. To compensate for the shortage, people built homes designed to maximize solar heat retention.

The Sicilian Expedition and the Continuation of the Peloponnesian War 415–404 BCE

Not long after the Peace of Nicias, Athens sent a fleet to Sicily in an attempt to claim it as a colony and gain control of Italy's and Sicily's immense forestlands; however, Sicily defeated the Athenian navy. Athens looked to Perdiccas, king of Macedonia, to supply wood for shipbuilding, and this supply enabled a newly constructed Athenian fleet to destroy the Spartan fleet off the coast of Asia Minor. Six years later, a newly rebuilt Spartan fleet destroyed most of the Athenian navy.

Ecological Condition of Athens after Its Defeat 404 BCE; A New Ecological Consciousness 428–347 BCE

Years of growth and war caused significant deforestation in the environment surrounding Athens. In response, as evidenced by the writings of Archilochus, Plato, and Aristotle, a new appreciation for the importance of forests emerged during this time.

New Techniques for Survival: Farming, Solar Design, and Smelting 400–301 BCE; Secular and Sacred Regulation of Wood Use

Due to deforestation and its ecological effects, a variety of new methods for survival were developed in fourth-century BCE Greece. Additionally, many city-states adopted laws to protect forests (including sacred groves) and to regulate wood use.

Wood Resources and the Rise of Macedonia 400–300 BCE

Despite attempts to decrease wood consumption, the Greeks still needed huge quantities of wood. In the fourth century, Athens used Macedonia as its "timber yard," and other Greek powers also sought to acquire control of Macedonia's forestlands. However, Macedonia began to use its trees for its own development, and it became a premier power until the Romans conquered Macedonia in 167 BCE.

SEVEN Rome

The Early Primeval Forest 753–200 BCE; The Romans as Forest People; The Forest as Rome's Mother

Covered by forests, Rome (and the surrounding lands) was coveted by the Athenians due to the proximity of fir and silver fir trees, ideal wood types for shipbuilding. It was said that Romans came from the forests, and the woods nurtured Rome's growth like a mother nurtures and protects her children.

The Loss of Local Forests, Republican Era 509–27 BCE; A Leading Citizen's Concern; Conquest of Forests

As Rome grew, forests disappeared, and ranching and intensive agriculture also exacerbated the loss of wood. Cicero spoke out against the decline of Rome's woodlands and framed the loss of an important forest as the loss of valuable material for waging war. But instead of conserving, Rome increased its wood supply through conquest.

The Roman Conquest of the European and North African Wilderness 146 BCE–50 CE; "Noble Savages"; The Forest as a Barrier to Conquest

As the Romans moved into Western Europe and North Africa, they encountered expansive forests that left many of the men, including Caesar, with a sense of mystery and awe. Romans characterized the inhabitants of these forests as "noble savages." These inhabitants used the wooded cover to ambush the Romans as they attempted to conquer the lands; to counter this tactic, Caesar ordered the forests be cut down, but his adversaries simply moved deeper into the woods.

"Pax Romana" and Roman Prosperity 27–180 CE; The Baths

Rome's conquest of Europe generated immense wealth and encouraged emperors such as Caligula to develop an insatiable appetite for all things material and pleasurable; fellow Romans, particularly those with wealth, also adopted opulent lifestyles. The baths were a central part of Roman life, and the desired high temperature of the water drove wood consumption.

A Revolution in the Glass Industry ca 100 CE; Extravagance in Architecture; Heating Buildings; Public Buildings; The Price of Luxurious Living; Meeting Basic Needs: Water, Fuel, Bronze, Iron, Olive Oil, and Bricks

Glass became a common material in the first century CE, and the glass industry required significant supplies of wood to fuel its furnaces. Wood was also needed to support the construction of extravagant homes, heat buildings, and produce the lime-based concrete used in the construction of many public buildings. Forests were ravaged to meet basic needs and also support the creation of bricks, which were highly desired as a building material.

A bas-relief from the palace of Sargon II, who ruled Assyria at the end of the eighth century BCE, depicts a lively timber trade between a place in the Mediterranean, possibly an island such as Crete, and the Near East. (CM Dixon / Print Collector / Getty Images)

Decline in the Italian Woodlands 25 BCE–75 CE; Romans Learn to Conserve; Solar Energy in Ancient Rome; Silviculture; Erosion; Changing Attitudes toward Trees among Philosophers and Thieves

Forests dramatically decreased between the Republican period and the first century of the Roman Empire. With wood shortages affecting many parts of Italy, attempts at wood conservation included the use of recycled glass, employing new framing techniques in construction, using wheat stalks for fuel, and adopting a greater focus on solar energy. As wood became scarce, both philosophers and thieves began to value it more.

Wood Shortages and Industrial Flight ca 100 CE; Transforming the World in Its Own Image 200–300 CE; Wood and the Decline of the Roman Empire 40–300 CE

Fuel supply shortages forced industries such as glass manufacturing and ceramic production to leave central Italy, eventually leading Rome to surrender its role as the capital. Roman conquest of the barbarian world caused extensive forest loss and created many of the same problems Roman Italy had faced. Rome's growth was financed with silver from Spanish ore, and the production of this currency required significant quantities of wood. Silver production declined as fuel disappeared, contributing (along with famine) to the decline of the Roman Empire.

EIGHT Africa

Steel in Antiquity ca 100 CE

Archaeologist Peter Schmidt discovered that during the time of the Romans, the African Haya people produced medium-carbon steel. He also discovered that the production process required large amounts of timber, which led to deforestation and the search for a more energy-efficient fuel process. Wood scarcities eventually led to the end of iron production in the region, which lasted for at least five centuries.

Bassar, Togo—The Ruhr of Africa 1300–1800 CE

Between the fourteenth and nineteenth centuries, a large iron- and steel-producing center flourished in Togo's Bassar region. Iron production during this period required the burning of nearly a million trees, causing widespread deforestation, increased fuel costs, and the eventual decline of the Bassar ironworks.

The Great Kingdom of Kush 700 BCE–600 CE

Kush was one of the great African kingdoms. In Meroe, its capital, ironworking was kept inside city walls and sustained by large quantities of acacia wood. During a twentieth-century archaeological expedition exploring the ruins of Meroe, only a few trees were discovered in a nearby village.

Mema 800–1100 CE; The Importance of Iron in Precolonial Africa

Like Meroe, the region of Mema now consists of impoverished villages and hamlets surrounded by great quantities of iron slag, indicating that Mema once specialized in iron production. In precolonial Africa, access to iron conferred political power, and its production depended on wood as a fuel source. Deforestation, the rising cost of iron, and cheaper imported iron contributed to the demise of the African iron industry.

NINE The Muslim Mediterranean

Pre-Islamic Egypt 2600–00 BCE

Egypt needed wood to build its ships, houses, and wagons, all of which required particularly large pieces of wood. However, Egyptian trees did not grow large enough to meet this requirement. To address this problem, Egypt began trading with Phoenicia (modern-day Lebanon).

The Phoenicians Reclaim the Timber Trade 1100 BCE

Phoenician rulers were emboldened by Egypt's dependency on Phoenicia for timber. The abundance of large timber allowed the Phoenicians to build technologically superior ships, establishing a fleet that was more powerful than the Egyptians'. The Phoenicians became the dominant sailors and traders of the region.

Arab Conquest of Egypt 639–646 CE; Building the Fleet

The Byzantines, or latter-day Romans, were experienced seamen who used their ships to attack Arab holdings in Egypt and Muslim positions in North Africa. The Arabs, who had previously undervalued sea power, reevaluated its importance after these defeats and chose the city of Alexandria as the central location for their docks. Lacking suitable wood to build a capable fleet, the Muslim rulers of Egypt looked northward for timber.

The Conquest of Sicily 827–902 CE; Spain Becomes Muslim 710–797 CE

With their powerful fleet, the Arabs conquered Sicily, an island with a vast supply of timber. However, Sicily could not compare with Spain, a land immensely desired and even compared to the Garden of Eden. After next conquering Spain, the Arabs took advantage of its vast natural resources and built many great shipyards; the resulting vessels both enabled access to wooded areas and provided transport for the timber.

The Mediterranean—A European Sea Becomes an Arab Lake 902 CE

The dominant Muslim fleets ruled the Mediterranean Sea. Christians fled north in the face of Muslim sea power, resulting in a reorientation of Western European political power and ushering in far-reaching social, cultural, and political changes.

Cairo—The Flower of the Islamic Mediterranean 985 CE; Wood Makes Cairo Possible

New ports emerged on the Muslim-controlled coast, and wealth generated through trade catalyzed the growth of Cairo during the tenth through the twelfth centuries; the city eventually surpassed Baghdad as the center of the Islamic world. Wood sustained Cairo and was used in the production of ships and waterwheels, as well as serving as a cooking fuel. The demand for wood was satisfied by importing timber from Arab-controlled areas throughout the Mediterranean.

Egypt Loses Its Sources of Wood 961–1091 CE

Resulting from a period characterized by weakness and corruption, Egyptian power wavered. This created an opportunity for Christians to attack the divided Muslims, causing the Egyptians to lose access to many woodlands in areas such as North Africa and Spain.

Toward Self-Sufficiency 1000 CE

In response to the significant loss of wood, Egypt's rulers during the eleventh century prioritized the cultivation of trees within the country's borders. Many trees were planted in southern Egypt, and wood was used for construction

and to make sugarcane presses, olive mills, and sugar mills. By the middle of the thirteenth century, however, care for the forests reached its lowest point.

Dealing with the Infidels ca 1200 CE

The disappearance of local forests forced thirteenth-century Egyptians to use foreign sources for wood. In the late tenth century, Egyptians and Venetians began to trade in wood, but the practice was subsequently outlawed by the Byzantine emperor. Despite this move, some wood shipments still made it through.

Wood and the Balance of Payments ca 1400 CE; Wood and Venetian Ascendancy

Wood merchants were paid handsomely for their efforts. Wealth transferred via these merchants was great enough to shift the balance of payments to Europe, the profits making Venice the richest European state during the Renaissance.

TEN The Venetian Republic

Northern Italy ca 500 CE; The Early Venetian Republic 697–1000 CE

Theodoric, the barbarian king of sixth-century Italy, ordered that timber be collected from the watershed of the Po River. The timber built a thousand ships, forming a fleet that enabled Italy's participation in trade. Centuries later, Venice utilized its own fleet to engage in trade and become the richest nation in the Christian world.

The Arsenal 1104 CE; The First Conservation Laws 1200–1300 CE

Long-term supremacy at sea required the Venetians to produce more and better ships than their rivals. To accomplish this, the doge of Venice consolidated the privately owned shipbuilding industry into a single, state-run shipyard called "the Arsenal." The Venetian government enacted a series of conservation laws to ensure the availability of wood and pitch, critical resources for shipbuilding.

The Turkish Threat 1470 CE; The Venetians React

In 1470, a massive Turkish fleet defeated the Venetian navy in a battle for control of Euboea, an island off the coast near Greece. The Muslim Turks had developed and maintained their large, superior fleet due to aa vast supply of wood supply. and were able to maintain a large fleet; Venice realized it could only limit the size of the Turkish fleet by limiting the number of trained soldiers available to the Ottomans. Venice also tightened conservation measures and regulations to ensure an adequate supply of wood for the Arsenal, particularly from heavily wooded areas such as Montello.

A Fight for the Woods ca 1400 CE; The Venetians Strike Back

Those living in forested areas, especially those near Montello, felt that the new conservation regulations compromised their rights to the woods and threatened their welfare. In the forest of Montello, people refused to submit to Venetian authority. Venice responded by adopting strong measures, including hiring an armed deputy and two wardens to patrol the forest of Montello.

Venice Loses Most of Its Timber ca 1500 CE; Why Venice Lost Its Trees 1400–1600 CE; The Consequences of Deforestation; The Rise of the Northern European States

Deforestation occurred in regions that were not guarded, and the Republic's significant loss of trees was also caused by the growth of Venetian society during the fifteenth and sixteenth centuries. The Arsenal grew, as did the glassmaking industry, which increased the use of wood for fuel. However, forest fires claimed more trees than the Arsenal or

glass manufacturing industry and created a number of consequences for Venice, including the silting of the lagoon (Venice's harbor) and the decline in merchant ship construction. Shipowners then began purchasing ships abroad, which transferred wealth to states in northern Europe.

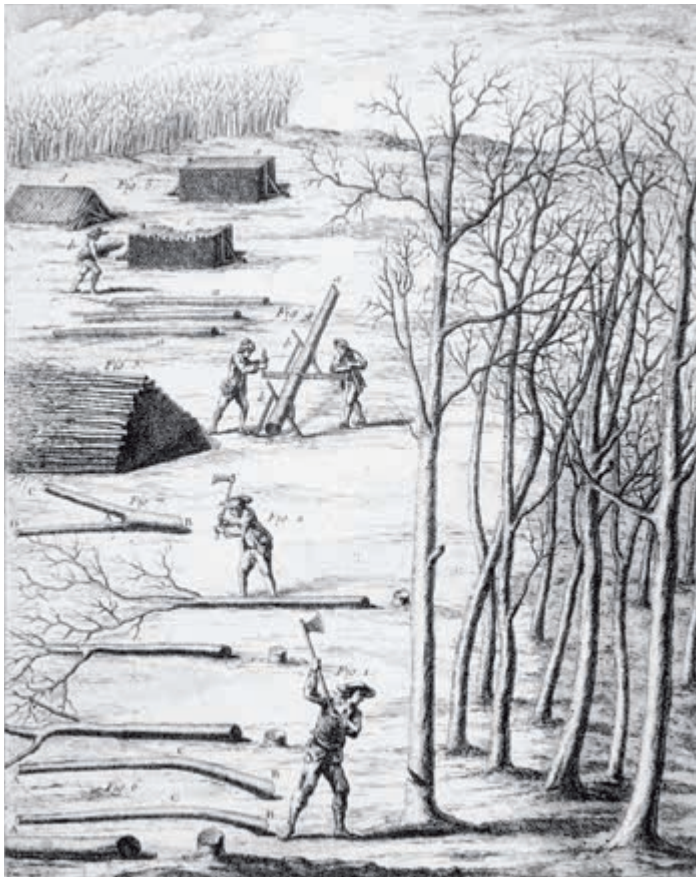
ELEVEN England

EARLY TUDOR 1485–1543 CE; An Abundance of Wood; England's Relative Backwardness; The Vulnerability of Dependence

England had an abundant wood supply, much of which was exported to other countries. The wood surplus resulted from England's lack of maritime and industrial development (compared to other European countries) and required the country to rely heavily on imports of both luxuries and necessities. However, trade relationships changed beginning in the late 1530s as rumors of war circulated and the governess of the Netherlands prohibited the export of munitions to England.

Development of the English Arms Industry ca 1540 CE; Changes in Sussex Due to the Iron Industry

The arms embargo by the Netherlands made it clear to Henry VIII, King of England, that his country needed its own arms industry. Sussex, a region rich in high-phosphorus iron and woodlands, became a center of English industry, and by 1549, fifty-three iron forges and furnaces were operating in the area. A thriving iron industry was established, but at great cost to rural Sussex as forests were rapidly destroyed.



Fuel cutters at work in a coppice. (University of California, Santa Barbara, Davidson Library, Special Collections)

A Commission Investigates 1548 CE; Rebellion over Wood Supplies 1549 CE; Attempts at Legislating Forest Preservation

The people of Sussex complained about the rapid industrialization of their area, and the Duke of Somerset sent a fact-finding commission to investigate the situation. The commission sided with the local population, who recommended that only the ironworks a fair distance from the coast should remain. Because no action was taken in response to the commission's findings, the commoners rebelled in Sussex and surrounding counties. The revolts were subsequently suppressed but bills were later introduced to Parliament to guarantee wood supplies for the English people. None of the proposed legislation passed.

ELIZABETH I 1558–1603 CE; Self-Sufficiency; Copper Smelting; Salt

When Elizabeth I came to power, efforts were made to create industries to produce goods that had previously been imported. The establishment of copper mining and a national salt industry are examples of the move to increase self-sufficiency.

Glass 1570–1590 CE; The Royal Navy and Merchant Marine; Increased Construction; Ravishing the Oaks and Other Hardwoods; Rise in the Price of Wood; Complaints from the Navy

Elizabethan policy encouraged the domestic production of glass and the construction of commercial and fishing ships; these ships increased the number of commodities that flowed into England and could also be used by the navy in times of war. Many citizens benefited economically from these policies, and construction increased; however, home construction, shipbuilding, glassworking, and metallurgy caused rapid deforestation, particularly of oak and other hardwoods. The resulting wood scarcity caused its price to increase and spurred government efforts to protect timber for shipbuilding purposes.

Commoners Join the Fray 1562 CE; Direct Action; A Letter from Buckhurst; The Mayors and Aldermen Go to London; The Navy's Victory Over the Ironmasters

Due to rising fuel costs and the growing scarcity of wood, inhabitants of Kingston-upon-Thames appealed to Parliament to take action against iron mills. When no change came, some citizens took direct action to protect local woodlands. A group of mayors and aldermen of Hastings, Winchelsea, and Rye sent a letter to Lord Buckhurst to express their concern regarding his newly constructed ironworks. Lord Buckhurst's subsequent dismissal of their concerns convinced these men to appeal directly to Parliament, resulting in a new law to protect local woodlands. At the navy's request, the Privy Council also took action against the iron industry to reduce its wood consumption.

Conservation and Coal 1592 CE; Wood Sales; The End of Manorialism

The relative scarcity and high price of wood led to the adoption of coal as the principal fuel source. Despite conservation efforts, landowners continued to sell the wood from their holdings. Landowners' sale of wood to those in other areas changed the manorial economy to a market economy.

Converting Woods into Arable Land 1581 CE; A Bleak Future 1570–1590 CE; The Cause of the Gloom; Sober Words from the Earl

For economic reasons, many landowners converted forests to pastures and arable land, a trend that led to writer William Harrison and cartographer John Norden to voice their pessimism about the future of the woodlands. The ninth Earl of Northumberland also expressed regret over the widespread destruction of trees.

THE EARLY STUARTS 1603–1649 CE; Some Consequences of Deforestation as Predicted by Harrison and Norden; Famine 1608 CE; Arthur Standish, Pioneer Forester; Royal Support for Forest Preservation; Royal Prohibition of Timber for Firewood and Building

The consequences of deforestation predicted by Harrison and Norden began to appear during the early part of the reign of James I; additionally, famine emerged due to a scarcity of wheat. Agricultural writer Arthur Standish noted how deforestation also contributed to famine, arguing that planting and preserving timber was the only way forward. James I acted on this advice and prohibited the use of timber for firewood and building.

Royal Prohibition in Using Wood for Glass Production 1615 CE; James Bows to Financial Pressures 1612 CE; The Iron Industry Expands to Regions Still Well Wooded ca 1630 CE; Exploitation of the Irish Woods 1589–1641 CE

To further preserve wood, in 1615 King James prohibited its use as fuel for glass production; the king displayed contradictory behavior, though, by attempting to monetize the royal woods to pay off debt created by his lavish lifestyle. The iron industry expanded in well-wooded English regions, and English industrialists began exploiting the Irish woods for glassmaking and other purposes during the late sixteenth and early seventeenth centuries.

Charles's Money Problems 1633–1649 CE; Taking the Royal Woods Private; Stretching the Boundaries of the Royal Forests; Using the Timber

Like his father, King Charles I sought to sell the royal woods to generate income, but to decrease the likelihood of public outcry, the woods were gradually sold off in small portions. Charles expanded the boundaries of parks and forests to further enhance his income. Some timber, however, had to be used to sustain the navy, and wood was acquired from several areas, including forests such as Sherwood, Dean, and Chopwell that had previously been untouched by the navy's ax.

The Forest of Dean—Land of Many Uses 1630–1645 CE; Making Enemies

The Forest of Dean was extremely valuable because of its wood and iron ore. As portions of the forest were sold off, and the grantees entered the forest, conflict occurred between the outsiders and local inhabitants. Sir John Winter acquired eighteen thousand acres, but cut down so much timber so quickly that the Long Parliament feared that no timber would remain for the navy's use, and removed Winter from the forest. The Long Parliament also returned the expanded borders of the royal forest to its previous boundaries, with tension increasing between the king and Parliament.

CIVIL WAR TO LATE STUARTS; Fuel Crisis in London 1643 CE; Trees Fall with Charles's Head 1649 CE; Vanishing Forests and Woodlands

Tensions increased between Parliament and the king, and a civil war occurred that led to reduced access to coal and the increased felling of trees. Parliament also made much of England's great forests available for sale, and timber was used to generate revenue and build a massive fleet. Ultimately, many trees were lost in England and Ireland during the rule of James I and Charles I.

Restoration of the Monarchy and the Forests 1660 CE; Renewed Interest in the Forest of Dean; A Sinister Force Appears; Protection for the Forest of Dean

The monarchy was restored in England in 1660, along with an interest in regenerating the forests; an example of this is the association of shipwrights that presented a petition to the king complaining about the great destruction of trees in previous years. This petition led to John Evelyn's study on the timber crisis. Evelyn's study catalyzed attempts to revitalize the Forest of Dean; however, John Winter reappeared during this time and resumed cutting down trees. Parliament then passed the Dean Forest (reafforestation) Act to protect the area.

War with Holland and London's Great Fire Test England's Wood Supplies 1666 CE; Even Less Timber; Where Good Timber Remained; The Navy Turns to Foreign Sources; Apprehension; Proponents of Imported Timber Respond; Use of Foreign Plank Wins Royal Approval

England's home supply of timber was strained by the war with Holland in the 1660s and London's great fire in 1666. Vast quantities of wood were used to rebuild London, which reduced the amount available for shipbuilding. Little accessible timber remained in the country, which caused the navy to import wood from the Baltic's great forests. While this decision provoked criticism from some, King James II approved of the use of foreign plank.

Coal Becomes King 1678 CE; An Early Opponent of Smog; Complacency Sets In; An Ominous Opinion

Wood shortages led to the increased use of coal, which, as John Evelyn noted, produced an abundance of smog. Despite criticism from Evelyn and others, the use of coal and imported timber increased, which led to complacency among the population. Some people, such as English publisher John Houghton, even called for the destruction of woodlands, reflecting the viewpoint that a treeless countryside was a mark of civilization.

ENGLAND LEAVES THE WOOD AGE 1677 CE; The Impossibility of Smelting Iron with Coal; Agroforestry Supplies the Ironworks; No Timber for the Navy; The First Railroads; Canals 1760–1796 CE; Farm Products

The chemist Robert Plot observed in the late 1600s that coal fueled most manufacturing processes except for iron smelting. The dependency of the ironworks on wood as a fuel source led nearby landowners to raise trees as crops for sale to ironmasters. The use of agroforestry, called coppicing, in the late seventeenth and eighteenth centuries reduced the amount of timber available for the navy. Similarly, the construction of canals and wagonways (the precursor to railroads) further reduced the available wood supply.

The First Machines: Cotton and Wool Mills ca 1760 CE; Bull Market in Wood; The Plight of the Ironmasters

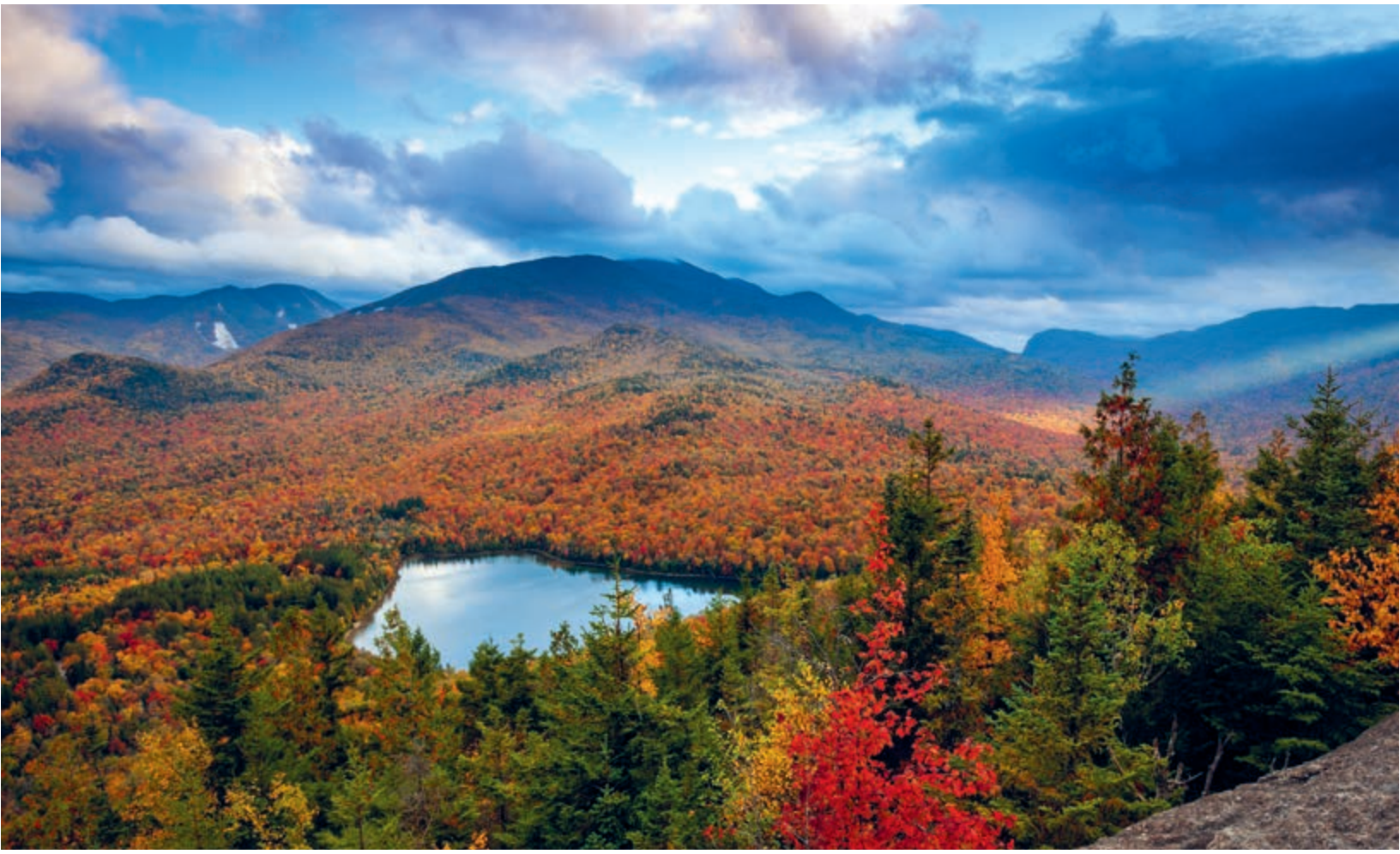
The appearance of spinning machines in the 1760s increased the demand for wood (for example, oak was used for the waterwheels that powered the mills. Additionally, industrialists needed wood to construct factories, and the textile industry required wood to heat combs that were used to keep the wool fibers soft, flexible, and elastic. These demands for wood increased the pressure on ironmasters, who still required wood for fuel.

The Iron Industry Changes to Survive ca 1670 CE; Demand Outstrips Production; Scarcity of Wood Inhibits Growth; Iron Manufacturers in England Suffer

Ironworks owners adapted to the wood shortage by burning slag left by Roman metallurgists, paying people to gather charcoal, joining with other ironmasters to form powerful conglomerates, and by separating forges from furnaces. While these measures prevented production from slipping, wood scarcity ultimately prevented output from meeting the rising demand for iron. England therefore increasingly imported iron to meet its needs (the majority coming from Sweden), causing English iron manufacturers to suffer.

The Coal Revolution 1747–1796 CE; The Effect on England and Western Civilization of Making Iron with Coal

Abraham Darby used a malt kiln to produce a purified form of coal called "coke," then used the coked coal to successfully produce cast iron. Darby's son, Abraham II, continued his father's work and discovered a form of coked coal that produced high-quality iron. As a result of this discovery, domestic production of iron mushroomed, and England joined the Iron Age. Wood had made this possible; timber was used in the construction of mineshafts, and coal was transported via wooden carts and boats.



THE NEW WORLD

TWELVE Madeira, the West Indies, and Brazil

The Discovery of Madeira 1420 CE; The Magic of Its Forests; Processing the Cane; Building Ships for Oceanic Travel ca 1450 CE

The island of Madeira, discovered by the Portuguese in 1420, was so densely forested that the explorers named it *isola de madeira*, or "island of timber." The island offered natural resources such as rich soil, streams, and rivers that were ideal for growing sugarcane. To access these resources, though, the land had to be cleared. Massive fires were used to remove the trees, and additional wood was used to process the cane and store sugar which was then shipped to Europe. Madeira's sawmills transformed wood into huge planks that the Portuguese used to build massive ships.

The Adirondack Park is draped in fall colors, Maine. (Michael Melford)

Columbus Discovers America 1492 CE; Reading about America; Growing Sugarcane; The Consequences of Deforestation; The Effect of Sugar Mills on the Forests of Madeira and the West Indies

During his travels westward across the Atlantic, Columbus sighted several islands, one of which was particularly wooded; he named this island Espanola. Subsequent explorers were impressed by the amount of vegetation in the New World. Europeans learned about this new, densely wooded land through books, yet this admiration did not prevent explorers from cutting down trees in Madeira and the West Indies to expose the fertile soil; significant quantities of wood were consumed as sugar mills were constructed to convert cane into sugar.

Von Humboldt's Observations 1799–1804 CE; Other Problems Caused by Deforestation; The Introduction of Slavery 1517 CE

Alexander von Humboldt, one of Charles Darwin's heroes, explained how deforested lands, particularly in the tropics, experienced a cascade of negative effects. Planters in Barbados noted how deforestation caused the soil to lose its fertility along with contributing to erosion and landslides; by the late seventeenth century, these conditions caused planters to look toward Jamaica. Europeans wiped out both the trees and the native populations of the West Indies, leading to the slave trade to provide labor for the sugar mills.

THIRTEEN America

NEW ENGLAND: DEVELOPMENT; New England Supplies the West Indies with Wood 1673 CE; Rum and the Development of New England 1749–1751 CE; New England Wood to Madeira, Portugal, and Spain

West Indian planters compensated for local wood shortages by importing wood from New England. In return, Yankee traders obtained three million gallons of rum; these traders then sold the rum to European slave merchants or used it in Africa to trade for slaves. New England wood merchants also sold wood to inhabitants of Madeira, Portugal, and Spain.

Shipbuilding in New England 1697–1747 CE; Wood and Everyday Life in New England 1620–1640 CE; Exploiting the Forests' Wealth Leads to Increased Tensions with Indigenous People; Massachusetts Takes Over Maine 1647 CE

New England's vast supply of wood attracted shipwrights from England who produced vessels for whaling and fishing. New England's wood supply also improved the settlers' standard of living, as families burned wood in fireplaces, used wood to construct buildings, and traded wood for other goods (including luxuries). However, as the timber industry thrived and more Europeans arrived in Maine, habitats and wildlife were impacted, and tensions grew between Native Americans and the settlers. Massachusetts purchased Maine to access its timber resources.

NEW ENGLAND: STRATEGIC VALUE; Masts and the Survival of England; An Alternative to the Baltic; The Importance of New England Wood to Britain 1664 CE; Holland and France Threaten England's Mast Supply in America

England's survival depended on sea power, and to maintain that power, the English required a constant supply of ship masts. They relied on the Baltic states for the supply of masts, but the Dutch threatened the supply route. New England offered a way for the English to break their dependency on foreign masts. Trees in New Hampshire and Maine supplied the Royal Navy with timber ideal for masts, but Holland and France threatened this supply.

NEW ENGLAND: SEEDS OF INDEPENDENCE; Learning from the Massachusetts–Maine Affair; King Charles Takes Action; A New Policy toward Governing America 1691 CE; The Earl of Bellomont's Mission 1699–1700 CE; The Struggle between the Colonies and the Mother Country Begins

England realized that in order to maintain its North American wood supply, it had to control its colonists. King Charles II therefore gave Maine's forests a protective status equal to that of the royal forest in England. To further ensure the continual supply of wood (including large trees for masts), King William, a successor to Charles I, sent the Earl of Bellomont to North America. His mission: changing the colonists' behavior to align with England's forest policies. Bellomont suggested regulations to prevent the cutting of timber for profit, which created tension with the colonists.

The Surveyor versus the American People 1708 CE; Local Officials Side with the People; Parliament Acts 1708 CE; The Problem of Enforcement; Dr. Elisha Cooke, the Champion of the Woodsmen 1720–1737 CE; The Consequences of Dunbar's Defeat

As English surveyors attempted to prevent the American people from cutting trees, the former experienced challenges that eventually caused Parliament to pass legislation to protect trees desired by the Royal Navy. The English struggled to enforce the law, and the colonists found a strong advocate in Dr. Elisha Cooke, who fought the Crown's attempts to control logging. A turning point was Lieutenant Colonel David Dunbar's fleeing the woods after failing to regulate the activities of Cooke and his fellow lumbermen.

THE THIRTEEN AMERICAN COLONIES; Timber in New Jersey; Everyone a Lawbreaker; Holding the Land by Force

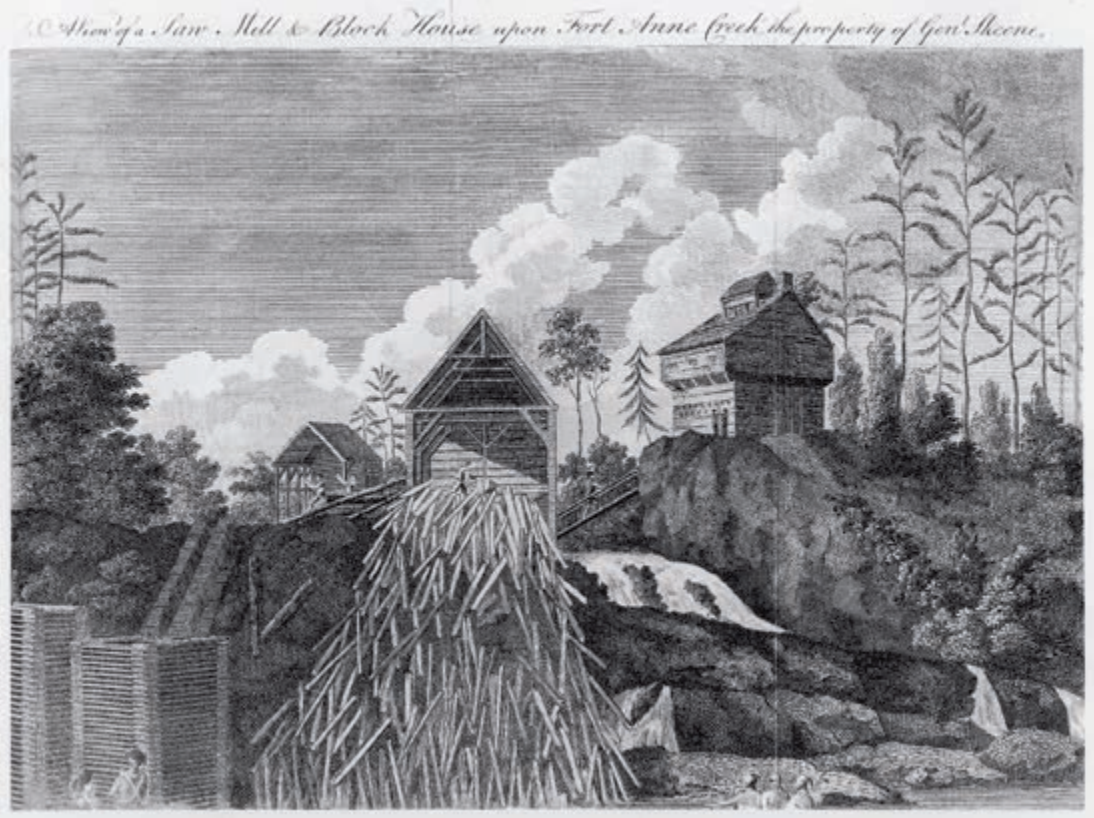
Conflict occurred in New Jersey between landowners and those not possessing land deeds. Emboldened by the jailbreak of Samuel Baldwin, New Jersey residents ravaged forests in defiance of landholders and regulations to preserve timber.

A Different Opinion 1750 CE; Encouraging American Iron Imports to England; Sacrificing American Woods to Save English Forests; Interest in American Iron Revived ca 1720 CE; An Earlier Act Held Up as a Model 1703 CE; Introducing a Bill to Encourage the Importation of Iron from America; Unexpected Opposition; Proliferation of Ironworks in America 1732 CE

The colonists' rebelliousness persisted until English soldiers arrived in the late 1750s. About a decade earlier, new English legislation ("An Act to Encourage the Importation of Pig and Bar Iron from His Majesty's Colonies in America") was passed. Various factions in England had argued for nearly two centuries that the country's iron industry should be moved to America to help preserve English forests. However, opponents killed early attempts at legislation that would have increased American iron production. Some wealthy individuals and investors in England built furnaces in America, regardless.

Keeping the Americans Down 1763 CE; England's Shipbuilding with American Wood; Selling to the Enemy; A More Conciliatory Approach; Every Restriction a Tax 1769–1772 CE; Wood + Iron = Power 1776 CE

The "Act to Encourage ... Iron from ... America" was passed in 1749, angering many Americans and dramatically increasing the amount of pig iron exported to England. In addition to iron, American timber had long been in high demand by the English, and various individuals had considered how to best exploit American timber to build English ships. New Englanders had also been sending plank and other timber to France and Spain (adversaries of England) so Parliament addressed this problem in 1721 by rescinding all duties on American lumber and restricting where Americans could trade timber and iron. These restrictions, along with direct taxation through the Stamp Act, further provoked the colonists' anger. The American colonists utilized their vast supply of iron and timber to defeat the English in the Revolutionary War.



AMERICA AFTER THE REVOLUTION; The Great Primeval Forest; England Loses Its Timber Storehouse; England's Postwar Policies 1783–1804 CE; England's Loss Is France's Gain; The Odysseys of André and François Michaux 1785–1791 CE; Father Hennepin's Plans Revived

After victory in the Revolutionary War, Americans gained access to massive forests beyond the Appalachian Mountains. Meanwhile, England confronted its loss of the great American supply of timber and took measures to preserve domestic wood. England also limited trade with America to the use of English ships, which worsened England's timber situation and created a new trading opportunity for the French, who began admitting ships with American timber duty-free. French botanists André and François Michaux studied the trees in the United States and sent back seeds to France; France also sought American timber for shipbuilding.

America Takes Charge of Its Timber and Wood 1810 CE; Mills and Factories 1800–1900 CE; Heat for Manufacturing Processes 1810 CE; Ironworks 1830–1890 CE; Building Houses and Factories

Economic leaders such as Tench Coxe predicted that America's vast supply of wood and timber would spur development and give the United States a distinct advantage over Europe; Coxe's prediction was confirmed during the next fifty years, as mills and factories developed and wood provided fuel for various manufacturing processes. Thanks to charcoal-burning mills, ironworks also thrived during this time. Wood was also used to provide housing for the growing American population.

Many of the mills such as this one sawed potential masting material, frustrating British efforts to save large trees for the Royal Navy. (Library of Congress)

Transportation; The Use of Wood for Travel by Land 1810 CE; Bridges and Vehicles; Railroads 1830–1861 CE; Waterways and Steamboats

The vast size of the United States and its dispersed population made the development of transportation systems essential, and wood played a key role in this process. Wood was used to build land-transport vehicles as well as bridges, while logs and planks aided road travel. Railroad ties, trestles, and even early rails were also built of wood. Waterways were used to float timber to different destinations, and large quantities of wood provided fuel for the increasingly common steamboats navigating these waterways.

The Forest and the Settler; The Growth of America 1783–1860 CE; A Critique of Forest Use in America 1867 CE; Amount of Woods Sacrificed for America's Growth; The Physical Evidence 1840 CE; The End of the American Frontier

Pioneers used wood from the forests to build and heat their homes, provide fuel for cooking, and more. Wood also provided a source of income, as settlers sold felled timber to city dwellers for cooking and heating, and those near waterways supplied the river trade. Ultimately, wood played an essential role in the country's growth from the end of the Revolution to the start of the Civil War, and a tremendous amount of wood was sacrificed in the process. In 1850, 25 percent of the land area of the United States was densely forested, but 15 years later, this number had fallen to just 15 percent.

A Tale of Two Censuses 1810 CE, 1880 CE; John Muir, Gifford Pinchot, and the Big Trees of the western United States; The Big Trees of California; Pinchot Sours on the Timber Industry; The Denuding of Forests Continue 1980s CE

In his prefatory remarks to the census of 1810, Tench Coxe argued for the removal of trees, and in the census of 1880, Charles Sargent wrote about protecting them. Sargent's remarks were based on the increasing disappearance of trees in areas such as New York, Ohio, and elsewhere. John Muir and Gifford Pinchot expressed alarm at the devastation of the forests, and called for the establishment of government-protected forest reserves. Both were delighted by the giant sequoias of California and alarmed by their destruction at the hands of lumbermen. Pinchot advocated for public control of lumber, but forest devastation only increased as private timber interests grew more powerful and woodcutting technology advanced. Greed and conveyor-belt lumbering during the 1980s further heightened the devastation.

Epilogue

THE IMPORTANCE OF FORESTS FOR OUR SURVIVAL; The Value of Old-Growth Forest Rediscovered; Carbon Storage and Forest Soils: Trees as Geochemical Agents; Forests, Temperature Control, and Water Supply

Research shows that old-growth trees act as powerful carbon dioxide reservoirs—in fact, old-growth trees absorb more carbon dioxide than small trees. Science has also shown that root systems play an important role in fixing carbon dioxide safely in the Earth's crust. In addition, trees keep the Earth temperate by emitting water into the atmosphere; this water changes into vapor and reduces heat while also supplying rain to distant areas.

Migratory Birds and Forest Health; Forests and Human Health; Enkidu and Humbaba's Curse

Old-growth forests are also essential in that they provide a habitat for migratory birds; as these trees are removed, migratory birds are threatened and their loss impacts the wider ecosystem. Forest destruction also threatens humans because deforestation is linked to the spread of Lyme disease, malaria, and even the worldwide Coronavirus. The protection of old-growth forests is essential if humanity is to survive.