

THE HISTORICAL SIGNIFICANCE OF OAK

by J. V. THIRGOOD, *Faculty of Forestry, University of British Columbia, Vancouver 8, B. C., Canada.*

ABSTRACT. A brief history of the importance of oak in Europe, contrasting the methods used in France and Britain to propagate the species and manage the forests for continued productivity. The significance of oak as a strategic resource during the sailing-ship era is stressed, and mention is made of the early development of oak management in North America. The international trade in oak logs and lumber is also discussed.

HAVING BEEN ASKED to speak on the importance of oak in Europe from earliest times—the uses of oak wood and forests, the methods of handling oak stands to propagate the species, natural and artificial cultural methods, and other significant management practices, and the early uses of oak and treatment of oak stands as forestry developed in the United States—I feel somewhat like a certain Egyptian mummy: pressed for time. For the story of oak is the story of European forestry and, to a large extent, the story of Europe itself.

Oak, the strategic resource and the essential commodity of domestic and industrial life, has been a major factor in the evolution of the European people and in the struggle of the great powers for dominance.

I would have wished to trace the management, commerce, use, and strategic importance of the tree through the classical period. I am tempted also to look to the maritime states of the Medieval and Renaissance periods; for the great fleets of the Byzantines, the Turks, the Italian maritime

states—and the pirate flotillas—were dependent on oak.

Unfortunately, time does not permit; so I must restrict myself to western Europe and, more specifically, to France and England, for long the principal protagonists on the world scene. Their contrasting attitudes toward oak management provide several nice lessons. I will also touch on the development of world trade in oak lumber. Even within these limits I can only introduce the subject.

FRANCE

Woolsey (1920) and Reed (1954) provide comprehensive accounts of present-day French forestry, while Osmaston (1968) in his chapter "Development of Forest Management" gives an excellent discussion of the evolution of European silviculture and forest management. I have drawn extensively, though not exclusively, from these sources.

Modern France is almost the sole quantity producer of fine-quality oak, and oak is still the largest component of the French forests.

Today one-fifth of France is under forest, and oak comprises 25 percent of this. Of 301 representative forests of over 5,000 acres, 246 have oak as their dominant species.

The primitive landscape comprised a broadleaf forest with oak predominating. Clearances began with the arrival of the Bronze Age Gauls, about 1000 B.C. At the time of Caesar two-thirds of the country was still under forest. Wide belts of trees formed frontier zones between the tribes. The center of the country contained the oak forests that were important in the Celtic religion. For the Gauls the oak was sacred. Trees with mistletoe had been visited by the gods. Only the Druids could enter the sacred groves. The name Druid is derived from the Celtic word *deru*—oak.

The Romans were ill prepared for the northern forests. These forests were the antithesis of civilization. To tame the forest and its inhabitants, the Romans divided it up with roads and brought it to manageable proportions. The disagreeable problems of jungle warfare and the psychological dread of the mystery and darkness were reduced.

The settled lands and adjacent forests were apportioned to the nobles; but tenants and serfs enjoyed rights to fuelwood, timber, and grazing. Areas reserved to the landowner were *foris*—outside the areas of common rights. The vast unorganized tracts, more than half the total forest area, common property or—better—nonproperty under the Gauls, were Imperial domain. Here time-served legionaries and immigrant tribes were settled, and the prevailing philosophy was "*Quid est agricola?*" "*Silvae adversarius*". What is the farmer? The foe of the forest.

The trees sheltered more than barbarians, gods, and Druids; they also fed great herds of swine that provided the principal meat supply of the Gauls and an export trade in salted pork with the cities of Italy.

With the retreat of Roman rule, whole communities disappeared. Not till the 6th century was the advance of the forest stopped. The principal enemy now was not the Roman legions but the Roman church. Land reclamation became one of the recog-

nized duties of monastic life. By the 8th century one-third of the total area of France had passed to the Church, which remained the greatest single forest owner until the Revolution of 1789.

The Early Forests

A conflict of interest developed between the peasant-cultivator and the great lords. Medieval game laws were severe. The value of the forest lay in its potential for agricultural clearances and for the chase; but slowly the intrinsic value of woods for timber and pannage became recognized. Throughout the Middle Ages the forests were also the refuge of the outcasts of society. Europe was plagued by bands of outlaws, and every region had its legendary Robin Hood.

The net result of reclamation and colonization was the transformation of the rural economy. The forests began to appear as great wooded islands in a sea of cultivated land. In time of war or plague, the forest expanded. In the 14th century, population fell by half and even to one-third. It was said that "the forest returned with the English".

Forest law continued to develop. Common rights became firmly established. Indicative of values is that while deadwood might include also living trees such as alder and thorn, rights never extended to the cutting of the oak or beech that provided the pannage. Forests were often measured in terms of swine, one pig representing 2½ to 4 acres depending on the quality of the wood. Certain areas were the absolute reserve of the owner. On the feudal estate, timber could be cut only with permission and for personal use.

By the 16th century there were local shortages of oak timber. Forest legislation was still closely tied to the game laws. The feudal *droit de garenne* provided a slight check on the threat to the survival of the forest. The pace of industrial life was quickening. Wood ash was needed for glass works and soap manufacturies; timber was required for mining. Artisans established themselves in the forests—charcoal burners, iron smelters, sabot-makers, and woodworkers of all kinds. Also there were the

trade guilds or *compagnonnages*, tanners who demanded oak bark, weavers and bakers who had prescriptive right to wood for looms and furnaces. By the 14th century the population reached 20 million, and since then the rural population has probably changed little. The forests covered 13 million hectares or only 2 million more than today.

In the early Middle Ages, France's timber needs had been relatively small and could be met from agricultural clearances. The central parts of the forests were reserved for hunting. By mid-13th century, regular timber fellings had become financially necessary in the royal forests, providing the government with a quarter of its revenue. One hundred years later the coastal forests of Normandy were being systematically exploited for naval timber. The unregulated selective fellings (*Furetages*) were difficult to control.

The problems of management were (1) to control right holders who made excessive demands on the forest and whose animals destroyed recruitment; (2) to prevent abuses in the small scattered high forest *coupes* and selective fellings where fraud and corruption were both easy and common; and (3) to obtain seedling regeneration.

Controls Developed

Coppice management, practiced since at least the time of Charlemagne in the early 9th century and by the Romans prior to that, was well understood. Coppice requires careful treatment if it is to be kept productive. Maiden trees have to be stored to provide for the replacement of wornout stools. Great significance is attached to maintaining a proper proportion of these trees of appropriate ages, and the method becomes coppice with standards.

Controls developed early. These methods were now adapted to the high forest. The many ordinances from 1280 to 1597 illustrate the evolution. Yields were limited to the *possibilité*. Annual *coupes* were prescribed, not by numbers of trees as previously but by area (*aire*) of 10 to 15 hectares. *Coupes* were surveyed and clearly delineated by hammer-marked boundary

and corner trees selected from the best oaks. An additional minimum of 6 to 8 seed trees were reserved per acre. Fellings were done with care to facilitate regeneration. *Coupes* were enclosed by hedges or fences to exclude grazing, and hunting was regulated.

The positioning of the high forest *coupes* was important. For more than a hundred years these *coupes à aire* were made without fixed plan. In the 16th century it was prescribed that they be located where the stand required regeneration. These scattered *coupes* caused confusion. Ordinances of 1544 and 1597 stipulated that *coupes* be *de proche en proche, à tire et aire*. That is, annual *coupes* by area, in felling series, had to have at least one boundary contiguous and coincident (*à tire*) with the previous coupe, and successive *coupes* had to proceed in the same general direction.

This formalized yet simple *tire et aire* system was necessary to maintain order in working unmapped high forest without a network of roads and rides; also it provided an orderly sequence of age-gradations moving steadily around the forest, which later enable the development of periodic blocks. By the mid-16th century an organized forest administration and ordered silvicultural management had been developed in the royal broadleaf forests. Silvicultural techniques were advanced and thorough, including retention of an adequate number of seed sources, cultivation and supplementary hand-seeding, conservation of advance recruitment, a 10-year cleaning cycle, enrichment sowing and planting, and improvement fellings to remove deteriorating seed trees and "wolves" and undesirable coppice and inferior species. It was recognized that, "like a woman, a tree becomes barren with age".

Unfortunately "national emergencies" were endemic and the *coupes ordinaires* were suspended all too often in favour of *coupes extraordinaires*, which meant the cutting of larger areas than was prescribed in the management plan.

Forests Depleted

In the 17th century the progress made was lost. A corrupt staff overcut the for-

exchange). In 1959, 2½ million francs (\$9,000) was paid for one tree. This was 310 years old, 92 feet to the crown, and 14 feet in girth. At 36 feet the trunk forked; each fork measured 8¼ feet in girth. In this forest the average tree sold contains 250 cubic feet of good timber. These sales attracted buyers from all of France and abroad.

The details of the Tronçais Uniform System are as follows: At rotation end there are about fifty-five 250-year-old trees to the acre. A small proportion of 150-year-old beech and hornbeam form an understory for soiling values and to keep the oak clean. The floor is shaded and bare of vegetation. A *coupe d'ensemencement* (seeding felling) removes about a third of the volume. The pedunculate oak is removed as well as the beech and hornbeam to ensure the regeneration of the less prolific sessile oak. The resulting seedfall produces a *brosse* of regeneration. Three to 8 years later a *coupe secondaire* removes the seed trees. There may be one to three of these fellings. Some trees are left to reseed the gaps left by the secondary fellings, and the final felling is made when the young crop is complete. The interval between first and final cuttings is between 12 and 18 years. Care is necessary to prevent weed invasion into overlarge openings. The gaps left by the last trees are cultivated and planted.

All trees are branched and then felled by *culée noire*. The roots are cut below ground level, and the ground is leveled and left clear of stumps.

In the new crop, beech and hornbeam are cut back at 5-year intervals until the oak is 40 years old. From 40 years the thinning cycle is extended to 10 years, and the understory is allowed to grow up.

Year	Stocking (No. of trees)	Cubic-feet per acre
At establishment	12,000	—
30	4,000	—
50	700	2,824
100	160	5,360
150	90	7,060
225	55	11,260

A fixed periodic block was used initially, but in 1928 a floating periodic block was introduced for greater flexibility. A thin-

ning experiment illustrates the precision and long-term nature of the enterprise. The objective is to produce trees with larger girth through more drastic thinning. From age 50 heavier thinnings are adopted, and at 100 years the stands will contain a maximum of 120 trees per acre instead of the present 160 to 190. At 200 years the final crop will contain 48 trees measuring 9,896 cubic feet as against the normal stand of 60 trees measuring 8,900 cubic feet.

Conservatism Justified

Certain features of French forest administration should be emphasized. The state forests are almost invariably managed on longer rotations than are private forests. Traditionally communal and private woods have been coppice, heavily cut on short rotations, with high interest rates and inferior products. Early this century, when eight-tenths of private forest was coppice, losses due to coppice management were \$60 million a year. Even in the state forests one-third of the producing forest was coppice with standards.

Today coppice comprises one-third of the total forest area, and an area only slightly smaller is under coppice with standards. State rotations are clearly non-financial. The basic premise is that in a great country commerce requires wood of large size. State ownership alone can accept this situation of low returns for general welfare.

The wisdom of holding such stocks, and of the "quarter in reserve", is said to be borne out by France's past history. Despite the demands of two World Wars, of trench warfare and the Occupation, the forests have been able to meet national demands. In recent times some change is becoming apparent; nevertheless the French forester is far from accepting the economic principles that increasingly dominate North American, Scandinavian, or British forestry. Perhaps with his sense of history he is not overly impressed by transient values.

A quotation from the American forester, Theodore S. Woolsey, sums up the attitude of the French forester:

The art of the French forester lies in his keen perception of his objectives and in his simple methods. He deals with stands

rather than trees. In the regulation of the yield he computes the cut with admittedly inaccurate formula—but he gets the required results—a reasonably equal annual cut—and he realizes that with frequent inventories the inaccuracies of the formula will be corrected. His mensuration is a rough guess, many refinements considered essential in the United States even with its extensive conditions are omitted as unnecessary to the objective. If an error is made in estimating the volume of a sale this is taken up in the bidding.* Timber sales are kept small so as to give the small local mill a chance as well as to increase competition. No logging is done by the State. It is as a silviculturist that the French forester is best and regulation statistics are rarely allowed to interfere with silviculture.

In this necessarily brief account I have limited myself to the *tire et aire* and Uniform Silvicultural Systems. The interested reader should refer to Troup (1952) for other methods that are used where local conditions require. Inherent to all is the recognition that management and silviculture are intimately related. A rational silviculture, systematically applied, can be practiced only within the framework of the managed forest.

*The bidding Woolsey mentions is in auctions conducted according to the "Dutch System" of downward bidding. This is a sensitive procedure when dealing with high-priced materials in high demand.

ENGLAND

Until the last 50 years, British forestry developed differently from forestry in continental Europe. The striking differences are explainable in the context of British mercantile, industrial, and social traditions. Large-scale growing of trees on the European pattern rarely occurred outside a very few state forests, originally preserved for game and later for the supply of naval oak—and not always in these.

Oaks in England grow in small woods, hedgerows, and parks. Whereas the French forester dealt with forests, the English concern was with individual trees and small woods. Inherent in this arboricultural tradition was the care of landscape, and a concern that trees, even if planted primarily for economic reasons, should appear seemly.

Generations of landed proprietors have felt a positive affection for stag-headed old oaks. Sentiment allowed these trees to pass into a picturesque and decaying old age in spite of the entreaties of naval purveyors and timber merchants. The long-held national ideal has been the "great tree" with large crown and massive branches. Even today, to most English people the characteristic oak is the veteran of parkland and hedgerow rather than the straight-grown forest tree. Many such notable trees survive. There are records of trees with girths of 48 feet, containing 3,000 cubic feet of timber.

Lowland Britain originally had a deciduous forest in which oak predominated. Yet at the beginning of this century there were only 60,000 acres of Crown woodlands, and for the rest there was the familiar patchwork of private demesnes, small woods, copses, and hedgerows. In 1952 one-sixth of the national timber inventory was in hedgerows and in woods of less than 5 acres, equivalent to a forest of $\frac{1}{4}$ million acres. Oaks accounted for one-third of the total woodland area, one-third of the hedgerow trees, and one-third of the standing volume.

In England, forest did not imply trees, but a tract of land subject to the forest law, which, to the end of the 13th century, was concerned with the well-being of the deer, *ferae naturae*. The value of the forest had nothing to do with the growth of timber. Most forests were held by the Crown. By the time of Henry III, one-tenth of the country was so held. Other persons might possess lands within the bounds of the forest, but were not allowed the right of hunting or of cutting trees at their own will. The 13th century *Magna Carta* and the lesser known *Charte Forestie* redressed the balance to an extent, yet the severity of the game laws remained.

Aside from the chase, forest values lay in pannage. In about 1086 the Domesday Commissioners asked, "How much wood?" A typical village entry says: "There is wood for forty swine"; so tax was levied accordingly. Some manors had wood for as many of 2,000 swine. Earlier a law of King

Ina (d. 726) had prescribed a fine of 30 shillings for felling a tree and double this if the tree was large enough for 30 hogs to shelter in its shade.

The Manorial Estate

The "waste" was essential to rural life. Customary rights varied, but there were privileges of wood for building and carpentry and fuel "by hook or by crook"—by pulling branches from standing trees. Villagers required timber to build cottages, to warm their hearths and cook their food, to make carts, ploughs, farm tools, and household furniture. The forests also meant pig pannage and extra pasture. Then as later, game swarmed—especially coney or rabbits. On the King's forests, ever diminishing, and the enclosures, chases, and holts of the lords and gentry, ever increasing, severe game laws were enforced; and so was the less formal but equally drastic club law of the gamekeepers. Nevertheless, agricultural clearing for agriculture went on apace. In the words of an Anglo-Saxon poet, the plowman was "the enemy of the wood". By Chaucer's time 1340-1400, the woods of many manors had shrunk before the encroachments of "assart" farms.

The knowledge that oak yielded the best beams for building led the landlords to require the preservation of all oak saplings among their coppices. These were left to grow into standards and could be cut only on the express instructions of the lord of the manor. Every lord of the manor had need for oak trees to meet his tenants' lawful demands. The emphasis on individual trees is brought out by the documents of carpenters and the Medieval pipe rolls. Repeatedly we find gifts of oak trees by king, lord, or bishop for the construction of great buildings.

A Statute of Enclosure in 1482 permitting landowners to enclose coppice after each cutting indicates a recognition of timber values. Earthen banks planted with thorns were thrown up to exclude deer and cattle. On the dissolution of the monasteries, England saw the first wholesale felling of trees for timber purposes. Many woods passed into the hands of Henry VIII's courtiers. Many were promptly felled. In 1542 a

Statute of Woods or Act for the Preservation of Woods was enacted. The preamble indicates the awareness:

The King our sovereign, perceiving and right well knowing the great decay of timber and wood universally within the realm of England, and that, unless a speedy remedy in that behalf be provided, there is a great and manifest likelihood of scarcity and lack, as well as of building houses and ships, as for firewood:

This Act applied to all woods throughout England. It provided for exclusion of grazing and reservation of standards. Its result, with other successive Acts, was the enforcement of coppice with oak standards as the national system of silviculture, primarily for growing ship timbers. The system produced great branches and big crooks and curved timbers suitable for shipbuilding and for the construction of framed buildings. A result was that over the years everyone concerned with the growing of timber became convinced of the necessity of giving each individual tree a more or less free and isolated position. In time this principle came to be applied to all high-forest timber crops.

Wide Spacing

Thus from an early date, English practices have involved heavy thinning, or, at least, wide spacing. This was a significant difference from continental practice.

These methods of oak culture stimulated the Danish Count Reventlow's advocacy of High Thinning with emphasis on the release and development of selected individual trees and rapid growth, as opposed to the Low Thinning of Hartig, with emphasis on dense stands, closed canopies, and slow growth, that Reventlow attacked so strongly. Thus present-day concepts of heavy thinning can be traced to King Henry VIII's Act that ordained for England the coppice-with-standards method of growing timber trees for the production of naval timber.

This long emphasis on heavy thinning and wide spacing, with stimulation of heavy branch formation at the expense of long clean stems to meet the needs of a special market, has left considerable areas

of degenerate and unsalable scrub coppice and large-crowned oaks with massive branches. In retrospect it is amusing to read the report of the Royal Commission of 1786-1793. This strongly criticized the management of oak stands in the Forest of Dean. These had been ruined for want of proper thinning—they had been allowed to grow close with tall straight stems.

Many present-day British foresters would wish that more trees had been “ruined” by this “incorrect” thinning. But the wheel is turning full circle, and now there is an experiment in the same Forest of Dean to investigate the possibility of growing short-boled oak with large crowns for high-grade peeler logs on relatively short rotations. The 1786 commissioners would approve.

The open-grown character of English oak contributed to the vaunted superiority of the “hearts of oak” used in British men-of-war. Throughout the wooden ship era, English oak was strongly held to be more durable than French or Baltic (largely German) oak, particularly in the critical parts between wind and water, and less brittle. The significance of rapid growth for strength was recognized in the earliest writings.

From the mid-16th century the major concern was fear of a national shortage of oak. English forest policy from this time to the middle of the 19th century was primarily an effort to curb the extra-naval demands on the oak woods in the interests of the dockyard supply. Albion's (1926) study of the “timber problems” of the Royal Navy from 1626 to 1862, and of the impact of naval demands on the woods and political strategies of England provides the principal source of the maritime aspects discussed here, as it has for all other writers on the subject during the past 40 years.

Effect of Industry

During Elizabethan times particularly, a great expansion of mining took place, and these industrial activities were a considerable drain on the woods. Tanning was a thriving trade in every town and required quantities of tanbark. Quantities of wood and charcoal were burned in the new manufacture of glass. Measures such as the 1558

Act that “Timber shall not be felled to make coals for burning of iron”, which prohibited the cutting of trees within 14 miles of the sea or any navigable stream, were ineffectual. There are many records of extensive wooded regions being deforested. Industrial works often had to be removed to fresh fuel sources.

The movement of industry then as now was not popular. The English iron-masters who turned to Wales when the Wealden iron works became exhausted were natural targets for tree-loving Celts. The Welsh poem *Coed Glyn Cynon* set the mood:

Many an oak tree green of cloak
(I'd like to choke the Saxon!)
Is now a flaming heap of fire
Where iron workers blacken.

Depletion was heavy. In Duffield Forest, 59,412 large oaks and 32,820 small ones in 1560 were reduced to 2,864 and 2,032 small in 1587. At St. Leonard's Forest in Sussex over a million cubic feet of timber was cut on royal license in 20 years. The yearly increase in shipping and the clear perception that England's future lay on the sea made it needful but difficult to maintain growing timber within reach of the dockyards. At least one galleon in the Armada had instructions to take and destroy the Forest of Dean to cripple the English Navy.

The shortages then as later lay in the great compass timbers. It was economically and even physically impossible to move great masses of timber for any distance, except by water. Though in upland districts there were still untouched “monumental” oaks, in other districts the disappearance of wood gave the cottager a cold house and a bread and cheese diet and restricted the manufacturer.

Coal came more and more into use for both industrial and domestic purposes, but in many areas there was a gap between the Wood Age and the Coal Age. Local wood shortages were common. In the reign of William III (1689-1702) cow dung was used as fuel in Leicestershire.

In the decade preceding the Civil War, the 300 ironworks in the country were consuming 300,000 loads (15 million cubic feet) of timber a year. To restrain the

waste of naval timber, a Surveyer of Iron Works was appointed. The early Stuarts saw the forests as a source of extra-parliamentary revenue, and Crown woods were sold as timber or alienated, often in the face of Parliamentary opposition. The Civil War and Commonwealth brought devastation. During the Commonwealth there was almost continuous naval war with the Dutch. Cromwell sequestered the crown lands and great estates and built a great navy. But wooden ships decay faster than oaks can grow, so the Cromwellian ship-building orgy was followed by a dearth.

Naval Problems

The records of the New Forest in Hampshire clearly indicate the demands of the fleet. In a 1608 survey 123,927 oaks were registered for Navy use. By 1707 the Navy Survey could report only 12,476 oaks of ship quality. The other royal forests tell the same story. At East Bere from 15,274 oaks in 1608 there were only 256 in 1783. A single ship of the line required 4,000 well-grown oaks—150,000 cubic feet of timber.

Durability was not a virtue of wooden ship construction. The average life of a ship was 10 to 20 years before great repairs were necessary, in effect complete rebuilding. Many ships built under stress of war were of green wood. Ships started to rot almost upon entering water and required continual repair. One ship-of-the-line was scuttled by a sailor punching his fist through the hull. One third of the oak in the dockyards went for repairs.

Samuel Pepys, Secretary to the Navy Board under Charles II, described his inspection of a vessel in 1677 when he gathered "toadstools . . . as big as my fist". During the inspection of the Fleet in 1791 it was necessary to shovel away the dryrot before the timber could be seen. Rot often worked away at the futtocks just above the water line where the heavy guns were carried. The entire bottom fell out of the Royal George, one of the great ships of the sailing era.

The woodlands never fully recovered after the Cromwellian cutting.

The matter was referred to the newly formed Royal Society. In 1662 members

heard John Evelyn lecture "Upon the Occasion of certain Quaeries propounded to that Illustrious Assembly, by the Honourable the Principle Officers and Commissioners of the Navy.." Two years later his *Sylva, or a Discourse on Forest Trees and the Propagation of Timber in his Majesty's dominions* was published. This book went through many editions and was a major influence on forestry for more than 200 years. Evelyn wrote, "Truly the waste and destruction of our woods has been so universal, that I can conceive nothing less than a universal plantation". Considerable private tree planting ensued.

Not all landowners devoted themselves to growing oak. One Restoration peer made the memorable comment that woods were "an excrescence of the earth provided by God for the payment of debts". Undoubtedly many immature stands were cut to raise money. Even the Master and Fellows of Queen's College, Cambridge, felled their timber to raise funds for the erection of a brewhouse. Fortunately for England the sense of family continuity, self-restraint, patriotism—and ready money—allowed the majority of landowners to grow their oaks to full maturity.

Demands for Oak

Most of the ships at Trafalgar were built of oaks grown as a result of Evelyn's efforts, assisted by exceptionally favorable economic conditions for the growing of oak timber between 1666 and 1700. The 18th century private planting interest was based not only on strategic needs and patriotic fervor, but also on a sound appreciation of the economic soundness of the venture when corn and wool prices were falling. Nevertheless there was competition between oak and corn. In 1544 Parliament had declared that "the turning of woodland into tillage is prohibited", but this was quite ineffectual against the enclosure movement.

The constraints of the tree exerted an important retarding influence on naval architecture. Between 1637 and 1860 the size and design of men-of-war changed very little, being determined by the sizes and shapes of the "Great" timbers. The stern post of a ship-of-the-line had to be

30 inches square and 36 feet long. Though masts could be composite, solid and naturally shaped pieces were required for constructional timbers. The outcome of naval engagements was determined not by superiority in ship construction but by the tactical skills of the admirals and the seamanship and gunnery of the sailors.

"Great" trees fetched very high prices, but landowners were not eager to grow oak to the considerable age necessary because the risk of decay was great. The high value of the large pieces scarcely compensated for the possibility of finding a dotard oak on felling. Trees were rooted up to use the roots for knees and crooks.

The management of the Royal Forests was characterized by feverish planting in times of crisis, alternating with long periods of neglect. Eleven thousand acres were enclosed and planted in 1668 under an Act for the Increase and Preservation of Timber within the Forest of Dean, the first real plantations made by an English government. There were other though generally smaller spurts of planting as after the Dutch Wars and the Fire of London, when it was said that the Norwegians warmed themselves by the Fire—an allusion to the quantities of Baltic timber that were imported in Norwegian ships. Similarly, after the Seven Years War in the mid-18th century, there was a timber shortage followed by a planting revival. Much oak was planted on unsuitable sites.

The demand for wood for other uses continued. In 1708 coal was first substituted for charcoal in smelting. By the end of the century less than a quarter of England's iron production was made with charcoal. Industry moved from the oakwoods of the south to the coalfields of the north. The general introduction of coal, with all its implications for the future industrial revolution, was hastened by the scarcity of naval timber.

Shortages continued. The Maritime Wars of the 17th and 18th centuries were a heavy and continuous drain. Numerous commissions were appointed to enquire into the state of the national forests and woods, yet still no consistent national forest policy emerged. In 1771 an Act for Efficiently Se-

curing a Quantity of Oak Timbers for the Use of the Royal Navy was a prohibition on the building of merchant ships by the East India Company.

Era of Stagnation

The deplorable condition of the British ships during the War of Independence contributed largely to the outcome of the American Revolution. These poorly founded ships were unable to break the French blockade of the American coast. Though the loss of supplies of colonial masts was critical, the poor condition of the hulls also contributed. This was the only time during the long period of British naval dominance when England lost control of the seas and, consequent upon this, suffered her only defeat on land.

The poor condition of the British ships and the dependency upon American sources of supply in contrast to the better founded French squadrons, with the secured wood supply in the home forests, at least contributed to the ultimate result. There are accounts of ships so rotten that their hulls had to be strapped with cables to keep the planking in place. The Queen Charlotte of 1810 rotted before she could be put to sea. The Report of the Parliamentary Commissioners of 1782 said that in that year 2½ million cubic feet of oak timber were used in the dockyards. They recommended that another 100,000 acres of oak plantation be established.

In spite of these periodic resurgences of interest, depletion became progressively more alarming. During the Napoleonic Wars the fleet was in a shocking state, and the condition of the British ships at Trafalgar was deplorable. The Royal Forests had fallen into a notorious condition. In 57 years they supplied the Navy with the equivalent of only 4 years' consumption.

Finally in 1808 an official planting policy was adopted to enclose and plant 100,000 acres at the rate of 1,000 acres a year to meet forecast naval needs. This got underway, but once Britain had gained control of the seas, the project met the fate of all other national forestry projects. Import duty was taken off colonial timber in 1841

and from all foreign timber in 1866, and the price of home-grown timber fell so low that oak-growing, for centuries an important rural industry, became unprofitable. In 1861 there was a revival of interest, with the Navy making the largest purchases of oak of all time. Then in 1862 suddenly came the end of the wooden ship era when in Hampton Roads the ironclad Merrimac demonstrated the superiority of iron over oak.

There followed an era of stagnation in the woods, evidenced by the lack of trees planted between 1865 and 1915. With the appearance of the industrialist landowner, woods were no longer a part of a self-sufficient rural economy and came to be prized more as pleasure grounds for ornament and sport. The pheasant shoot had priority over the woodyard and the game-keeper over the forester. Existing woodlands were treated as game coverts and amenity appendages of large rural pleasure estates. The keeper has undoubtedly helped to conserve woods and even establish new ones since 1862, but he has added little to their proper silvicultural management. Trevelyan wrote:

During the last decades of Victoria's reign, the landlords who had planted diligently in the 18th and early 19th centuries lost interest in forestry as a trade, when the government no longer needed great oaks to build battleships and when timber poured in from Scandinavia and North America at low prices. England in 1880 could boast of finer trees than any other country, if judged by aesthetic, not by commercial standards. The forests were all gone, save a patch or two . . . Yet seen from the air, the landscape would not have appeared ill wooded. The trees were hedgerow timber scattered over the countryside, or park trees preserved for their beauty, or coverts planted for game. Estate agents were not interested in timber values and neglected to cut ivy, to thin out, and to cut and sell at the right time. The conifer was creeping in for the purpose of the new plantations, and so was the rhododendron, approved by the taste of that age. Both were exotic in most parts of the island, but both were well fitted to lodge the "kept cock pheasant, master of many a shire".

For more than 100 years there was enormous growth in population, and rapid in-

dustrialization. By 1900 nine-tenths of the national timber requirements were imported. Today Britain is still the world's greatest timber importer, but with not so much money.

Striking Contrast

In retrospect, if planting and management of the Royal Forests had been pursued consistently, there would have been sufficient oak for the Navy. In fact they rarely supplied more than a tenth of naval supplies. Despite the lack of a consistent government policy, the requirements were met by the squirarchy of England. Oak from the parks and woodlands of the landed gentry was the mainstay of the Navy. Timber was available, and sea power was maintained—although frequently by a narrow margin. Seen in this light Britain's forest policy, or lack of it, was successful.

The contrast with France is striking. There an authoritarian state intervened and, by force of example and forms of encouragement and compulsion, maintained a viable and continuing national forest policy. In Britain the state, with a Parliament controlled by landed interests, did nothing. Whereas in France private timber could be requisitioned for naval use, in England landowners could flatly refuse to sell timber to the Navy or could exact high prices, and over a century a corrupt timber monopoly developed that was finally controlled by one man and that completely cut off the supply of naval oak just prior to Trafalgar. To quote Albion, the influence of the English timber shortage may be seen in many ways, "not only in the Navy itself, but in international law, in naval architecture, and in England's foreign, colonial, commercial and forest policies as well".

One perhaps surprising effect of the 19th century hiatus was that an enormous inventory of matured timber was available in 1914 and 1939. The area of woodlands that had resulted from the Enclosure Movement of the 18th and 19th centuries was in the order of 2 million acres. Most of these acres were stocked with trees ripe for the axe. Additional were the many thousands of acres of small coppices for shelter, amenity and sport, and the hedgerows. One

hundred and eighty thousand miles of new hedges had been planted during the agricultural enclosures. By 1951, despite the inroads of two wars, there were still 73 million hedge and park trees, containing one-fifth of the remaining growing stock.

The timber shortages of World War I succeeded where earlier shortages failed. A forceful forest policy was implemented. During the last 50 years a strong, highly professional forest service has implemented a large-scale plantation policy. But oak forms a negligible proportion of state planting. In the early 1960's the British Forestry Commission was planting 1,100,000 oaks annually, but this was less than 1 percent of the total. In private woodlands oak still finds a place, though most often in conifer mixtures and with somewhat doubtful economic justification.

The Problem Tree

It is important to realize that the characteristic woodlands, part of the inherent beauty of the English landscape, did not occur by happenstance. They were the consequences of planning and landscape design that rested upon a sound rural economy. Changes in economy mean changes in planning and design and changes in the landscape. This is occurring today. The hedgerow oak remains, but there is no doubt that these are being removed by hedgerow clearing, felling, and death faster than they are being replaced despite planning controls, tree-preservation orders, and the other restrictions that are accepted as necessary to control the British landscape. The mechanical hedge trimmer is not as selective as the oldtime countryman with his billhook.

Oak is now the problem tree of British forestry. The commonest and the easiest to grow, its timber is hardest to sell at a fair price to the grower. Those properties that once gave almost any piece of open-grown oak a special value now have little significance in a bulk market. The present national forest policy envisages the eclipse of broad-leaved woods as strong features in most landscapes and the domination of conifers in forests and large woods, all for the first time in recorded history.

This policy is being applied with drastic effect. Thrifty 30-year-old plantations on excellent sites have been cleared for hardwood pulp and replanted with conifers because economic evaluations indicate their unprofitability. The paradox is that while young oak promises nothing but loss, aging oak of good form is still highly profitable to keep growing on in the woodlands. Small size oak fetches only 9¢ a cubic foot, but high-quality selected sawtimber realizes \$1.50 or more, while veneer quality is eagerly sought after at \$3.60. The finest trees are shipped to the continent for veneer cutting.

But, despite the eclipse of oak as a commercial species, the demise of oak in the English countryside is still far off. Saxon oaks are still standing, while some of the great specimen oaks that illustrate Evelyn's *Silva* are unchanged since Restoration times. A print dated 1495 of an oak in Sussex depicts the tree as it is today. If England were abandoned because of some great natural catastrophe, the first men to return after a century would surely have to hack their way through a thicket of oak.

INTERNATIONAL TRADE IN OAK

Lumber is the oldest export from North America. Though the sages record that Lief Ericsson brought home a cargo of wood from Vinland in A.D. 1000, the first recorded exports were by the Virginia Company. In the second expedition under Captain Newport in 1609 there were eight Poles and Dutchmen skilled in erecting sawmills. It is probable that the first mill was erected at Jamestown, although the first recorded mill was at York, Maine, in 1623. Mills were operating in the Colonies 150 years before English conservatism allowed them into the home country.

Newport carried wainscot oak on his return journey. William Strachey, the first Secretary at Jamestown, wrote to London, "The oaks here, by stature and timber, may compare with any, being so tall and straight, they will bear 4 square of good timber for twenty yards long. . . ." Earliest interest was in masts and naval stores, but in the last years of Elizabeth, interest was directed toward oak also. Thus in 1615, "to relieve

the great and pitiful waste of our English woods . . . we may help ourselves out of Virginia and Sommer Islands”.

So, as early as 300 years ago, England was looking to her American colonies for timber. The same year as the appearance of Evelyn's *Silva*, imports from Europe were prohibited to encourage the growing of trees in England and to develop an American timber trade. This trade offered mutual advantages. Unlike the English landowner who grew oak for profit or amenity, the colonist had to remove the trees anyway, and a market was presented to him.

But the American white oak developed a bad repute with British shipbuilders and Navy Inspection Boards. After a few trial shipments, except for small importations after the Seven Years War, the Navy made no use of colonial oak. Nevertheless American oak indirectly relieved the drain on English oak. Round logs of American oak were imported into the United Kingdom from the beginning of the 18th century. The southern colonies had the live oak, the choicest timber of all; but the indifference of the southern colonists to the timber trade made this only a minor factor in the solution of the English oak problem.

Latham (1957) is a principal source of information about the British timber trade, and Albion (1925) details the world search for naval timber during the 18th and 19th centuries.

Of the New England colonies, it has been remarked that if, as is said, the commerce of the Puritans smelled as strongly of fish as their theology smelled of brimstone, it surely rested on a foundation of pine and oak. But the Royal Dockyard prejudice was perhaps not unfounded. There is one revealing comment on colonial timber dealers, “I could wish that men of religion that bring them (knees) hither would not, when brought, cull or garble them by selling the best to private men, and when the refuse will not off, then to sell the remainder as a great service to the State at an excessive rate”.

Dry Rot

Shipbuilding became a major colonial industry, and through additions to the mer-

chant fleet, reduced the pressure on the English woodlands. But colonial ships had a poor reputation for durability. In defense of American timber, though at the expense of colonial business morality, ships built to order were often thrown together with any kind of unseasoned white oak, while the colonials sent south for live oak for their own vessels. At the outbreak of the War of Independence, colonial ships amounted to a third of the total British registry.

Also in mitigation of the bad repute of imported oak, both American and Baltic, these were often rafted, then loaded into ships' holds wet, where they became infected with dry rot before they arrived in port. Live oak was undoubtedly superior to English oak. With low, heavy branches, heavy, rapidly grown wood, and compact grain, it produced good knees and short timbers. The colonists used it for shipbuilding from 1750. But English shipwrights were not interested in the quality of oak in the forest. They knew only that imported timber was much more susceptible to dry rot by the time they were ready to use it.

During the reigns of Queen Anne and the Georges, there was considerable concern to encourage the import of American timber. Extra-naval uses reached great proportions, and imports from America exceeded those from the Baltic, the traditional source of supply. This was by no means a one-way street: there was for long a thriving return traffic to the colonies—of poachers and other forest offenders.

We all know the story of rising colonial discontent over the imperial timber policy and the enforcement of the French *mortelage* or preempting of timber for government use, which ended in the Declaration of Independence. A policy, incidentally, long rejected by the British Parliament in the home woodlands.

The Reservation of Live Oak

After Independence, the timber trade of the South expanded quickly. One of the first southern hardwood mills, and certainly the most historic, stood on St. Simons Island, Savannah, near the shipyards. Here in 1797 the sawmiller John Couper cut the frames and timbers for the famous frigate

Constitution, later a thorn in the flesh of the British in the War of 1812. But ships were built up and down the coast, and the northern shipyards continued active.

The depredations of Algerian pirates and the aggressions of the French Navy led Congress in 1784 and 1788 to authorize the President to provide warships for the protection of American merchant shipping. This led to concern for future supplies of naval timber and the first action of the Federal Government regarding timber lands. In 1799 \$200,000 was appropriated for the purchase and reservation of timber or timberland suitable for the Navy. The strategic considerations that have activated concern for timber resources throughout history from the time of ancient Greece thus were instrumental in developing an interest in forest reservation on the part of the young American republic. Little was in fact done because most of the known live oak, the prime naval timber, was in Florida and Louisiana, then under Spanish and French rule. However two islands off the Georgia coast, 1,950 acres in all, were purchased.

The policy of naval expansion after the War of 1812 led to an Act of 1817 that authorized the Secretary of the Navy to select tracts of oak (and red cedar) and imposed a penalty for cutting such timber from public lands. Thus did the Republic return to a policy comparable to the strongly resisted Broad Arrow policy of colonial times.

Florida was annexed in 1819, principally for its live oak, and the President was empowered to use military force to stop the rapid destruction of the supplies of this species. In 1827 he was further authorized to take proper measures to preserve oak timbers on public lands and, further, to reserve such lands anywhere in the public domain. Additional funds were appropriated for the purchase of oak timberlands. In Florida the Government undertook experiments in transplanting and cultivating live oak. These short-lived experiments were the first attempt at Government forestry research in the United States.

A Law of 1831 superseded the 1817 Act in a further effort to protect reserved tim-

ber. This law forbade the removal of oak (and cedar or any other timber) from any lands of the United States.

Under these various Acts, small timber tracts were reserved in Georgia, Florida, Alabama, Mississippi, and Louisiana. But the depredations of timber thieves and the encroachment of settlers could not be prevented. In 1843 the Government began to dispose of these reserves and, except for a few tracts in Louisiana, completed the process after the Civil War. As in Europe the development of iron ships ended the Government's concern for ship timbers as a strategic material.

The Search for Oak

By the end of the 18th century, Britain was importing a large proportion of her consumption. A famous historian has written, "Among the regular British imports there was only one true bulk trade and one only—the timber trade". With the Napoleonic Wars and the enforcement of the Continental System, Britain was effectively cut off from her European sources of supply, and North American timber was of considerable significance. Other parts of the world also were searched for dockyard timber. Some 33,000 cubic feet of "African oak" (Iroko) were imported as early as 1823.

The world-wide search for ship timbers by the northern powers contributed to the destruction of the Italian forests. The shipwrights of Toulon had fully appreciated the oak of northern Italy. Their contemporaries in Portsmouth and Chatham recognized its value to supplement home supplies, particularly of the valuable crooked "compass" timber, after the British brought home the stores from Napoleon's dockyards at Genoa in 1814. There followed a lively rivalry for Italian oak. Diplomatic negotiations were conducted at Turin to secure the oak of Sardinia. Tuscany and the Papal States stripped their forests to build British and French warships. At the close of the wooden ship era, half the oak lying in the English dockyards was from Italy.

Other countries felt the impact of the naval rivalry. Albania, Croatia, and Hun-

gary also supplied oak. In 1899 the British arranged a loan to the Sublime Porte in return for permission to export oak from Albania. To be on the safe side they also concluded an agreement with Ali Pasha, the brigand who had carved out a virtually independent domain in the Balkans, for the sale of the Albanian oak he had previously made available to the French. The port of Parga, under British control, was exchanged for 50,000 loads (2½ million cubic feet) of naval timber as part of this deal, and its population was evacuated.

The first shipment of American oak lumber arrived in London in 1861 from Virginia. This white oak became famous in the English timber trade as "Virginia oak". Later the Central and Southern States became large suppliers, and in due course American "red oak" became established on the British market. By mid-19th century, considerable supplies of American oak were entering England. In 1865 Liverpool received 1,180,634 cubic feet of oak. In the 1880's one merchant advertised his new imports by means of a brass band playing on a wagonette placarded with "Buy my American prime cuts"—hardly according with our image of Victorian decorum but referring to the sawn and graded lumber that swept the market at the expense of the log trade.

Today, although bulk demands are a thing of the past, a market still continues for quality wood. During the immediate post-war years, world-wide hardwood sources were combed to satisfy the need of reconstruction. During the late 1940's over 350 different hardwoods figured on the British Customs Entry forms. Sawyers still have memories of the shell fragments in the German oak that was brought onto the British market at that time, until the use of mine detectors in the woodyards solved the problem. Since World War II the most notable use of oak in Britain was perhaps the reconstruction of the bombed Palace of Westminster—The House of Commons—when surveyors again combed the ancient oak woods for suitable bends and pieces for hammer-beam roof construction and wainscot panelling.

Whereas in 1938 out of a total importation of 38,663,000 cubic feet of hardwood imports into the United Kingdom, 13,139,000 cubic feet came from the United States, in 1955 of a total of 45,260,000 cubic feet, only 1,241,000 cubic feet came from the United States. The gap has been filled by tropical hardwoods, while Japanese oak imports have risen by over 2 million cubic feet and have largely replaced the American oak that previously had a firm place in the British lumber trade.

Pointer to the Future

Today patterns are again changing, and imports are of quality veneers from France and Yugoslavia. Perhaps some have been produced from the prime oak butts exported from the English woodlands and hedgerows.

The continuing use of oak as a fine wood is perhaps a pointer to the future. It is a more comfortable note to conclude on than to contrast the two ships in which I have crossed the Atlantic: the first time, in 1958, in the Queen Mary, characterized by lavish use of wood, and the second, 10 years later, in the S. S. United States, of which it was boasted that the only wood in the entire ship was the butcher's block in the galley and the grand piano in the passenger lounge.

This account of the history of oak, and incidentally, of European forestry, has been concerned with the contrasting attitudes of France and Britain. Little reference has been made to those other countries in which *Quercus* forms a significant component of the forests and in which there have been significant contributions to its silviculture.

Nevertheless the story, even if incomplete, has several lessons that are not without significance. The French experience shows the stages of progress from early empirical and comparatively extensive methods to complex management and understanding of the crop. Developments have been in step with general social standards and political organization, with changes in silviculture and biological knowledge, and with industrial development, demands, and inventions.

A lesson is that the management of any forest must be influenced by its past, its consequent present structure, composition, and accessibility; it must suit the silvicultural and other knowledge, skills, and resources available; it must anticipate future demands on its products.

Certain stages experienced in European forest management will be omitted and methodologies will differ substantially. Nevertheless the progressive phases of European forestry provide lessons useful to us all. We will be the poorer if we ignore these lessons.

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