Ancient wood, woodworking and wooden houses

The article introduces a record on the management and use of prehistoric woodland gained from the research of the Somerset Levels.

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1. The Somerset Levels

In efforts to understand how ancient people obtained supplies of wood for their houses, barns, fences and other equipment, archaeologists often have to rely upon a record that has barely survived time‘s arrow of destruction. The raw material most consistently and abundantly used in ancient times, and in fact into the 20th century in some areas of the world, has not often been preserved for detailed study, and even where traces survive, their quality may be unsuitable for scientific research. Where ancient wood has been maintained in a good condition, archaeologists have an obligation to extract as much useful information as possible, as their results may be relevant to other archaeological situations where conditions of preservation are not as good. It is, of course, important to remember that the woods available and used in certain areas, where they have survived, may not be exactly comparable to those of other areas where survival is poor, and care is thus needed in extrapolation of results. Nevertheless, there are important reasons why archaeological sites and regions containing abundant preserved wood can be used in the construction of a general assessment of ancient woodlands and wood technology, so long as care is taken in utilising the results. In this paper, one area where preservation has been exceptionally good will be used to show the character and quality of evidence that can survive, and this will be used as a guide to the woods used in the construction of ancient buildings.

The Somerset Levels are an area where conditions for the preservation of the environmental and cultural records allow some degree of generalisation about prehistoric woodlands and woodworking. Due to extensive peat formation over 5,000 years (4,500 BC - AD 500), the peat bogs buried hundreds of ancient structures, and because the area is low and flat, silts and clays have also helped seal many sites from decay (*Coles and Coles 1986*). The advantage of a wetland such as the Levels is that it contains within its peats not only the wooden elements of trackways, platforms and other structures, including houses, but also the record of the woodlands growing in and around the area. Pollen analysis, allied to macroscopic identification of leaves, seeds, bark and charcoal, and the wood of structures, provide an important record of the changing use of primary and secondary forests, the development of woodland management practices, and the exploitation of preferred species for particular purposes. Allied to exper-

	Acer	Alnus	Betula	Carpinus	Clematis	Corylus	Cornus	Fagus	Fraxinus	Frangula	Hedera	Ilex	Malus	Myrica gale	Pinus	Populus	Prunus spinosa	Prunus avium	Quercus	Rhamnus	Salix	Sorbus	Taxus	Tilia	Ulmus	Viburnum	
Sweet		◉	○	○?		●	○		◉		○	◉	○?			◎			●		◎		○	◎	◎		bc c3000
Bisgrove			●																		○						
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Burtle Br.			●																								
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Signal Pole			●																								
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East Moors						●																					
Eclipse	○	○				●	○		○										○						○	○?	c1500
Meare Heath		◉	◎		○	◉			○								○		●	○	◎	○	○		○	○	
Tinney‘s		●	◎			○			○	○				○					◎		◎		○			○	
Godwin‘s		●	◎																○		◎						c1000
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Westhay			●																								
Withy Bed	○	◉				◎			○										◎		◎	○					
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Shapwick	◎	◎				◉		◎	○																	○	c500
Meare West	○	◉	○			○			○							○	○	○	◉		○	○		○			
Glastonbury		●	◎			◎			◎				◎				◎		●		◎					◎	bc/ad
Difford‘s	○	◉	◉			◎			○					○			○				◎						

Table 1 Species of wood identifications from prehistoric structures in the Somerset Levels, circa 3200 BC – circa 100 AD.
● - dominant; ◉ - common; ◎ - occasional; ○ - rare

imental work in the Levels, we can now make some suggestions about ancient wood technologies, from species selection to felling, splitting and working, and also about the likely yield from various kinds of woodlands of the timber and roundwood needed for structures.

Among the many archaeological structures and other discoveries in the Levels, 36 sites can be extracted which provide a useful guide to the woods selected over circa 4,500 years (circa 4,000 BC - AD 500) (**Table 1**). From these sites we can identify 26 species of wood actually used in the constructions (*Orme and Coles 1985*). The age, size and condition of the different species can be measured, and other studies can indicate the nature of woodworking tools used and the quality of woodworking. Primary forests, previously untouched by man, are also indicated in the record of pollen preserved in the peat beneath the earliest structures. It is apparent that a wide range of tall and ancient trees, such as oak, ash and lime, existed in this ‚wildwood' for utilisation circa 4,000 BC. By circa 3,000 BC, managed woodlands containing coppiced hazel had been long established, and these were still in existence by circa 2,000 AD. Regenerated forests were heavily exploited circa 1,500 BC, but yielded timber mostly of inferior size and quality to those of the primary forests. After circa 500 BC, oak woodlands were diminished and a wider range of trees was being used.

Such differing varieties and qualities of wood have important implications for the character of ancient structures, just as has the development and use of different tools for working of wood. The felling, splitting and working of a variety of woods, and the use of both roundwood and timber, is represented in the Levels by 100,000 recorded Neolithic, Bronze Age and Iron Age wooden artefacts from the trackways, platforms, houses and dumps so far identified, and by several million pieces of wood observed over the past 25 years. Some of the archaeological evidence for primary woodworking on a variety of trees through time will be examined in the paper, and suggestions will be made about the implications for the ‚wildwood' through such activities.

2. Classifications

(See *Rackham 1980*)

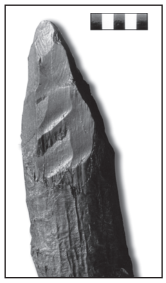
Timber is sometimes used to describe trees large enough to make planks and beams. In this case, the word wood is reserved for smaller trees suitable for poles, rods and other small-diameter stems. Most wood consists of underwood, grown by a coppice system, in which a tree is felled and the stump thus encouraged to send up shoots or stems; in time the stump or stool yields many crops of poles and rods, felled at intervals dependent on the length and diameter of the poles or rods required. Branch wood is mostly unsuitable for building purposes, and is one of the principal sources of firewood (see below).

In a prehistoric woodland where some form of control was exercised there would be both timber, or timber-bearing, trees and wood, or underwood or roundwood, of more slender dimensions, all growing together in a system sometimes described as coppice-with-standard. The underwood in England might be elm, hazel, ash or lime, and timber trees would be oak; conifers would be represented in Alpine regions, birch was important in parts of northern Europe, and cedar was pre-eminent in northwest coastal America.

In the Somerset Levels, we accept these basic definitions, but for the recording of pieces of prehistoric wood found in the trackways, platforms and collapsed houses we use the terms timber and roundwood. Timber refers to split wood, as distinct from roundwood which is an unsplit stem or branch. The division between the two categories may be blurred when dealing with half or quarter trunks; in the Levels these are described as split roundwood, and timber is reserved for pieces which have little or no outer surface remaining. Timber may be further classified on site as planks (length circa 1.0m - 10.0 m or more; width circa 0.15 - 0.50 m or more; thickness < 0.15 m), boards (length circa 0.30 - 1.0 m; width circa 0.15 - 0.50 m) and slats (length circa 0.1 - 1.0 m; width < 0.15 m, thickness < 0.05 m) (**fig. 1**). Smaller pieces of timber are silvers or chips. Beams are heavy pieces of timber of plank or board length and > 0.15 m thick. Many pieces are found broken and so such definitions are often difficult.

3. Felling and axes

The evidence surviving from the Levels allows some observations to be made about the felling of trees, and in the use of different axes of stone, bronze and iron. It is very unusual to recover any direct evidence of the felling operation itself. However, tree-stumps occasionally survive in the Levels' peats, and show the precise method of felling, e.g. very acute chopping, around the whole stem, marks the felling operation on yew circa 1,500 BC. The chopped ends of stems and branches are less reliable as they may have been re-worked after felling. Timber burnt at one end may suggest the use of fire to assist



■ Fig. 2 A roundwood peg of hazel from the Early Neolithic of the Somerset Levels. Note the clear facets left by a narrow-bladed stone axe. (photo J. M. Coles)

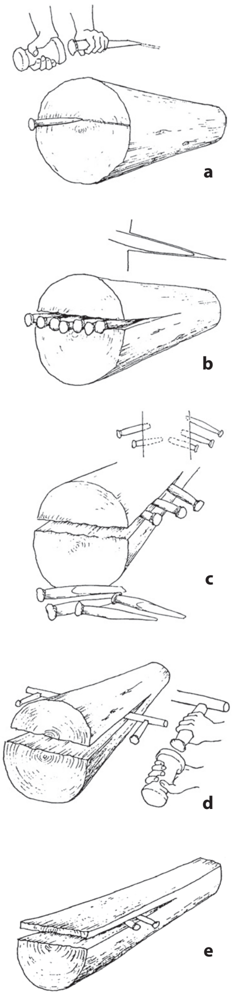
■ Fig.1 Timber (oak planks, boards and slats) of the Early Neolithic from the Somerset Levels. Note the tapered edges, flat surfaces, perforations and notches. (photo J. M. Coles) in felling, but only if, as in the Levels' evidence, the wood was not being re-used from earlier structures. Because trees once felled were most often cut to shape, it is only the rather rough substructural components that preserve traces of the felling operation.

The size of trees felled in different periods may be compared, taking evidence mainly from the Early Neolithic and the Bronze Age. The evidence is largely derived from estimates of total tree diameter based on examination of the tree-rings in the cross-section of planks. These indicate that stone axes could be used to fell trees at least as large as those exploited in later periods. Neolithic stone axes were adequate for clearing primary and secondary deciduous forest, including oak trees up to one metre thick and 350/400 years old. Most of the Bronze Age oaks observed were only 30-50 cm in diameter, but that is a reflection of the woodlands in the Levels rather than the tools. The gross size of woods used in the structures gives a general impression of the nature of the wood species available, although tree-ring analyses are also required to obtain a better picture of the quality of trees.

4. Roundwood

Roundwood is an easy term to appreciate, as it is the basic state which is encountered. For archaeological recording of roundwood in a structure we use our descriptive terms carefully while admitting that wood, being a flexible medium, allows infinite variation in the ways by which it may be worked. For roundwood there are seven obvious elements to consider; species of wood, whether green or seasoned, its growth rate, the type of tool, angle of cut, shape of product and character of facets (*Coles and Orme 1985*).

Many thousands of pieces of roundwood from the Levels bear clear axe-marks, or facets, and some have evidence for the shape of the blade used (**fig. 2**). Where the blow carried through, a facet is left. Experimental work has shown that the number of facets on a piece bears little relation to the number of blows used in working the wood. In recent experiments, as many as 50 or more accurate chops with a stone or bronze axe would produce a sharpened stake but the artefact would bear only 5 or 6 identifiable facets or axe-scars, the others truncated or lost by the sequence of action. This in a way is the same as retouch on flint, where many of the first flake scars are lost. Particularly useful are occasions where the axe head bit into the wood and had to be pulled clear, without necessarily detaching a chip, leaving a mark of the cutting edge which may survive and identify the blade. Clear marks of this sort are often present on Bronze Age wood but not on the Neolithic. And sometimes where the blade has been damaged in use or in casting, it leaves a ‚signature' on the wood, generally a small ridge or set of ridges on each facet produced by that blade; the potential correlation of worked pieces is obvious.



■ **Fig. 3** The use of wedge and mallet to split a cedar tree. Although the tools shown are from northwest coastal America, the basic principles for working European oak, pine and other large trees are the same. Cedar was particularly easy to split and the European trees may have been somewhat more difficult to work. **a** marker wedge to define the line of split; **b** wedges driven to start the split; **c** wedges driven in along both sides; **d** a spreading stick pounded on both ends to spread the split; **e** the process repeated to make planks. (based on Stewart 1984)

5. Timber

It is likely that the bulk of trees were processed soon after felling and not left to season. The rate at which a tree dries, or seasons, depends partly on species; of the timber trees discussed here, alder is relatively quick and a tree felled for six months is noticeably different to work to one that has just been cut down. Oak is slow to dry, and may be worked 'green' for up to two years. Ash is intermediate, perhaps closer to alder than to oak. No information is available to us for lime owing to its present scarcity, and elm of recent years has all been well-dead, thanks to disease.

Side branches would be trimmed from the felled trunk before splitting, and topwood removed to leave the bole clean. In the finished timber occasional knots and quirks in the grain indicate where side branches once grew. An overall impression of the prehistoric timber from the Levels suggests that there were few side branches on the trunks felled for timber, indicating that the specimens had grown in close competition with other trees, probably in a forest, although a considerable number of pieces from the oak forest of ca 1,500 BC were distinctly twisted.

The timber recovered from the Levels consists predominantly of planks and stakes, with some Iron Age beams, and in discussing the conversion of trunks the production of planks will be considered first. From the Neolithic, planks up to 5 m long are known; these are of ash and lime. The oak planks occasionally exceed 3 m. Bronze Age planks have been rarely preserved over 2 m in length but 5 m lengths exist and there are records of timber of ca 10m length (*Orme and Coles 1983*).

6. Wedges and beetles

(*Darrah 1982*)

The tools needed to convert a fallen tree into timber are wooden wedges and a mallet or beetle. The process of such timber production is simple and well-understood, but in practice it is often different from its theory. By driving wedges to exploit the basic lines of wood structure, stems can be split, and some woods such as oak and cedar are thus easily reduced (**fig. 3**), other woods are more intractable. Where knots and branches exist on a stem, the wedge and beetle technique will be less easily applied. Our experimental work, however, has demonstrated the effectiveness of wedge-splitting on a variety of woods in different conditions.

Seasoned oak chips make suitable wedges, but unless they are well-preserved on sites, they may not be distinguishable from ordinary chips detached in preparing wood. Wedges heavily used in splitting will often bear clear signs of such use, in compression, curvature, splitting and burring of the head. Due to the great weight of freshly-felled stems, splitting would be logically carried out in the woodlands, and so wedges may well not be in great abundance on the sites of structures themselves; nonetheless, wedges for secondary splitting may well be present.

Mallets are tools requiring more preparation, and represent fine examples of the woodworker's craft. Made from stem and branch intersection in one piece, or from the insertion of a straight handle into a heavy chunk, they should survive in waterlogged conditions. From the Somerset Levels, only one Neolithic mallet has been found, but there are several later and smaller specimens; the Neolithic mallet was made of yew, one of the toughest native species of the British Isles. This mallet showed its use as a heavy blunt instrument, in the burring down of the inner parts of the rounded ends. The use of such a tool was either to drive pegs or piles, or to force wedges into tree stems in the early stages of timber or plank production. Experimental work shows how easily fresh oak, and ash, can be split with wooden wedges and beetle, and our work suggests that a heavy oak tree once felled could be reduced to 8ths or 16ths within an hour or so, granted a stem without major imperfections. Prehistoric timber from the Levels occasionally carries the traces of wedge ‚burring' (*Orme and Coles 1983*). Normally however it would be expected that the further trimming of split wood, or its use in structures, would remove or disguise such primary signs. Nonetheless such traces should always be sought.

From the start of our record both radial and tangential planks are found, with a few split diagonal to the rays and some straight through the middle of the tree (**fig. 4**). Different approaches to splitting the trunk are required for these different types. Radials, the most common type of oak plank, can be produced by splitting a trunk in half and half again and then splitting ‚slices' off each quarter. Tangentials require carefully controlled splitting across the natural planes of weakness in oak, and are perhaps easier to produce in ash which has no rays and splits more readily along the growth rings (**fig. 4**). A plank split across the centre of a trunk is effectively what is left when a tangential plank has been taken off opposing sides of the trunk.

In experimental work, oak can be shown to split easily and cleanly, but ash is generally a more difficult proposition, particularly if many side branches and knots occur. Alder is relatively easy to split but birch in contrast is more resistant and sappy. In all these operations it is not force that is required, but the eye of the worker in turning the wedge to follow the line, and to bypass or force through the more convoluted parts of the stem. In this work, it is noticeable that when completed, the faces of the plank will bear traces of clean splitting of the wood interrupted by burring of the faces where the wedges were forced in and often the wedges will remain stuck between the main face and a slender but resistant sliver of wood stubbornly attached to the wrong side. In such cases the sliver would be axed free. Such slivers have been observed on Levels' sites.

Cross-sections of oak timbers illustrate that in practice there were many variations on the basic theme of radial and tangential splits (*Orme and Coles 1983*) (**fig. 5**). The Neolithic pieces are mostly variations on a radial split, and those which deviate only slightly probably do so because of the grain of the wood rather than any deliberate intention of the woodworker. There is a preponderance of true radials. Redirected radials occur where the wedge has been re-positioned in the course of a split, to change the line slightly. This was usually done for one surface of the plank only and the purpose would appear to be to achieve a flatter plank than a true radial. It has been a frequent practice in our experimental work. There are also some examples of tangential splits.

The Bronze Age examples range from redirected radials to true tangentials. The pieces intermediate between radial and tangential are split across the primary natural planes of weakness in oak, namely the rays, and across the growth rings which can also allow easy splitting. Theoretically, these examples are the most difficult to produce, yet they are found in both Neolithic and Bronze Age structures. The true tangentials are relatively small timbers, and may have been produced by secondary splitting of a hefty radial. Lime tree-ring samples provide some information about the working of this species in the Early Neolithic; they appear to be rather thick tangentials split in two down the centre, and true tangentials have been recorded.

7. Secondary splitting

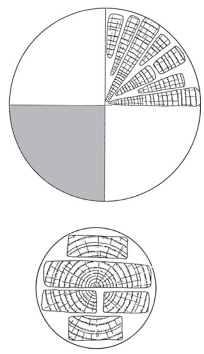
Four categories of secondary splitting have been distinguished (**fig. 6**), one of which, the radial with extra splitting, may overlap with the redirected radials discussed above. Some pieces, however, cannot have been produced in the single operation of detaching timber from trunk, and they include results best described as parallel-ray, diagonal-ray, or tangential with extra splitting.

■ Fig. 7 Finished planks of oak of the Bronze Age from the Somerset Levels. Note the smooth split and axed surfaces, and the vertical-sided hole and notch. (photo J. M. Coles)

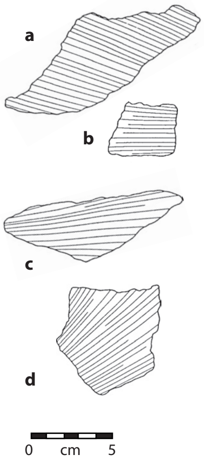
Although there are relatively few planks and beams from the period c 500 BC - AD 500, those that survive from the Iron Age settlements reach 3 m or more in length and often bear signs of axe or adze on their surfaces; they were presumably split radials later truncated. Of particular note are the slats or slender planks interpreted as loom parts, from Glastonbury; these were mostly of ash and some were said to have been adzed. The thinness of some of these slats, down to 25 mm, suggests a high degree of skill and experience in working with wedge and axe or adze. Indeed, a few smaller pieces were split to under 5 mm thickness.

8. Sapwood

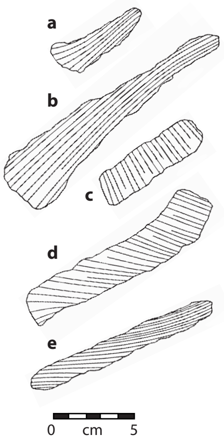
In the majority of oak timbers studied recently from the Levels, the sapwood was trimmed off. The discovery of chips of sapwood indicates that this stage in the wood-working was some-



■ Fig. 4 (top) A large tree stem split radially to make planks of maximum width equal to the radius of the tree. (bottom) A small tree split tangentially to make planks of maximum width equal to the approximate diameter of the tree.



■ **Fig. 6**
Sections of oak timber from the Somerset Levels to show secondary splitting methods. Neolithic and Bronze Age. **a** tangential with extra split; **b** parallel-ray stake from tangential split; **c** radial with extra split; **d** diagonal-ray strake.



■ **Fig. 5**
Sections of oak timber from the Somerset Levels to show different splitting methods. Neolithic and Bronze Age. Radials **a** and **b**; **c** and **d** tangentials; **e** intermediate.

times carried out at the place of construction. Sapwood chips have rarely been identified, though, and it is likely that the planks were generally trimmed soon after splitting, before being taken to where the track was to be built. For example, of 115 pieces of timber used to build up a Bronze Age chronology eight retained sapwood and the rest had been trimmed, or originated in the inner part of the trunk. Very occasionally, axing has been evident down the side of a plank. Sapwood rots more quickly than hardwood and its removal delays decay of the timber. Oak has a marked sapwood zone and elm has approximately 20-30 sapwood rings but lime is less clear. It is not surprising that even in the Early Neolithic, sapwood was almost always removed from timber; the structures built involved considerable pressure on plank edges, and a sapwood edge would rapidly collapse.

9. Finishing

The degree of axe work in the preparation of plank surfaces, subsequent to splitting, is often difficult to calculate. A plank split to its requisite thinness may well be considered adequate for the purpose of, e.g., a track or house foundation. For walling and flooring however, or for a raft or other fitted piece, some finishing of the split timber would be necessary. This would involve axing the plank along its two faces, trimming off splinters and other imperfections, and creating a straight face by eye or line through the careful axing of the entire surfaces (**fig. 7**). In experiments, this work on oak planks has been carried out with stone axe, flat bronze axe and iron axe. It is important to note that the finished surfaces of timber worked with iron and bronze axes were barely distinguishable, and that the stone axe created a rougher surface with many small rather bruised splinters still partly attached to the surface; after a few months of weather and/or use, all of these traces would vanish through wear and weathering, leaving a smooth face hardly distinguishable from that worked by metal axes. The creation of half-lap joints with the same stone axe was equally comparable to those produced by iron axes, the difference being in the time taken to complete the work. Familiarity with the stone axe might reduce the time disparity to a minimal and unimportant level. The conclusion of this work is that the quality of work does not seem to depend upon the tool, but upon its user, whether stone or metal is used, and that a stone tool can produce comparable effects to those made slightly more easily with a metal tool.

10. Building

Although there are many thousands of planks and posts known from the prehistoric structures in the Levels, there is still relatively little evidence of Neolithic and Bronze Age buildings. Ash, oak and lime planks, unneeded for the contemporary buildings of the Early Neolithic, came to rest in the marsh, and they show that structures of the period could have contained planks 5 m long, and up to 40 cm wide, split and worked into remarkably uniform timber. Bronze Age timber includes planks of oak up to 10 m long, as well as heavy beams. All of these planks could be perforated to take pegs or posts, or ties. For the Iron Age of the Levels there is ample evidence for buildings at the settlements of Glastonbury and Meare. The advantage of the Somerset Levels is that it shows not only the character and quality of woodworking of the Neolithic, Bronze and Iron Ages, but it also demonstrates the nature of the woodlands from which the raw material for structures was obtained. These factors can be used when we turn from the Levels to the wider field of ancient buildings and the character of the wood used in them. We will approach this in two ways, the first concerning the size of trees, and their yield of timber and roundwood. The second approach will be directed towards particular types of structure, in an attempt to estimate the quantity of wood needed in their manufacture.

If we take three sizes of trees such as are known from the Somerset Levels, we can calculate their yield of roundwood and timber for house posts, walls and floors. Tree A, the largest, existed in primary or long-established woodlands; it had a stem diameter approaching 100 cm, and a clear stem length of 12 – 15 m. before major branching. If of oak, it could be circa 400 years old, but other species such as pine could be less old. A tree of this width, if of oak or other suitable species, can be split radially to make at least 16 planks, each circa 13 m long, circa 40 – 50 cm wide and 12 – 15 cm thick near the (trimmed off) sapwood. Tree A thus yields 16 × 13 × 0.45 = circa 93 square metres of planking. Such a tree might also be split radially into more than 16 thin planks, given an evenly-grained tree and a skilful worker. We will calculate below on the basis of circa 90 square metres of planking from an A tree. The stem could be used as a heavy roundwood post, but branch wood was restricted in useful lengths to perhaps 50 m in total.

Tree B existed in secondary woodland, previously cut-over and opened out, so clear stem length is reduced; if oak, it was 100 years old, with a stem diameter of 40 - 50 cm and a usable stem length of 10 - 12 m. A tree of this width can only be split tangentially if relatively wide planks are needed; it would yield four planks, each 10 m long, circa 35 – 45 cm wide and circa 8 cm thick. Tree B thus yields 4 × 10 × 0.4 = 16 square metres of usable planking. If radially split, into eight planks each only 25 cm wide, the yield is about 20 square metres. Otherwise, the roundwood yield is 10 m of thick stem, and perhaps 100m of useful branch roundwood in short lengths.

Tree C was a younger stem, again in secondary woodland, possibly coppiced oak, ash, lime, or other species such as pine; if oak it was 40 - 50 years old, if pine a younger tree, with a stem diameter of 20 – 30 cm, and a length of 3 – 5 m or so. It would be split tangentially for planks 20 cm wide, or radially for 10 - 15 cm wide timber, and the yield was about 4 square metres per tree. Note that it is the size of trees that we are dealing with, not the species. The stem could also serve as a heavy roundwood post; branch wood would be rather weak.

As noted, these trees could yield not only stems for timber, but also branches and topstems for roundwood. But the main source of roundwood for posts, pegs and rods is likely to have been younger trees of fast-growing species such as hazel, alder, ash and pine. These, as do other trees including oak, respond well to a management system involving regular clearance down to the stool, to encourage new vigorous growth upwards (**fig. 8**). It is not often realized that coppiced or pollarded species can put on enormous rates of growth. An old ash stool, for example, if cut back properly will create in one year 20-30 shoots each 2-3 m long and 1-2 cm diameter. With natural pruning by weather and nutrient supplies, an ash stool 8-10 years old may have about 10-15 shoots left, each 3 m long and 5-8 cm diameter, excluding the topmost very slender shoots; that is 30 m of useful rods. At 15 years, the same species may have 8-15 shoots, each 4-6 m long and 6-10 cm diameter; that is up to 90 m of thick rods. These figures are based on actual observations in a well-watered position where stools were closely-packed, thus forcing the trees to reach upwards to the light.

For more open positions, on a stream bank for example, coppiced alder can provide equally rich yields of useful roundwood poles and rods. At age 3-4 years, a small stool may have 6-10 stems 3-4 m long and 5-6 cm diameter. At 8 years, the stool may have 8 stems 4-5 m long, 6-8 cm diameter, as well as several smaller shoots. At 10-12 years, a stool may carry 12 stems 4 m long and 10-12 cm diameter, plus useful smaller shoots as well as the thinner upper parts of the main stems; the yield is 48 m of heavy rods. At 15-20 years, an alder stool may carry from 6-20 stems, 6-10 m long, with diameters 15-20 cm; in addition, branch wood of exposed trees will also have developed from the larger shoots, providing slender rods. The yield from one such tree could be 20 m of heavy rods, more like small posts, and 40 m of slender rods; from another tree of the same age, up to 160m of rods of 5-15 cm diameter; from a third, 60 m of rods of uniform 15 cm diameter.

The archaeological record from the Somerset Levels and elsewhere speaks of managed woodlands from the Early Neolithic onwards, and of the fact that many trees were coppiced. It is not only ash, alder and hazel that were controlled in this way; oak was too. The point to make is that managed woodlands could and did yield vast quantities of useful wood for all the structures that have survived into the archaeological record, and for most of those that did not as well.

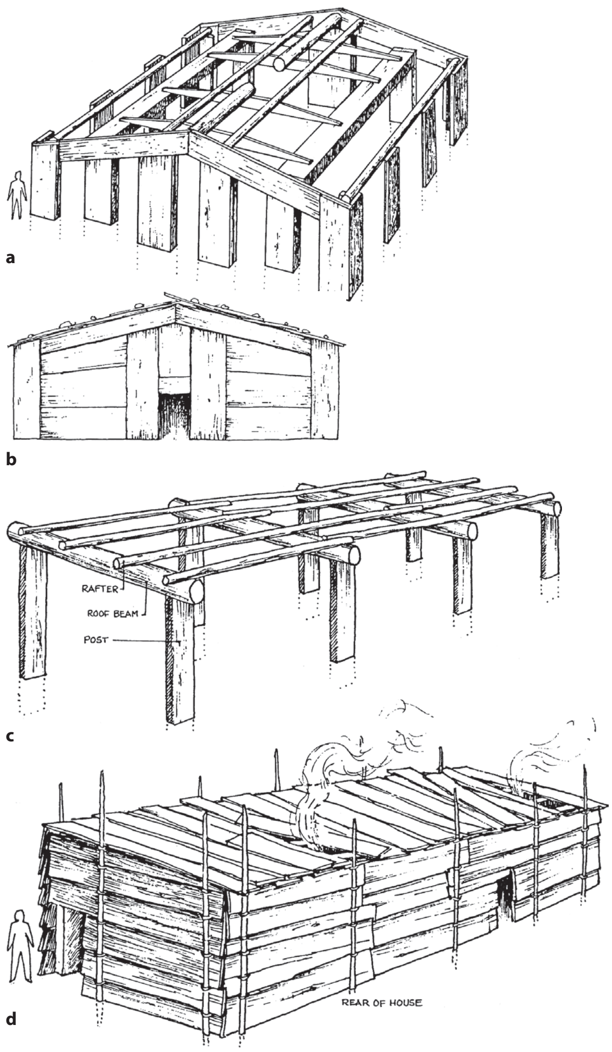
Although our interest here is in the wood for buildings, we should not forget the need by ancient farmers and others for wood for fences, for equipment and above all for firewood. Many records exist for the historic period which speak of the sole reason for the abandonment of a settlement as being the exhaustion of wood for fires.

11. Houses

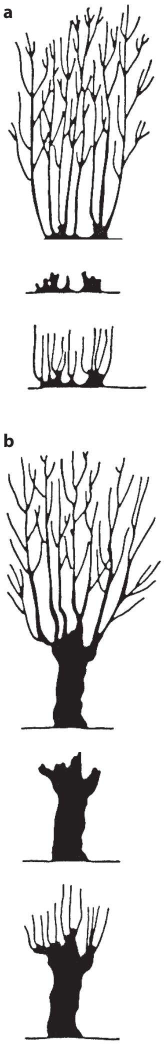
Let us now consider the timber requirements for several different kinds of houses such as are known from the prehistoric and early historic periods in Europe. First, however, there is one obvious remark to make. It will be obvious that different wood species have different characteristics, whether roundwood or timber is created. For example, in its ability to bend, and tendency to split, break or erode, a pine log will differ from an oak log, and an oak from an ash. Even within a single species, there can be considerable variation in growth rate and therefore density and strength. For example, an oak slow-grown in a dense forest may achieve a diameter of 35 cm in 100 years; as a coppiced oak, in a favoured environment, it could reach the same diameter in 35 years. But although of the same size, its strength will be different, as a slow-grown more densely-ringed tree will be in general stronger than a fast-grown less densely-ringed tree. But there can be exceptions to this in terms of, e.g. the degree of bending which a piece will sustain, and this feature alone is often the most crucial in selection of wood for structures. In addition, different parts of the same tree will yield wood of different densities, and hence its ability to be worked and to serve as a load-bearing element; branch wood tends to be more dense than stem wood, and rootwood the least dense, although there are exceptions.

The age of the wood used is an important element in any consideration of ancient buildings and modern reconstructions. At the Neolithic settlement of Hornstadt-Hörnle, extensive tree-ring analyses have shown graphically the variety in age and size of oak timber used in the house constructions over about 80 years (3586 - 3507 BC) (*Billamboz 1985*). The earliest structures were made with 100-year old B trees, radially split into 1/8, 1/12 or 1/16s. Structures built 15 - 20 years later used a mix of B and C trees of 50 - 80 years age, many of smaller diameter; these were split into 1/2, 1/4 or 1/8s. Thirty years later a further group of even younger C trees were used, from a regenerated woodland started at the time of felling of the first episodes; these trees were only 40 years old and of small diameter, split into 1/2 or 1/4s. The final episode of building, some 15 and 30 years later, used B trees from an old stand of oak, over 100 years old, and the wood was split into 1/12 or 1/16s. This final wood may have been standing in a ‚standard- width coppice‘ woodland but is believed to be a different old woodland than the first which had been felled 80 years previously.

There are, broadly speaking, two different ways of using wood in the construction of ancient houses. The first is by utilising the properties of oak and other trees of large diameter to make planks. The other is to use



■ **Fig. 9** (top) a Framework of a Tsimshian house of the northwest coast of America, with (below) the horizontal wall planks fitted into the grooved wall posts. centre. Framework of a Coast Salish shedroof house, with (below) the wall planks set between pairs of poles and tied in place. (after Stewart 1984)



■ **Fig. 8** Sketch of a coppice and pollard system. Top, a hazel coppiced stool with several years' growth of rods; middle, clear-felled of all rods; bottom, one year's rapid growth of straight rods. The pollard system works the same way, but the stem is cut above the height of grazing cattle and deer.

the round stems, or large branches, direct without splitting. In both cases, wall infilling may be by split timber or, more often, by woven wattle and daub. We will look now at several different kinds of houses to estimate their requirements for timber or roundwood; most of these house forms are based on actual excavated examples, and we concentrate on floors and walls rather than the more problematic roofs.

House 1 is 40 m long and 10 m wide with plank walls 2 m high, and it has a plank floor. Thus, 600 square metres of planking is required. That is 6-7 A trees at 16 radials per tree, or 30 B trees. The timber and poles for the roof of this house might require 4 more A trees or 20 B trees.

There seems little point in estimating the time needed to fell and split this wood, as efficiency of ancient tools and men is unknown, but experimental work suggests an A tree might take one hour to fell and one hour to split into 16 radials. A B tree might take 20 minutes to fell, and one hour to complete 5 tangential splits, or 20 minutes to make 8 radial splits. This is 20 man-hours on A trees, or 120 man-hours on B trees, for this house.

House 2 is a long house, 60 m long and 10m wide with plank walls 2.5 m high and an earth floor, like a Viking Age house. That is 350 square metres of timber from 4-5 A trees or 17 B trees or 100 C trees, or any suitable combination. With buttresses (100 square metres) and upper members (4 A trees or 20 B trees), the totals are approximately 10 A trees or 40 B trees. This is not far off an earlier estimate made for the Fyrkat Viking Age house of 50 trees, presumably of both A and B types.

As a comparison, the houses of cedar from the north-west coast of America may be briefly noted here (*Stewart 1984*). Houses were regularly 30 m long and 20 m wide, with corner posts 6 m high; most of the framework was roundwood cedar stems of a diameter of 1.5m. Some of the house posts were larger still. These houses were plank walled and roofed. Yet the native cedar trees available were so large that only two or three could furnish enough posts and planking for this substantial house. Another type of house was also of timber, and one described by a European explorer was 200 m long and 20m wide, with a front wall 6 m high and slanted roof (**fig. 9**); it was built of cedar planks (6500 square metres) and heavy support planks and posts set along the walls as well as in two rows along the interior. This two-aisled 'longhouse' provided shelter for many families; its construction again was no drain on the forests, as one cedar tree might yield almost 1000 square metres of planking. Planks 12 m long and one metre wide are recorded, and their production involved only mallets and wedges.

House 3 is smaller, 10 × 6 m, with front and back walls 2 m high, and 4 m at the ends, and a plank floor; this is like an Anglo-Saxon house in some models. The house would require 2 A trees or 44 B trees or 45 C trees.

House 4 is an Iron Age round house and is based on a well-documented house from the Glastonbury lake village (**fig. 10**). It is 6 m diameter with a planked floor area of 28 square metres The floor would require 2 B or 10 C trees which were growing near the site circa 100 BC; A trees were not available. The plans of house 74 at Glastonbury show the ancient planks clearly, and they fall into three distinct groups: 14 planks 0.5 - 1.5 m long, 17 planks 3.0 - 4.5 m long, and 12 planks 5.0 - 6.5 m long. They average 10cm wide. This is 1-2 B trees, yielding about 30 6 m planks, one set cut into unequal segments. In addition, the house had wattle and daub walls, and this introduces the second element in house construction for long, square and round houses of many periods.

The use of woven panels (hurdles, wattles) for house walls, as well as in roofing, is well attested and there are Neolithic, Bronze Age, Iron Age and early historic panels surviving in waterlogged settlements and trackways (**fig.11**). A convenient size is a panel 3 m wide and 1.5 m high, and this requires about 100 rods 3 m long, and 10 sails 2 m long; that is 320 m of rods. The rods might be of hazel, aged 4-9 years and 20 - 30 mm diameter. They were obtained from hazel or other species, grown from stools in a coppiced system of woodland management. Each stool could yield 15 - 20 rods 2 - 3 m long in every cycle, that is, 40 - 50 m of rods. Thus a panel is the product of 6 - 7 stools, and about one hour's work (*Coles and Darrah 1977*). House 4 had 70 stake or sail holes, arranged to suggest 11 panels each about 2 m wide; at 1.5 m high, that is 600 rods and sails, 1200 m of wood and 25 - 40 stools cleared, as well as the 1-2 B trees felled and split. A standard-with-coppice system in an area of woodland of under l00 square metres would hold all these trees.

House 1, a long house, with wattle and daub walling rather than plank walling would need 100 m of panels, say 35 panels from 210 – 225 stools. With timber panel-supports and other structural pieces, 2 - 3 A trees or 10 - 15 B trees would also be needed. A planked floor would also put demands on timber production.

Many houses of the prehistoric and early historic periods in Europe are not plank built, but rather are formed by the skilful relationship of vertical and horizontal roundwood posts and poles, and this has important implications for the character of ancient woodlands. These houses often have walls of wattle and daub, and others have infilled horizontal planks set between the major uprights. Sometimes the wall construction is not uniform, and a major part of the house may be of post and wattle construction, with an end portion of plank construction. Houses of the Bandceramic tradition are sometimes of this type. House 5, based on this model, is 30 m long and 8 m wide, and would need 40 wall posts 2 m long, and 56 planks each 50 cm wide; thus perhaps 10 B trees and 4 A trees. The internal posts for such houses are of larger diameter than the wall posts and this might mean 30 heavy internal posts, 10 of which were 5 - 6 m long from 5 A trees, and 20 of 4 m length from 5 A/B trees. The major horizontal roofing members would total 90 m, from 6 B trees. The overall sum is thus 9A, 5 A/B, 19 B trees. The wall infilling is of course extra, about 5,000 m of rods from 250 coppiced stools; this all could have been growing in about 1,000 square metres of managed woodland with both standard trees and coppiced hazel or other species.

House 6 is a long house of the early historic period in northern Europe and might be 35 m long, 5 m wide; such a house will have 90 wall posts of 15 cm diameter and 2 m long, and 30 internal posts for the roof of 20-25 cm diameter and 3 - 4 m long. This is about 300 m of B tree 30 stems, say B trees. The panel infilling for 80 m would require almost 10,000 m (about one tonne) of coppiced rods and sails, from 500 stools.

House 7 is a log and plank built cabin from the Iron Age settlement of Biskupin. There were over 100 of these structures at the site. Each required about 10 B trees and 35 C trees, much of it from managed woodland. The whole site, with its palisade, roadways, gateways and outworks would have required a very large amount of wood from a wide area of organised forest. In comparison, several medieval or later timber built houses have been assessed for their requirements. A house 12 × 5 m would have needed about 80 C trees, and one 20 × 6 m would require over 300 trees, mostly of C type. A cathedral with a wide roof span would involve A or A/B trees; Norwich Cathedral is estimated to have required almost 700 A/B trees. But an ordinary large three-decker ship of the line in the 17th century needed 3,500 A/B trees, from about 900 acres of woodland.

Some may question the precise quantities of wood for these houses, and I have paid little attention to roofing roundwood, but it is surely of importance that the large amount of straight stems, fine timber, and the enormous quantities of rods and slender poles signify the existence of well-managed woodlands with stands of coppiced trees and tall standards. Such woodlands were in existence at least 6,000 years ago, and probably much earlier. Man's reliance on wood for more than houses must mean that care and attention was given to the control and management of the trees in his territory. Cyclical felling, and planting of whips and shoots, must have been a feature of life, and the woodlands thus in a sense owned and controlled. The very great value of A trees, and the need to ensure a good supply of B and C trees, as well as the continuing maintenance of the coppice cycles, all suggest an interest on the part of early communities in their woodland resources that was more organised than the term ‚wildwood' implies. It was wildwood in part, but domesticated as well.

References

Billamboz, A. 1985: Premieres investigations archeodendrologiques dans le champ de pieux de la station Hornstaad-Hornle I sur les bords du lac de Constance. Berichte zu Ufer- und Moorsiedlungen Sudwestdeutschlands 2, 125-147.

Coles, B. and J. 1986: Sweet Track to Glastonbury. Thames and Hudson, London.

Coles, J. M. and Orme, B. J. 1985: Prehistoric woodworking from the Somerset Levels:3. Roundwood. Somerset Levels Papers 11, 25-50.

Coles, J. M. and Darrah, R. J. 1977: Experimental investigations in hurdle-making. Somerset Levels Papers 3, 32-38.

Darrah, R. 1982: Working unseasoned oak. In S McGrail (ed) Woodworking, techniques before AD 1500, 219-229. British Archaeological Reports S129.

Orme, B.J. and Coles, J.M. 1983: Prehistoric woodworking from the Somerset Levels. Timber. Somerset Levels Papers 9, 19-43.

Orme, B.J. and Coles, J.M. 1985: Prehistoric woodworking from the Somerset Levels: 2. Species selection and prehistoric woodlands. Somerset Levels Papers 11, 7-24.

Rackham, O. 1980: Ancient Woodland. Its history, vegetation and uses in England. Arnold, London.

Stewart, H. 1984:. Cedar. Tree of life to the northwest Coast Indians Douglas and McIntyre, Vancouver

Summary

Altes Holz, Holzarbeiten und hölzerne Häuser

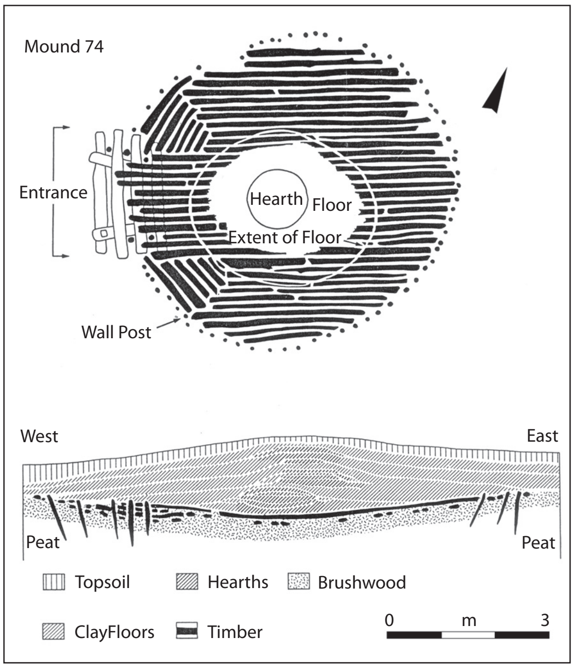
Feuchtgebiete wie die Somerset Levels bewahren in ihren Mooren nicht nur die hölzernen Elemente von Wegen, Plattformen oder anderen Strukturen wie Häusern, sondern sind gleichzeitig auch eine Quelle für die Waldbereiche, die in der näheren und ferneren Umgebung existiert haben. Sie stellen damit ein wichtiges Archiv der im Laufe der ur- und frühgeschichtlichen Zeit wechselnden Nutzung von Primär- und Sekundärwäldern, zur Entwicklung der damaligen Waldnutzungsmethoden und zur Gewinnung von bevorzugten Holzarten für spezielle Bedürfnisse des Menschen dar.

Die archäologische Überlieferung der Somerset Levels und anderer Feuchtgebiete zeigt die Existenz von systematisch genutzten und gepflegten Wäldern seit dem frühen Neolithikum an, viele Bäume wurden dabei einer Schneitelung unterzogen. Es handelt sich dabei nicht nur um Esche, Erle und Hasel, die auf diese Weise behandelt wurden, sondern eine systematische Nutzung lässt sich auch für die Eiche feststellen. Es ist dabei hervorzuheben, dass entsprechend kontrollierte Waldbereiche eine große Menge an Nutzholz für alle möglichen Zwecke bieten konnten und sicher auch boten, nicht zu vergessen dabei der Bedarf der frühen Bauern an hölzernem Material für Zäune, Geräte und vor allem auch Brennholz.

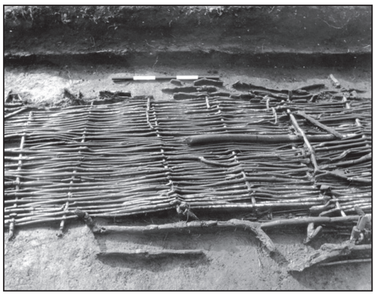
Bois préhistoriques, travail du bois et maisons en bois

Des tourbières, telle Somerset Levels, cachent non seulement des restes de santiers de caillebotis, de plate-formes de bois et d'autres structures, y compris des maisons, mais encore un enregistrement du développement des forêts dans la région, elles rendent des témoignages importants de changements d'exploitation des forêts primaires et secondaires, de l'évolution de la gestion des forêts et d'une exploitation sélective de certaines essences.

Des documentations archéologiques établies à Somerset Levels et sur d'autres sites révèlent la gestion des forêts dès le début du Néolithique, un rajeunissement de nombreux arbres. Il ne s'agit pas seulement du frêne, aulne ou noisetier, le chêne a été soumis, lui aussi, à cette gestion. Il faut remarquer que les forêts gérées étaient en mesure de produire et, en fait, elles produisaient une quantité importante de bois d'œuvre; il ne faut pas oublier que les agriculteurs/éleveurs préhistoriques en avaient besoin beaucoup pour pouvoir faire leurs habitations, des clôtures, du mobilier et surtout pour chauffer.



■ **Fig. 10** Plan and section of an Iron Age house from the Glastonbury lake village, Somerset.



■ **Fig. 11** Neolithic hurdles from the Somerset Levels. These were laid on the marsh to form a footpath but are otherwise of the type used extensively in wattle and daub house construction. (photo J. M. Coles)