

## TRACKWAYS AND TREE TRUNKS—DATING NEOLITHIC OAKS IN THE BRITISH ISLES

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### ABSTRACT

The Midlands and South-west of England are represented by a long oak tree-ring chronology spanning approximately 4500-3900 BC (calibrated radiocarbon dates). The wood on which it is based originates in a technologically advanced trackway crossing the low-lying Somerset Levels, in a coastal submerged forest probably killed by rising sea-level, and in flood-plain oaks washed down the River Trent. Cross-matching between the growth patterns of the three groups of trees is of good quality, yet so far the chronology has failed to cross-date with the long Irish and German dated chronologies. The reasons for this, and the implications of eventual dating, are discussed.

Für die Midlands und den Südwesten von England existiert eine lange Eichenjährringchronologie von etwa 4500-3900 v.Chr. (Geeichte C14-Daten). Das Holz stammt von einem technologisch fortschrittlichen Bohlenweg aus den unteren Somerset Horizonten, von einem versunkenen Küstenwald, der vermutlich beim Anstieg des Meeresspiegels abgestorben ist, sowie von Eichen, die von einer Überflutungsebene in den Fluß gespült worden sind. Die Jährringmuster der drei Baumkollektive zeigen untereinander eine hohe Ähnlichkeit, aber ihre Chronologie konnte bislang noch nicht mit den langen irischen und deutschen Chronologien datiert werden. Die Gründe der Undatierbarkeit sowie die Folgen einer eventuellen Datierung werden diskutiert.

Les régions centrales et sud-ouest de l'Angleterre sont représentées par une chronologie longue de chêne (*Quercus* spp.), qui s'étend de 4500 à 3900 av. J.C. (datations calibrées radiocarbone). Cette chronologie est basée sur des bois provenant d'une route construite par une technologie supérieure qui traversait une région basse connue sous le nom des Somerset Levels; d'une forêt submergée sur la côte, inondée probablement par des marées montantes; et des chênes transportés par le fleuve du Trent. La correspondance entre les courbes dendrochronologiques des trois groupes d'arbres est de bonne qualité, néanmoins la courbe moyenne ne synchronise pas avec les chronologies longues datées de l'Irlande du Nord et de l'Allemagne. Les raisons pour ce désaccord, et les implications d'une datation éventuelle, sont considérées.

### THE POSSIBILITIES OF PREHISTORIC DATING.

The construction of a long dated oak (*Quercus* spp.) tree-ring chronology for the British Isles has been in progress since the late 1960's (Baillie 1982), and has had a number of aims. Of great importance was the need to provide a calibration of the radiocarbon time-scale (Pearson *et al* 1983; 1986) independent of that established on bristlecone pine (*Pinus aristata/longaeva*) (Ferguson 1969). Another major application was the absolute dating of oak timber found on archaeological sites, and of trees killed by natural events. These have often been preserved by natural waterlogging. Tree-ring dating, especially when the outer sapwood (of estimable

width) is preserved on an oak timber, provides a chronological framework for associated archaeological and environmental deposits unsurpassed in its precision.

The long Irish chronology is based in its earlier sections on aged oaks found in peat deposits in Northern Ireland during motorway construction (see Fig. 1; Baillie 1982). It has recently been completed back to 5289 BC (Pilcher *et al* 1984). The Irish chronology is paralleled by a further chronology back to 4144 BC, based on trees from the gravels of the River Danube and on bog oaks and archaeological material from central and northern Germany (Becker & Schmidt 1982; Becker 1983).

Thus the prospect of dating finds of prehistoric wood in the British Isles has now become a reality. A few successful attempts have so far been reported. Bog oaks from Swan Carr in the Durham area of eastern England (Fig. 1) span 1155 to 381 BC, and an extensive series from the East Anglian Fens are dated through the period c3200 to 1700 BC (Baillie pers. comm.). Archaeological material from the Cullyhanna 'hunting lodge' in Northern Ireland was the first to be dated precisely (Hillam 1976; Baillie 1985); the palisade was made from trees felled in 1526 BC. Recently Irish trackways have been dated—Corlea to 148 BC (Raftery 1986) and Timahoe in two phases to c1380 BC and c1470 BC (Baillie 1985). In eastern England, the Hasholme log boat was made from a tree felled in the range 322-277 BC, and the Fiskerton 'causeway' proved to be a multiphase site with felling dates between 457 and 339 BC (Hillam in prep.).

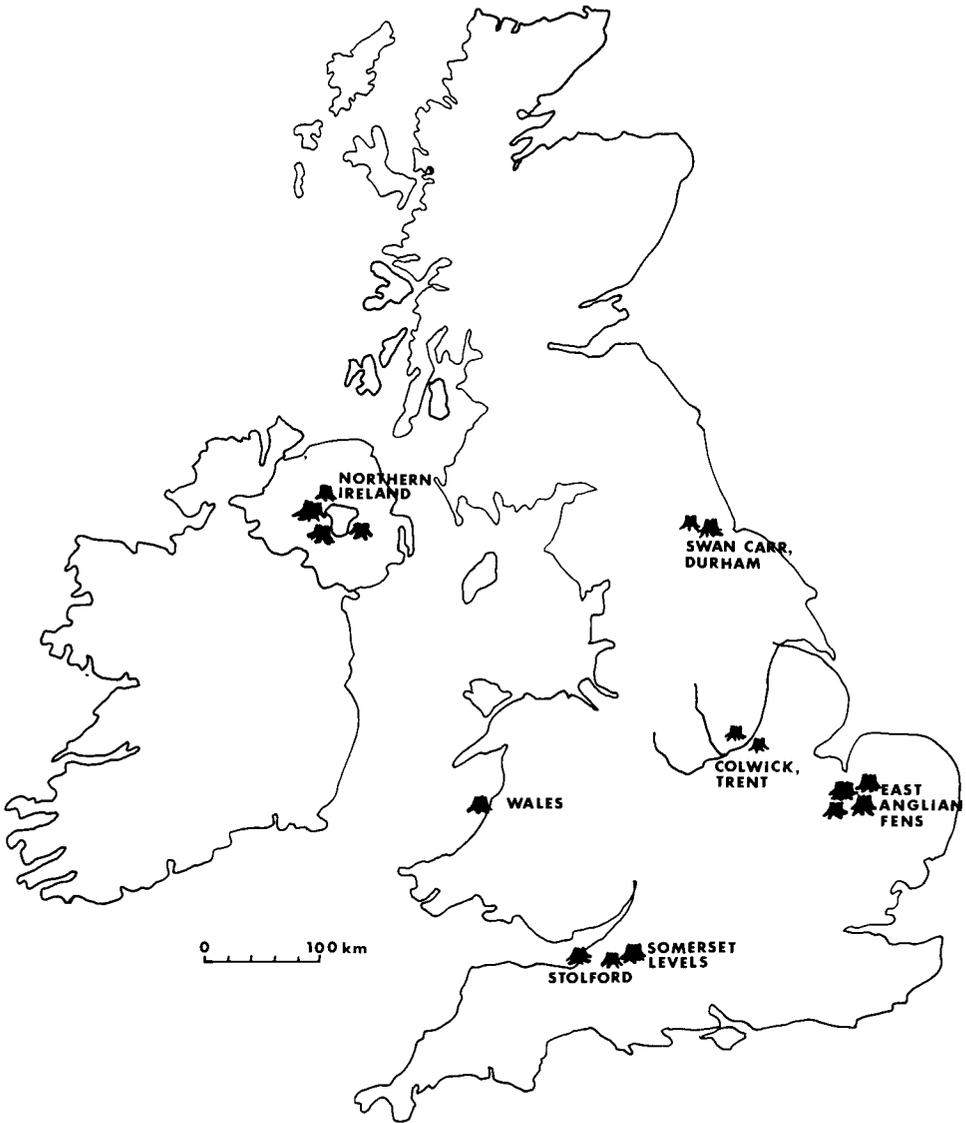
Over the past decade, several other chronologies have been developed in England at three distinct topographic settings—the peat bogs of the Somerset Levels, the 'submerged forests' off the British coast, and oaks buried in the floodplain deposits of the River Trent (Fig. 1). It is known that these three chronologies all date from the fourth millennium BC, but until recently they had not been successfully linked together. This paper describes their origins, cross-matching and attempts at absolute dating.

### THE SOMERSET LEVELS

The first chronology (Morgan 1984) represents over 250 wide oak planks used in the world's oldest trackway, the Sweet track (Fig. 2). This complex structure is known to have extended over some 1800m, enabling Neolithic people to cross the swampy Somerset Levels in south-west England (Coles & Coles 1986). The raised plank walkway was supported by a substructure of pegs and rails, and a study of all the wood gives some indication of the nature of the woodland clothing the surrounding limestone hills in the fourth millennium BC. Most of the planks were radially split from a few very aged oaks, over 400 years old and over 1m in diameter, though it is known from the tree-ring evidence that a second group of smaller trees, about 150 years old, had been exploited for the southern end of the track (Morgan 1984). Felling and splitting had taken place with stone axes and wooden wedges.

Cross-matching of ring patterns from the well preserved planks resulted in a chronology of 410 years (Morgan 1984). The most recent ring was equivalent to the year in which the trees were felled, since the entire sapwood zone and bark surface could be identified on several planks.

Radiocarbon dates have indicated a span of c.3600-3200 bc for the chronology, which becomes older by some 500-600 years when converted to calendar years using the bristlecone pine calibration (Klein *et al* 1982) or the Irish oak calibration (Pearson *et al* 1986).



**Figure 1.** Sketch map of the British Isles, showing the major sources of prehistoric wood, both archaeological and subfossil.



**Figure 2.** The Sweet track in the Somerset Levels, south-west England, constructed in the early fourth millennium BC. This section was exposed in 1973 during peat extraction. The rails and crossed pegs supported oak planks, one of which remains in place above the scale. Over 260 planks contributed to a 410 year tree-ring chronology. Photo: J. M. Coles.

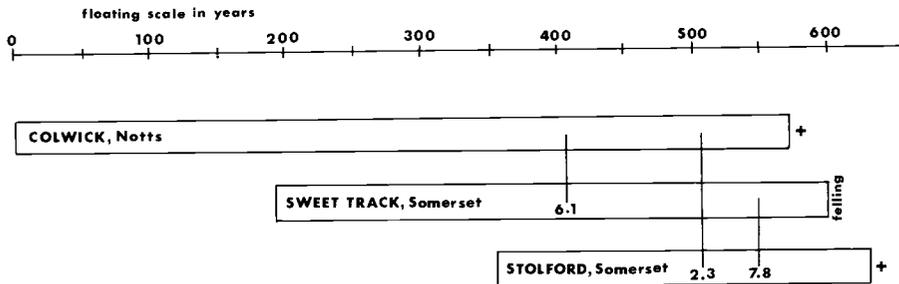
### SUBMERGED FORESTS

'Submerged forests', exposed at low tide along the shores of England, have been under study since the last century. The fen and salt-marsh peats provide the material used in the studies of Holocene sea-level changes and coastal ecology (for example, Tooley 1974). Slices of trees in the 'submerged forests' of the Bristol Channel in South-west England (Fig. 1) were studied by Heyworth (1978). Of particular importance were the dendrochronological studies from those trees exposed on the shoreline at Stolford, not far from the prehistoric trackways of the Somerset Levels. The Stolford trees were rooted in a series of freshwater swamp peats and marine silts, and had been killed by waterlogging induced by a rising sea-level. Attempts to cross-match their ring patterns, and those from other such deposits on the Welsh coast (Fig. 1), had been made by Heyworth (1978), and they were also the subject of a detailed series of radiocarbon analyses by Campbell and Baxter (1979). The radiocarbon analyses suggested that some trees might span a similar period of time to those of the Sweet track in the Somerset Levels.

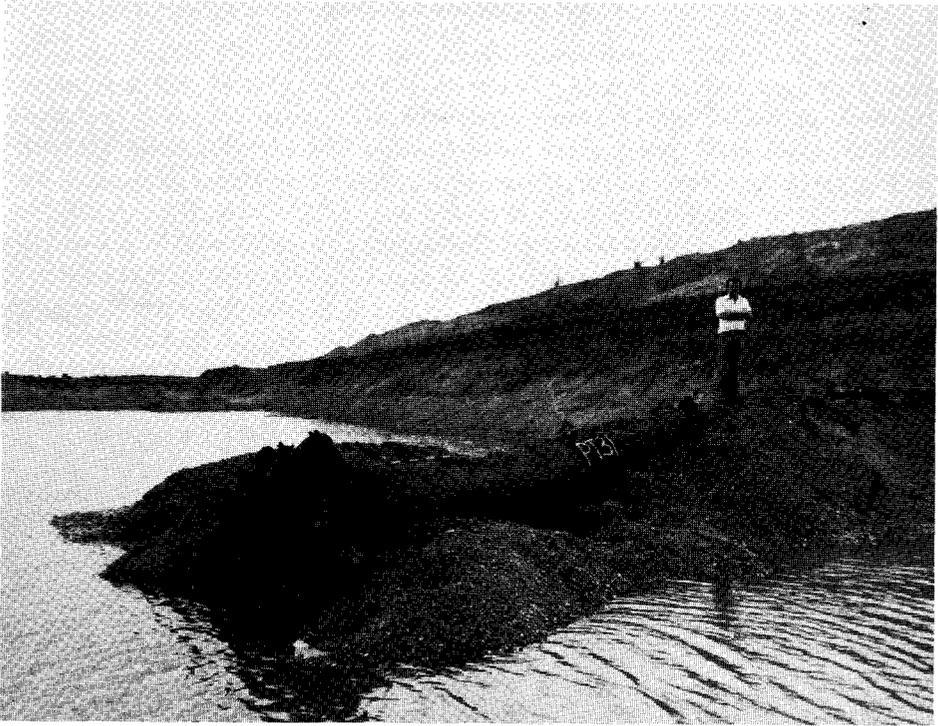
Recently Morgan and Heyworth compared the growth increment sequences from the Stolford submerged trees and the Sweet track planks. Examination of Fig. 4 shows that at least two of the Stolford trees (2 and 3) had been growing at the same time as each other and as the trees used in the Sweet track, and they demonstrated a very similar pattern of growth. Their correspondence was measured by the CROS program (Baillie & Pilcher 1973) as Student's *t* values; the *t* value for the match between the Stolford and Sweet chronologies was 7.8.

The Stolford ring pattern extended 32 years beyond the end of the Sweet chronology (Fig. 4); since little sapwood survived the processes of coastal erosion, the Stolford trees were probably killed at least 50 years after the construction of the Sweet track.

It is possible that a link exists between the silting up of the drainage system through the Somerset Levels, which necessitated the building of a trackway to keep open an established route, and the flooding and changes in the coastal topography which led to the death of the Stolford trees.



**Figure 4.** Bar diagram showing the time span of the three site chronologies included in the Neolithic master chronology, as yet floating in time but thought to span approximately 4500-3900 BC. Outer rings were missing from the Colwick and Stolford trees, but the bark surface on one plank defined the end of the Sweet chronology. Vertical bars give Student's *t* values, showing the degree of similarity between the chronologies.



**Figure 3.** One of the oak trees exposed in river gravels of the Trent at Colwick, near Nottingham. Photo: C. R. Salisbury.

### FLOODPLAIN OAKS OF THE RIVER TRENT

Gravel extraction in the floodplain deposits of the River Trent has exposed large numbers of ancient oak trees in the Trent valley, at Colwick near Nottingham (Fig. 1,3). The trees had been washed down from farther upstream, where they probably grew on the alluvial soils of the floodplain. Studies by members of the Tree-Ring Dating Laboratory of Nottingham University showed that a total of 27 tree-ring curves could be cross-matched to produce a 576 year chronology. Radiocarbon dates suggested a time span in the fourth millennium BC (Salisbury 1980; Salisbury *et al* 1984).

A detailed chronological sequence for the cross-dated trees was difficult to establish owing to the lack of sapwood; it seems that the trees died at intervals throughout several centuries, and were not killed by a single flooding episode.

The Colwick chronology was compared, using the CROS program, with the Sweet track chronology, and revealed similarities of pattern ( $t = 6.1$ ) over their common time span of some 400 years. Their component trees must have been growing at least 150km apart. The match between the Colwick and Stolford chronologies was not as good ( $t = 2.3$ ), though with a much shorter overlap.

## ATTEMPTS TO DATE THE CHRONOLOGIES

The three correlated chronologies were averaged into a new English Neolithic master chronology spanning 631 years. In view of the length of the chronology, there was a high expectation of success in cross-matching with the long Irish chronology. The approximate time span of the chronology could be calculated to around 4500-3900 BC by calibrating the extensive series of about 15 radiocarbon dates available from the combined curves.

Extensive computer comparisons and visual checks have been made by Morgan, and by Munro in the Belfast Tree-Ring Laboratory (Munro 1984), between the Neolithic master and the Irish long chronology, as well as their respective components. However, every effort to confirm even slight indications of cross-matching has so far led to failure. In consequence, the new English Neolithic chronology must remain floating in time, until further data can assist in assigning calendar years to its growth rings.

The reasons for the lack of common signal are unclear, particularly since the Irish chronology has been successfully applied to so much material from eastern England. Differing climatic conditions in central and south-west England may have led to variations in tree growth sufficiently great to mask any slight similarities in pattern. The trees may have grown under varying conditions, although it is not always clear in what they were rooted. It is thought that the Irish oaks actually grew in peat (Baillie 1982), as did the Fenland oaks (Godwin 1978); the Trent oaks probably grew on fertile alluvial soils, the Sweet track oaks on low limestone hills and the Stolford oaks in coastal woodland associated with limestone soils and later with brackish water. The origins of the trees thus varied considerably, yet their conditions of growth have led to two separate, but internally consistent, groups of tree-ring patterns.

There may be some significance in the fact that three chronologies span the same few centuries in the fifth-fourth millennium BC, when there are so few finds of wood or other chronologies for the entire prehistoric period. The coastal oaks were probably killed by saltwater inundation, and the Trent oaks by occasional flooding. The Sweet track oaks were deliberately felled by the local population, in response to a need to maintain a route across increasingly wet low-lying swamp, and the trackway was engulfed by peat growth within a few years. In all cases, there are thus indications of increasing wetness during the same one or two centuries.

## APPLICATIONS OF A NEOLITHIC CHRONOLOGY

Absolute dating of this long Neolithic chronology is of high priority and would have widespread implications.

Firstly, the precise year of construction of the unique Sweet track could be ascertained, giving dates for its associated jadeite and flint axeheads and fine carinated bowls (Coles & Coles 1986). Some of these artefacts do not occur in a dateable context anywhere else in Britain. Dating would also enable close links to be established with the extensive series of lakeshore settlements in Switzerland already dated by tree-rings (Ruoff 1981).

Secondly, dating would be possible to within decades of the death of the valley floor and coastal woodland oaks. The latter in particular are vital in understanding the progress of sea-level rise around the west coast of Britain.

Thirdly, the chronology would add to the existing network of dated material, and would enable further archaeological and subfossil wood to be dated.

It is hoped therefore that the combined efforts of several tree-ring laboratories, and the continued search for new sources of prehistoric wood, can eventually resolve the difficulties of dating such a long, well-replicated and geographically widespread tree-ring chronology.

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