

## DATING THE GEOGRAPHICAL MIGRATION OF *QUERCUS PETRAEA* AND *Q. ROBUR* IN HOLOCENE TIMES

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### ABSTRACT

Huber identified in samples from the forests of central Europe features for characterising by their wood structure the two species of British oak. We have confirmed for recently felled oaks the suitability of his method of analysis and applied it to timbers from ancient buildings and to samples from sub-fossil oaks.

The two species appear to have persisted in separate locations during the last ice age. Such analysis of the numerous Holocene oaks in Europe now being dated by dendrochronology offers the possibility of studying the separate migration of the species.

Huber's interest in research led him to examine the validity of the opinion that prevailed among foresters in Europe that certain species distinguishable by botanical features such as the leaf and fruit, could not be distinguished by anatomical differences in their wood.

The wood of discs of sessile and pedunculate oak (*Quercus petraea* and *Q. robur*) taken from trees that had grown in different areas of Germany and the surrounding region were examined by him and his colleagues at the Tharandt Forestry Institute near Dresden (Huber, Holdheide, and Raack 1941). It has long been recognised that the two species now occur together in many parts of Europe. In some areas, however, only one exists, e.g. the pedunculate oak in much of eastern Europe, the sessile in certain areas near the Atlantic coast. The pedunculate is suited to valleys and moist lowlands, the sessile oak to hilly terrain. The leaves of the species suggest the existence of hybridisation but the current view (Cousens 1965) is to regard leaf variations as arising from introgression between the species over a number of centuries.

Huber's analysis led him to select four features as characterising each species. Two, the number of rows of vessels in the earlywood and the fraction of annual growth formed by the earlywood, are quantitative but suffer from being limited to relatively wide (> 2mm) growth rings. The other two, the shape of the vessels in the earlywood, and the shape of the flames in the latewood, are qualitative. Table 1 gives our description of the four features (Nos 1-4) and adds a fifth that we find useful.

Such was the variability of the wood structure of the samples examined by Huber that the occurrence of all four of the criteria for sessile, or all four for pedunculate was relatively uncommon. So the condition for deciding the species was based, with certain provisos, on the presence of three of the four features. This gave the correct result for 69 out of 76 samples.

Those principles have been verified here (Walker 1978) with samples from felled trees of the two species that have grown adjacently in experimental plots in Bagley Wood near Oxford. Analysis has already been applied to certain categories of oak timber (Table 2), and samples in the course of being dated by dendrochronology are now routinely examined by us for species differentiation. When, however, the timber is composed almost entirely of rings of slow growth, characterization of the species is usually not possible.

**Table 1.** Features for characterising the wood of pedunculate and sessile oak.

| A. For annual rings $> 2$ mm wide                     | Pedunculate   | Sessile   |
|---|---|---|
| 1. Number of rows of vessels in the earlywood.        | 3 or more   | 1 or 2<br>exceptionally 3   |
| 2. Fraction of total width taken up by the earlywood. | Over 25%  | Under 25%   |
| 3. Transition from earlywood to latewood.             | Gradual   | Abrupt  |
| B. For rings irrespective of their width              |   |   |
| 4. Shape of vessels in the earlywood.                 | Oval. Often crowded and distorted.  | Almost circular. Uncrowded.   |
| 5. Appearance of "flames" in the latewood.            | Club-like: broad towards end of year or, if not, bifurcation frequent: diffuse. | Straplike or streamlike and bifurcation, if present, weak: small and clear. |

\*Not applicable to the first 5 to 10 rings from the pith.

**Table 2.** Characterisation of species in historic and prehistoric oak.

| Approx Date of use | Samples             | Origin                         | Number of Trees | Characterised as Pedunculate | Sessile |
|--------------------|---------------------|--------------------------------|-----------------|------------------------------|---------|
| 1200 to 1650 A.D.  | Building timber     | S.E. England                   | 76              | 44*                          | 23*     |
| 1400 to 1600 A.D.  | Panels for painting | England, France                | 12              | 6                            | 2       |
| 6000 to 0 B.C.     | Sub-fossil          | River terraces, central Europe | 8               | 8                            | Nil     |

\*Includes 14 and 10 respectively, classified as probable.

Application of the method to samples of Quaternary interest is still in its infancy. However, Dr. Becker recently selected samples, of increasing age up to about 6000 years, recovered from central European rivers for me to examine. All were identified as pedunculate. It may be possible in due course to plot distribution maps for the two species at different dates (derived from dendrochronology) and so gain more information about their migration in Europe during the Holocene.

### ACKNOWLEDGEMENTS

I am grateful to Mr. F.S. Walker and to Miss Louise Midgley for analysing many of the samples listed in Table 2, and to the former for bringing his wide experience of forestry and forest science to bear on this piece of research.

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