TREE-RING ANALYSIS OF TIMBERS FROM THE WHITE SWAN PUBLIC HOUSE, MARKET PLACE, LEEK, STAFFORDSHIRE

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With a building description and history by Faith Cleverdon

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SUMMARY

Tree-ring analysis of seven out of eight samples obtained from the three surviving trusses within the White Swan public house, Leek (one sample having too few rings), shows that all the dated timbers were cut as part of a single programme of felling undertaken between 1531–56.

From the material analysed a single site chronology was created, LEKDSQ01, this comprising five of the seven analysed samples. This has an overall length of 83 rings, these rings being dated as spanning the years 1436–1518.

Two measured samples remain ungrouped and undated.

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Introduction

Leek's thirteenth century town charter gave each burgher the right to have timber for building, and a court roll dating to 1548 indicates that this remained the practise until at least the sixteenth century. For the town itself, and those parts of Leek parish that lay on the Sherwood Sandstone, timber remained the most important building material until the seventeenth century.

The humbler houses of Leek were cruck framed. Urban examples include 2–4 Clerk Bank, the Black Swan public house (Howard *et al* 1998), and 'Old Timbers' on Stockwell Street. Wealthier people built box-framed buildings. These allowed more spacious surroundings and better headroom on the upper floors. Outside the town centre the earliest examples of box-framed buildings are to be found at Mosslee Hall, and the Hall House, both in Cheddleton (Howard *et al* 1998).

The White Swan public house stands to the north-west corner of the Market Place in Leek, at the junction of the A523, (Church Street/Stockwell Street) and the A520 (SJ 982 565, map Fig 1). Substantial traces of the original building survive. The oldest portion lies below the three roof trusses sampled for this report.

These trusses, A, B, and C, each consist of a tiebeam with a pair of principal rafters supporting double side-purlins. The absence of a ridge purlin, the presence of curved windbraces, and the use of coupled rafters, which in the case of the common rafters are placed broad-side down, are the features which indicate the buildings was in place by the 16th century. In addition, the in-fill panels appear to be large rectangles formed by studs without using a mid-rail, also a pre-seventeenth century detail. Both original end trusses, Truss A and truss C, were closed trusses (i.e. they had solid walls), but the central truss was open indicating a single clear attic space rather than two rooms as at present. A single empty mortice for a windbrace on the eastern side of Truss C indicates the building continued eastward (towards the Market Place).

Truss A represents the western gable of the original house, the filling of its panels being brick nogging. Since a further bay was added at this end in the seventeenth century or early eighteenth century, (represented by hog-backed coping on the exterior and a stone gable-end visible only in the roof-space), the brick nogging in-fill must have been original to have become so worn.

The present, bland facade to the east is an approximation of a frontage taken down in the 1980s, when the main pieces of timber were removed to a carpenters' workshop where the replacement frame was constructed. A video of this work made by the then licensee, Mr. O'Hagen, indicates the replacement is correct in outline but omitted all decorative details and failed to reproduce the original construction techniques.

Decorative detail from the video

The window openings are framed as part of the main construction; the studs run the full height of the storey, and have short lengths of timber inserted between, which is the reverse of the technique employed in the seventeenth century; and no provision is made for an attic window, which certainly existed at the time of the 'restoration', and is a standard feature where the attics were an essential part of the accommodation. In addition some very fine ornamental brackets and the mullions of a timber-framed window existed to the right of the present main doorway, all of which have been replaced in rendered brick. What could be told from the video was that the eastern part of the building had been built / rebuilt in the early seventeenth century using close-studding with mid-rails.

The ground floor plan of the timber-framed building was extremely simple, with two main rooms, one in each half of the main range, and a small room near the entry. At some point a further bay with a stone gable containing a chimney was added to the entry end. An inventory of the owner of this time, Thomas Bowers, suggests this had taken place by 1639.

The most important later addition was the Assembly Room, which was in use by 1789. Built of brick, this is a fine, symmetrical room with a shallow bow window at each end, and two fireplaces on the east wall (one now pierced to give access to the kitchens). The adjacent house and shops were part of the same build. Also of this period is the northern extension. Seen from the north it has two wide sash windows each with a pair of narrow flanking sashes set symmetrically either side of a slight recess with pilasters. This now contains a sash window that is clearly of a later date. At basement level the recess leads to an area with incurving brick horns, once a major entrance to the cellars. The window above replaces a doorway, which was formerly accessed by a flight of steps that must have provided the main entrance from Mill Street for those arriving by carriage, which entered via the newly built extension, which served as a reception area.

The earliest documentary reference to the building, though not by this name or indeed as an inn, is an extract from the deeds dated to 1565, with the sale of a

property by Sir Ralph Bagnall to George Vicgars. George Vicgars died in 1598, with one of his three daughters, Margaret, eventually inheriting the property. Margaret married one Thomas Bowers who, it is believed, built the additional bay to the east end. It is probable that the building became an inn during this time, being described as such in the inventory made at the time of Thomas Bowers' death in 1639. It is not until 1693, however, that a name, the Green Dragon, is mentioned. By 1781 it had become known as the Angel, with the name finally becoming the Swan by 1786.

Faith Cleverdon, September 2009

Sampling

Sampling of timbers within the White Swan was commissioned by the Moorlands Partnership and funded by Staffordshire County Council and Staffordshire Moorlands District Council. This was undertaken as part of a programme of research into the development of the town as represented by its historic buildings, medieval and town and the historic buildings of Leek, and as an aid to the better management and maintenance of the town's built fabric. It was hoped that tree-ring analysis would determine the date of the primary, timber-framed, phase of the building, and establish the development of this area of Leek with greater reliability.

Thus, from the timbers available at total of eight core samples was obtained. Each sample was given the code LEK-D (for Leek, site "D") and numbered 01–08. The positions of these samples were marked at the time of sampling on sections and plans made and provided by Faith Cleverdon, buildings archaeologist. These are reproduced here as Figure 3. Details of the samples are given in Table 1. In this Table, all trusses and the individual timbers have been identified following the schema of the drawings provided.

The Nottingham Tree-ring Dating Laboratory would like to take this opportunity to thank the Moorlands Partnership for commissioning this work and both Staffordshire Moorlands District Council and Staffordshire County Council for their generous funding and support. We would also like to thank Faith Cleverdon for the building history and description used in the introduction above and for the use of her plans and drawing elsewhere in this report.

Tree-ring dating

Tree-ring dating relies on a few simple, but quite fundamental, principles. Firstly, as is commonly known, trees (particularly oak trees, the most frequently used building timber in England) grow by adding one, and only one, growth-ring to their circumference each, and every, year. Each new annual growth-ring is added to the outside of the previous year's growth just below the bark. The width of this annual

growth-ring is largely, though not exclusively, determined by the weather conditions during the growth period (roughly March – September). In general, good conditions produce wider rings and poor conditions produce narrower rings. Thus, over the lifetime of a tree, the annual growth-rings display a climatically influenced pattern. Furthermore, and importantly, all trees growing in the same area at the same time will be influenced by the same growing conditions and the annual growth-rings of all of them will respond in a similar, though not identical, way.

Secondly, because the weather over any number of consecutive years is unique, so too is the growth-ring pattern of the tree. The pattern of a short period of growth, 20, 30 or even 40 consecutive years, might conceivably be repeated two or even three times in the last one thousand years. A short pattern might also be repeated at different time periods in different parts of the country because of differences in regional micro-climates. It is less likely, however, that such problems would occur with the pattern of a longer period of growth, that is, anything in excess of 54 years or so. In essence, a short period of growth, anything less than 54 rings, is not reliable, and the longer the period of time under comparison the better.

The third principle of tree-ring dating is that, until the early- to mid-nineteenth century, builders of timber-framed houses usually obtained all the wood needed for a given structure by felling the necessary trees in a single operation from one patch of woodland, or from closely adjacent woods. Furthermore, and contrary to popular belief, the timber was used "green" and without seasoning, and there was very little long-term storage as in timber-yards of today. This fact has been well established from a number of studies where tree-ring dating has been undertaken in conjunction with documentary studies. Thus, establishing the felling date for a group of timbers gives a very precise indication of the date of their use in a building.

Tree-ring dating relies on obtaining the growth pattern of trees from sample timbers of unknown date by measuring the width of the annual growth-rings. This is done to a tolerance of 1/100 of a millimeter. The growth patterns of these samples of unknown date are then compared with a series of reference patterns or chronologies, the date of each ring of which *is* known. When the growth-ring sequence of a sample "cross-matches" repeatedly at the same date span against a series of different relevant reference chronologies the sample can be said to be dated. The degree of cross-matching, that is the measure of similarity between sample and reference, is denoted by a "*t*-value"; the higher the value the greater the similarity. The greater the similarity the greater is the probability that the patterns of samples and references have been produced by growing under the same conditions *at the same time*. The statistically accepted fully reliable minimum *t*-value is 3.5.

However, rather than attempt to date each sample individually it is usual to first compare all the samples from a single building, or phase of a building, with one another, and attempt to cross-match each one with all the others from the same

phase or building. When samples from the same phase do cross-match with each other they are combined at their matching positions to form what is known as a "site chronology". As with any set of data, this has the effect of reducing the anomalies of any one individual (brought about in the case of tree-rings by some non-climatic influence) and enhances the overall climatic signal. As stated above, it is the climate that gives the growth pattern its distinctive pattern. The greater the number of samples in a site chronology the greater is the climatic signal of the group and the weaker is the non-climatic input of any one individual.

Furthermore, combining samples in this way to make a site chronology usually has the effect of increasing the time-span that is under comparison. As also mentioned above, the longer the period of growth under consideration, the greater the certainty of the cross-match. Any site chronology with less than about 55 rings is generally too short for reliable dating.

Analysis

Each of the eight samples obtained from the White Swan was prepared by sanding and polishing. It was seen at this time that one sample, LEK-D01, had less than 54 rings, the minimum required for reliable dating and it was rejected from this programme of analysis. The annual growth-ring widths of the remaining seven samples were, however, measured, and then compared with each other as described in the notes above.

At a minimum value of t=4.0 a single group comprising five samples could be formed, the samples cross-matching with each other at the positions indicated in the bar diagram Figure 4. The cross-matching samples were combined at these indicated off-set positions to form LEKDSQ01, a site chronology of 83 rings. Site chronology LEKDSQ01 was then satisfactorily dated by comparison with a large number of relevant reference chronologies for oak as spanning the years 1436 to 1518. The evidence for this dating is given in the t-values of Table 2.

Site chronology LEKDSQ01 was then compared with the two remaining, ungrouped, samples LEK-D06 and D08, but there was no further satisfactory cross-matching. The two ungrouped samples were then compared individually with the full range of reference chronologies but there was no further cross-matching, and both samples must, therefore, remain undated.

Interpretation

Analysis by dendrochronology of seven measured samples from this building has resulted in five of them being combined to form a single site chronology, LEKDSQ01.

This site chronology is 83 rings long, these rings being satisfactorily dated as spanning the years 1436–1518.

None of the five dated samples in site chronology LEKDSQ01 retains complete sapwood, that is, none of them has the last growth ring produced by the trees represented before it was cut. It is thus not possible to give a precise felling date for any of the timbers. Three of the dated samples, however, retain the heartwood/sapwood boundary (h/s in Table 1 and the bar diagram), and it is thus possible to give an estimated felling date range for the timbers. Given that the average date of the boundary on the three samples where it exists is 1516, it is estimated that the timbers represented were felled in the period 1531–56, such an interpretation based on a 95% probability that the trees represented had 15–40 sapwood rings.

There is, furthermore, no reason to suspect that the timbers represented by the other two dated samples, without the heartwood/sapwood boundary, were not felled during this time period also. The two timbers represented are integral to the structure and show no evidence of reuse.

Conclusion

Tree-ring analysis, therefore, indicates that all the dated timbers were cut as part of a single episode of felling dated to sometime between 1531–56. As such, this date is perhaps slightly later than might have been suggested on the basis of the stylistic evidence and the building description above, based on the stylistic interpretation of the forms of the trusses, particularly the closed east truss. Although, as stated, this has lost most of its lower members, what survives suggests large square or oblong panels of a type usually associated with the sixteenth century or earlier.

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Table 1: Details of tree-ring samples from the White Swan, Leek, Staffordshire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Heart/sap boundary date (AD)	Last measured ring date (AD)
LEK-D01	North principal rafter, truss A	nm	---	------	------	------
LEK-D02	South principal rafter, truss A	70	h/s	1449	1518	1518
LEK-D03	North principal rafter, truss B	58	no h/s	1453	------	1510
LEK-D04	South principal rafter, truss B	75	no h/s	1438	------	1512
LEK-D05	North principal rafter, truss C	80	h/s	1436	1515	1515
LEK-D06	South principal rafter, truss C	55	h/s	------	------	------
LEK-D07	Tiebeam, truss C	72	h/s	1445	1516	1516
LEK-D08	Collar, truss C	55	h/s	------	------	------

*h/s = The last ring on the sample is at the heartwood/sapwood boundary

nm = sample not measured

Table 2: Results of the cross-matching of site chronology LEKDSQ01 and relevant reference chronologies when the first-ring date is 1436 and the last-ring date is 1518

Reference chronology	*t*-value	Reference
Cheddleton Grange, Cheddleton, Staffs	6.0	(Arnold *et al* 2008)
2–4 Church Street, Leek, Staffs	5.9	(Arnold *et al* forthcoming)
Stonelowe Hall, Longsdon, Staffs	5.1	(Arnold *et al* 2008)
Unthank Hall, Holmesfield, Derbys	5.0	(Howard *et al* 1993)
Aydon Castle, Corbridege, Northumberland	4.9	(Arnold *et al* 2002)
Low Harperley, Wolsingham, Co Durham	4.8	(Arnold *et al* 2006)

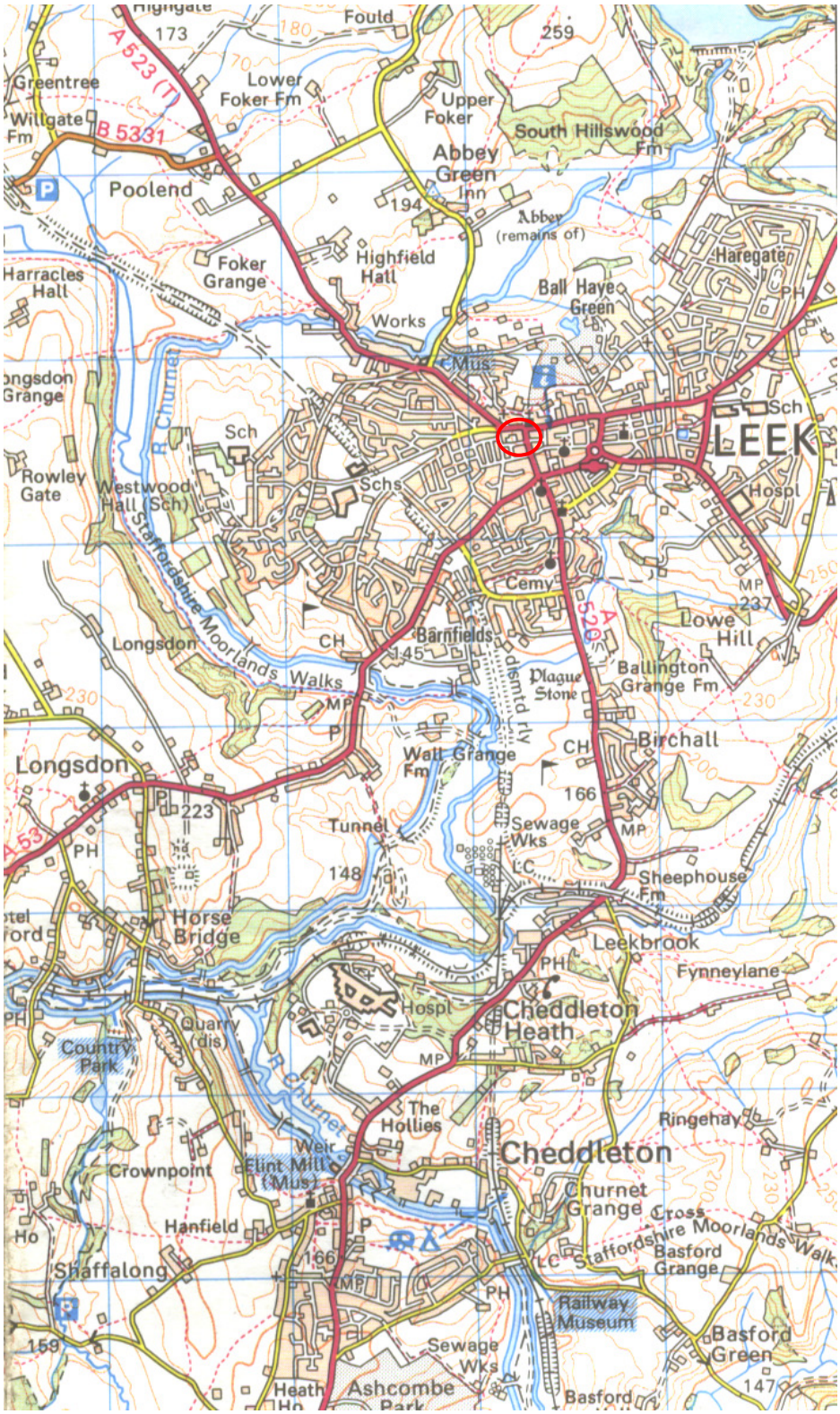


Figure 1: Map to show approximate location of the White Swan

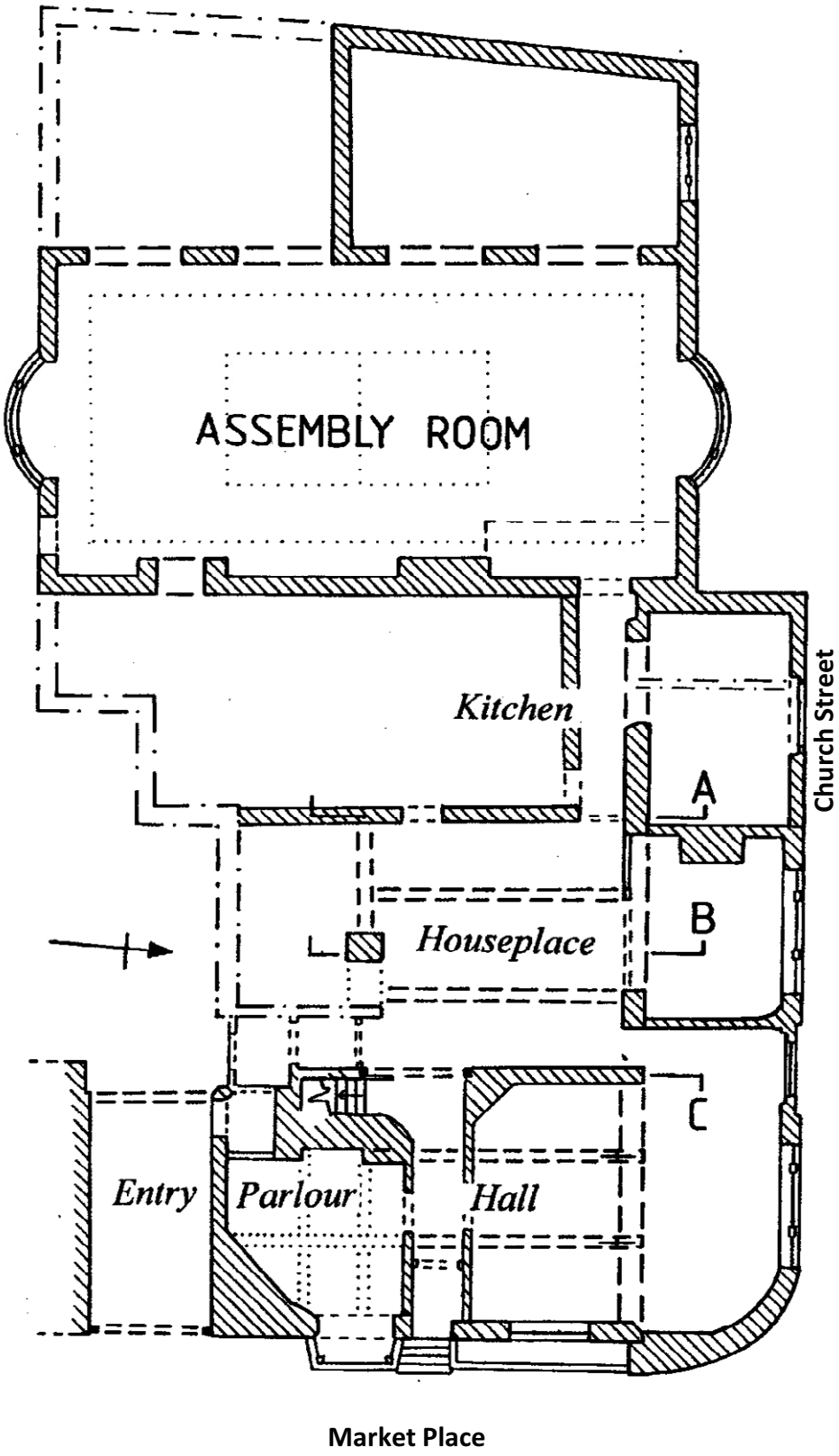


Figure 2: Basic plan at ground-floor level to show layout and truss positions (after Faith Cleverdon)

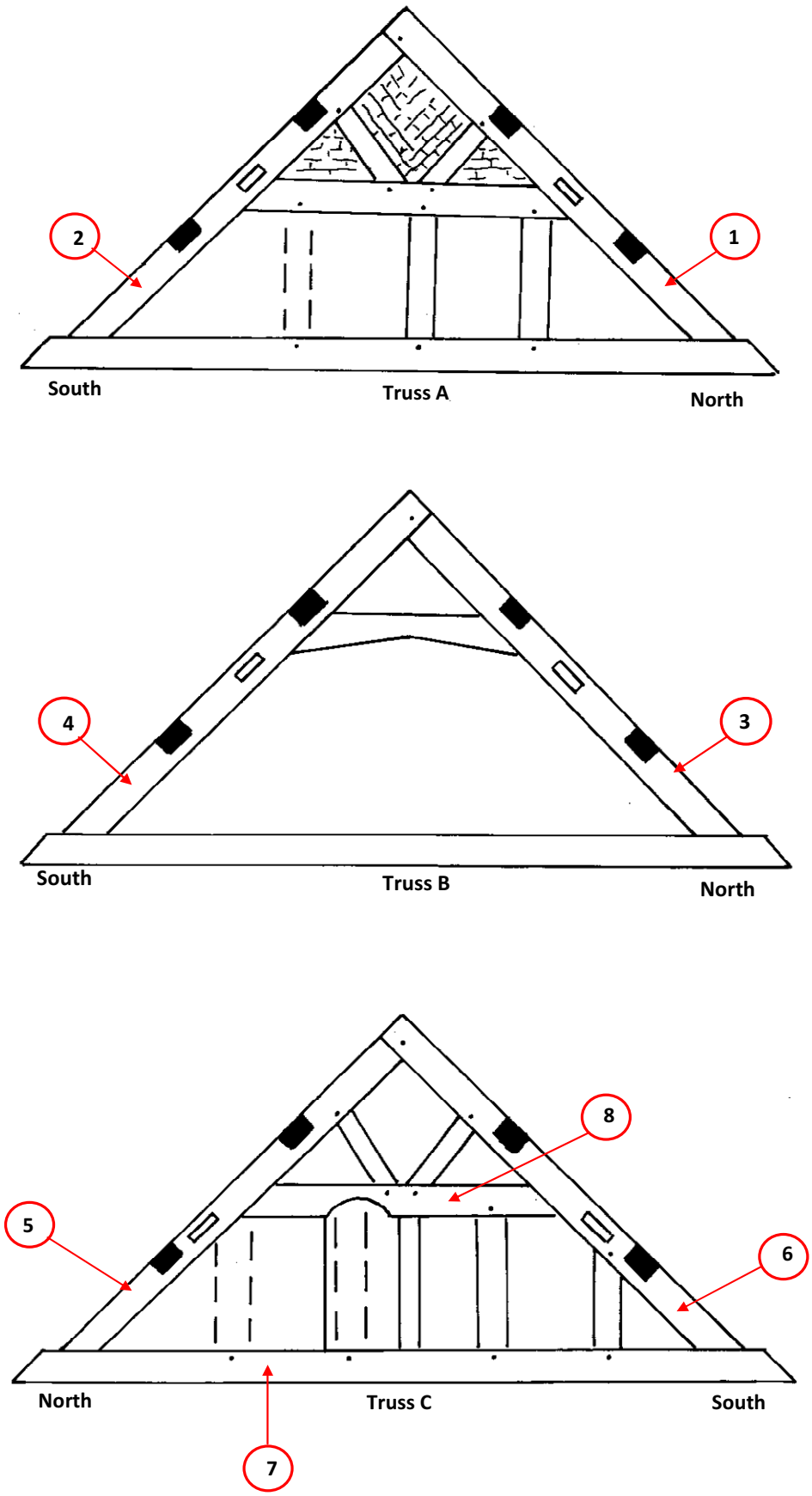
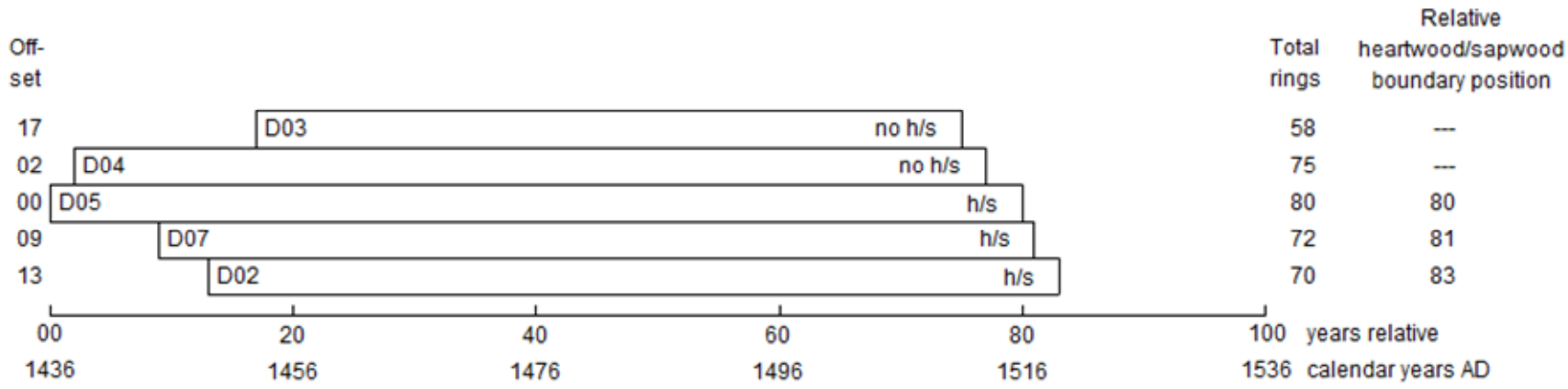


Figure 3: Truss sections showing sample positions
(after Faith Cleverdon)



White bars = heartwood rings
h/s = heartwood/sapwood boundary (only the sapwood rings are missing)

Figure 4: Bar diagram of the samples in site chronology LEKDSQ01