



**TIMBER COTTAGE
CROCKERTON GREEN
LONGBRIDGE DEVERILL
WARMINSTER
WILTSHIRE**

TREE-RING ANALYSIS OF TIMBERS



Alison Arnold and Robert Howard

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SUMMARY

Analysis by dendrochronology was undertaken on samples from 10 primary phase roof and structural timbers to this building along with three samples from the timbers to a possibly later inserted first floor window. This analysis produced two dated site chronologies.

The first site chronology comprises six samples, all of them from the roof of the main body of the house. This site chronology is 85 rings long, these rings dated as spanning the years 1409–1493. Interpretation of the sapwood on these samples suggests that the timbers represented were cut together as part of a single episode of felling at some point between 1503 at the earliest and 1528 at the latest.

The second site chronology comprises two samples, both from the window. This site chronology is 101 rings long, these rings dated as spanning the years 1419–1519. Interpretation of the sapwood suggests that these two timbers were also cut at the same time as each other, at some point between 1533 at the earliest and 1558 at the latest

Five samples remain ungrouped and undated.



Introduction

The Grade II Listed, thatch covered, Timber Cottage stands to the east side of the A350 Warminster to Shaftsbury road (ST 86701 42990, map Fig. 1a/b). The official listing entry gives no indication of the substantial quantity or quality of the timber framing within, but this comprises a series of heavily smoke blackened principal rafter with tiebeam and slightly cambered collar roof trusses. The trusses support single purlins to each pitch of the roof, these in turn supporting a series of common rafters (also smoke blackened) to each bay. There are curved windbraces from principals to the purlins. The lower floors appear to be of main wall post and box-frame form, there being, at first floor level, braces from the main posts to the wall plates.

The house is of 3 original bays, two of them originally open to the roof: at the south end is an originally unheated service bay formerly divided from the hall by a cross-passage. Beyond the hall was an original 2-storey parlour with solar over, lit by an oriel window. The north end is a converted outbuilding brought into the general circulation. From the earlier 17th century onwards the timber-framing was gradually replaced with stone and later brick. The property has been the subject of a recent survey by Wiltshire Building Record (Purdy and Treasure 2020).

Sampling

Wiltshire Buildings Record as a group has been investigating historic buildings in Wiltshire and charting their evolution since 1979, the archive now containing over 20,000 records including reports, photographs, plans, drawings, newspaper articles etc. A series of informative and accessible books have also been published. Since 2013 an on-going dendrochronology project has been looking at early roof types in particular, this having considerably increased the understanding of their development.

As furtherance of this programme of tree-ring dating, a funding application was made to the Vernacular Architecture Group to continue to study key Wiltshire buildings with early or unusual carpentry, and relating them to other buildings in the County. Amongst those selected was Timber Cottage, Crockerton, Longbridge Deverill, a Grade II listed timber-framed former farmhouse of *ca.*1500. It retains a near complete timber frame with a smoke-blackened hurdle roof. It has a prior historic building report completed by WBR. In this context it is hoped the Wiltshire Buildings Record would add interest and value to the VAG conference in Wiltshire in April 2025, the intention being to complete the dating project in advance in order that the results may be presented at that meeting.

Thus it was that sampling and analysis by dendrochronology of timbers to Timber Cottage were commissioned by the Wiltshire Buildings Record, the work being funded with the aid of a generous grant from the Vernacular Architecture Group. It was hoped that tree-ring analysis might more accurately and reliably determine the date of the building, perhaps demonstrate

something of its subsequent development, and perhaps demonstrate its relationship to other buildings in the locality.

An initial examination of the building showed that all the timber framing was of oak. This examination also showed that while many of the timbers were derived from fairly fast-grown trees, producing beams which thus might not have sufficient numbers of rings for reliable dating (despite their good sizes), there were a sufficient number of timbers which did appear to be suitable for analysis.

Thus, from the suitable timbers available, a total of 13 samples was obtained by coring. Each sample was given the tree-ring code CRK-A (for Crockerton, site 'A'), and numbered 01–13. Ten of these samples, CRK-A01–A10, were obtained from structural timbers to the roof and first floor frame, with a further three samples, CRK-A11–A13, being obtained from the timber framing of a first floor window to bay 1 (Fig 2 and 3a–d)

Details of the samples are given in Table 1, including the timber sampled, the total number of rings each sample has, and how many of these, if any, are sapwood rings. The individual date span of each dated sample is also given. In this report the building is deemed to stand north – south, parallel to the main road which is on the west side of the building. The front of the house (away from the main road) is deemed to face east, across the fields and farmland.

The Nottingham Tree-ring Dating Laboratory would firstly like to very much thank the owners of Timber Cottage Sidney Blackmore and David Wiltshire, for allowing tree-ring dating of this building to be undertaken, and for the help and cooperation on the day of sampling. The Laboratory would also like to thank the Wiltshire Buildings Record for supporting this programme of work, in particular Dorothy Treasure, for helping with access to the building, for their help on the day of sampling, and for providing the introductory paragraphs above. Finally, we would like to thank the Vernacular Architecture Group for their generous support for this project.

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 timber most commonly used in building construction until the introduction of pine from the late eighteenth century onwards) grow by adding one, and only one, growth-ring to their circumference each, and every, year. 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 a certain number of consecutive years (the statistically reliable minimum calculated as being 54 years) is unique, so too is the growth-ring pattern of the tree. The pattern of a shorter 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, and is considered less reliable. 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 45 years or so. In essence, a short period of growth, anything less than 45 rings, is not reliable, and the longer the period of time under comparison the better.

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 millimetre. 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 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.

Having obtained a date for the site chronology as a whole, the date spans of the constituent individual samples can then be found, and from this the felling date of the trees represented may be calculated. Where a sample retains complete sapwood, that is, it has the last or outermost ring produced by the tree before it was cut, the last measured ring date is the felling date of the tree.

Where the sapwood is not complete it is necessary to estimate the likely felling date of the tree. Such an estimate can be made with a high degree of reliability because oak trees generally have between 15 to 40 sapwood rings. For example, if a sample with, say, 12 sapwood rings has a last sapwood ring date of 1400 (and therefore a heartwood/sapwood boundary ring date of 1388), it is 95% certain that the tree represented was felled sometime between 1403 (1400+3 sapwood rings (12+3=15)) and 1428 (1400+28 sapwood rings (12+28=40)).

Analysis

Each of the 13 samples obtained from the timbers to Timber Cottage was prepared by sanding and polishing to clearly show the individual annual growth rings, the widths of each ring on all 13 samples then being measured. These measured data were then compared with each other as described in the notes above. This comparative process indicated that two groups of cross-matching samples could be formed.

The first group comprises six samples, all of them from the principal timbers to the roof of the main body of the house. These six samples cross-match with each other at relative positions as shown in the bar diagram, Figure 4. The measured data of the six cross-matching samples were combined at their indicated off-set positions to form CRKASQ01, a site chronology with an overall length of 85 rings. This site chronology was then satisfactorily dated by repeated and consistent cross-matching with a high number of relevant reference chronologies for oak as spanning the years 1409 to 1493. The evidence for this dating is given in the *t*-values of Table 2.

The second group comprises two samples, both of them from the timbers to the west first floor window in bay 1, to the north end of the building. These two samples cross-match with each other at relative positions as shown in the bar diagram, Figure 5. The measured data of these two cross-matching samples were also combined at their indicated off-set positions to form CRKASQ02, a site chronology with an overall length of 101 rings. This site chronology was then satisfactorily dated by repeated and consistent cross-matching with a high number of relevant reference chronologies for oak as spanning the years 1419 to 1519. The evidence for this dating is given in the *t*-values of Table 3.

The two site chronologies thus created were then compared with the five remaining ungrouped samples. There was, however, no further satisfactory cross-matching. The five remaining ungrouped samples were, therefore, compared individually with the full corpus of reference data for oak. There was again no further satisfactory cross-matching, and these five samples must, therefore, remain undated.

Interpretation

Site chronology CRKASQ01

None of the six dated samples of site chronology CRKASQ01 retains sapwood complete to the bark, and it is thus not possible to reliably say precisely when any of the timbers were felled. Five of the samples (all but CRK-A04) do, though, retain the heartwood/sapwood boundary (denoted by 'h/s' in Table 1 and the bar diagram). This last means that although the samples have lost all their sapwood rings, it is *only* the sapwood rings that are missing. Importantly, the relative position and date of the heartwood/sapwood boundary on these five samples is very similar to each other, this suggesting that the timbers originally had similar amounts of sapwood, this in turn suggesting that they were felled at, or at least about, the same time as each other.

Where it is likely that a group of timbers were cut as part of a single episode of felling, their likely felling date range is deduced by obtaining the average date of the heartwood/sapwood boundary. On the five samples of site chronology CRKASQ01 that retain it this is calculated as being 1488. To this date is added the minimum and maximum number of sapwood rings that oak trees usually have, 15–40 rings. As such this indicates a felling date of some point between 1503 at the earliest and 1528 at the latest.

Site chronology CRKASQ02

Again, neither of the two dated samples of site chronology CRKASQ02 retains sapwood complete to the bark, and it is again impossible to reliably say precisely when either of the timbers were felled. Both sample do, though, retain the heartwood/sapwood boundary, this again meaning that only the sapwood has been lost. Again, the relative position and date of the heartwood/sapwood boundary on these two is very similar to each other, this suggesting that these timbers also originally had similar amounts of sapwood this in turn again suggesting that they were felled at, or at least about, the same time as each other.

In the case of these two samples, the average heartwood/sapwood boundary ring is calculated as being dated to 1518. Adding the same sapwood figures as above, a minimum/maximum of 15–40 rings, would thus suggest a felling date of some point between 1533 at the earliest and 1558 at the latest.

Conclusion

From the analysis undertaken here, it would clearly appear that the initial interpretation of the house as dating to the very early sixteenth century is quite correct, the dating of the main structural timbers showing that these could possibly have been felled as early as 1503, and certainly no later than 1528. Analysis also shows that some alterations were made to the

building, with a first floor window being formed to the west side of bay one, these timbers for this feature dating to approximately the middle of the sixteenth century

Woodland sources

As may perhaps be seen from Table 2, although site chronology CRKASQ01 has been compared with reference material from all parts of England, there is something of a trend for it to match best with other reference sites in the southwest. While the woodland source(s) of the timbers used at these other sites are themselves not known, the matching seen here would suggest that the dated timbers represented came from a similar, and probably local, regional source.

Such a trend is, however, absent from the matching of site chronology CRKASQ02 (Table 3). This may in large part be due to this site chronology being comprised of only two samples, this perhaps making it somewhat less representative of any region in particular.

Undated samples

Four samples from the roof, and one from the first floor window, remain ungrouped and undated. Although one or two might show some slight distortion, there appear to be no particular problems with the annual growth rings of any of these samples, and the reason for the lack of dating is totally unknown. It is, however, a common feature of most programmes of tree-ring dating to find that some samples, for no apparent reason, will not cross-match with other samples from the same site, or date individually against the reference chronologies.

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Table 1: Details of tree-ring samples from Timber Cottage, Crockerton Green, Longbridge Deverill, Warminster, Wiltshire						
Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Heart/sap boundary (AD)	Last measured ring date (AD)
CRK-A01	West principal rafter, truss 2	78	h/s	1409	1486	1486
CRK-A02	East principal rafter, truss 2	64	h/s	1423	1486	1486
CRK-A03	East purlin, truss 2 – 3	57	no h/s	-----	-----	-----
CRK-A04	West purlin, truss 2 – 3	59	no h/s	1421	-----	1479
CRK-A05	Collar, truss 3	50	h/s	1438	1487	1487
CRK-A06	West principal rafter, truss 3	52	h/s	1437	1488	1488
CRK-A07	East principal rafter, truss 3	66	h/s	-----	-----	-----
CRK-A08	West principal rafter, truss 4	48	h/s	1446	1493	1493
CRK-A09	East principal rafter, truss 4	52	h/s	-----	-----	-----
CRK-A10	West main first-floor wall post, truss 1	63	h/s	-----	-----	-----
CRK-A11 \$	North stud to west first floor window, bay 1	98	no h/s	1419	-----	1516
CRK-A12 \$	Sill to west first floor window, bay 1	84	h/s	-----	-----	-----
CRK-A13 \$	South stud to west first floor window, bay 1	77	h/s	1443	1519	1519

h/s = heartwood/sapwood boundary, i.e., only the sapwood rings are missing

\$ = later phase timber

Table 2: Results of the cross-matching of site chronology CRKASQ01 and the reference chronologies when the first ring date is 1409 and the last ring date is 1493

Reference chronology	<i>t</i> -value	
26 Westgate Street, Gloucester, Gloucestershire	7.6	(Howard <i>et al</i> 1998)
Avebury Manor, Avebury, Wiltshire	7.4	(Arnold and Howard 2011 unpubl)
Gorcott Hall, Warwickshire	7.3	(Nayling 2006)
St John's Walk, Hereford Cathedral, Herefordshire,	7.1	(Arnold and Howard 2015 unpubl)
12 Pickwick, near Corsham, Wiltshire	6.9	(Arnold and Howard 2018 unpubl)
England, London	6.6	(Tyers and Groves 1999 unpubl)
Greyfriars' House, Friar Street, Worcester, Worcestershire	6.4	(Arnold and Howard 2017 unpubl)
Abbey Gatehouse, Bristol Cathedral, Somerset	6.2	(Arnold <i>et al</i> 2003)

Table 3: Results of the cross-matching of site chronology CRKASQ02 and the reference chronologies when the first ring date is 1419 and the last ring date is 1519

Reference chronology	<i>t</i> -value	
Crowtrees House, Barrowford, Lancashire	6.1	(Arnold and Howard forthcoming)
Old Manor House, Bockleton, Worcestershire	5.9	(Arnold and Howard 2022 unpubl)
Mackworth Church, Derbyshire	5.9	(Arnold and Howard forthcoming)
Cruck Barn, Hougher Fall Farm, Dutton, Lancashire	5.9	(Arnold and Howard 2012 unpubl)
Dower House, Fawsley Park, Daventry, Northamptonshire,	5.6	(Howard <i>et al</i> 1999)
St Peter's Church, West Liss, Hampshire	5.2	(Arnold and Howard 2012)
Whalley Abbey, Whalley, Lancashire	5.2	(Arnold and Howard 2015)
St Peter's Church (bell frame), Saltby, Leicestershire	5.0	(Howard <i>et al</i> 1995)

Site chronologies CRKASQ01 and SQ02 are composites of the data of the relevant cross-matching samples as seen in the bar diagrams, Figures 4 and 5, below. These composite data sets produces 'average' tree-ring patterns, where the possible erratic variations of any one individual sample are reduced and the overall climatic signal of the group is enhanced. These 'average' site chronology have then been compared with several hundred reference patterns covering every part of Britain for all time periods, cross-matching with a number of these only at the date span indicated. The Tables gives only a small selection of the very best matches as represented by 't-values' (ie, degrees of similarity). It may be noticed from this that the resultant t-values are well in excess of the $t=3.5$ value usually taken as the minimum acceptable level for satisfactory dating.

It may also be of interest to note that although site chronology CRKASQ01 has been compared with reference material from all parts of England, there is something of a trend for it to match best with other reference sites in southern and western parts of England, rather than anywhere else in the country, with other sites in Wiltshire, Gloucestershire, and Somerset being listed. Such matching might suggest that, perhaps not unexpectedly, the timbers used at Timber Cottage came from a similar regional source.

Such a trend is, however, absent from the matching of site chronology CRKASQ02. This may in large part be due to this site chronology being comprised of only two samples, this perhaps making it somewhat less representative of any region in particular.

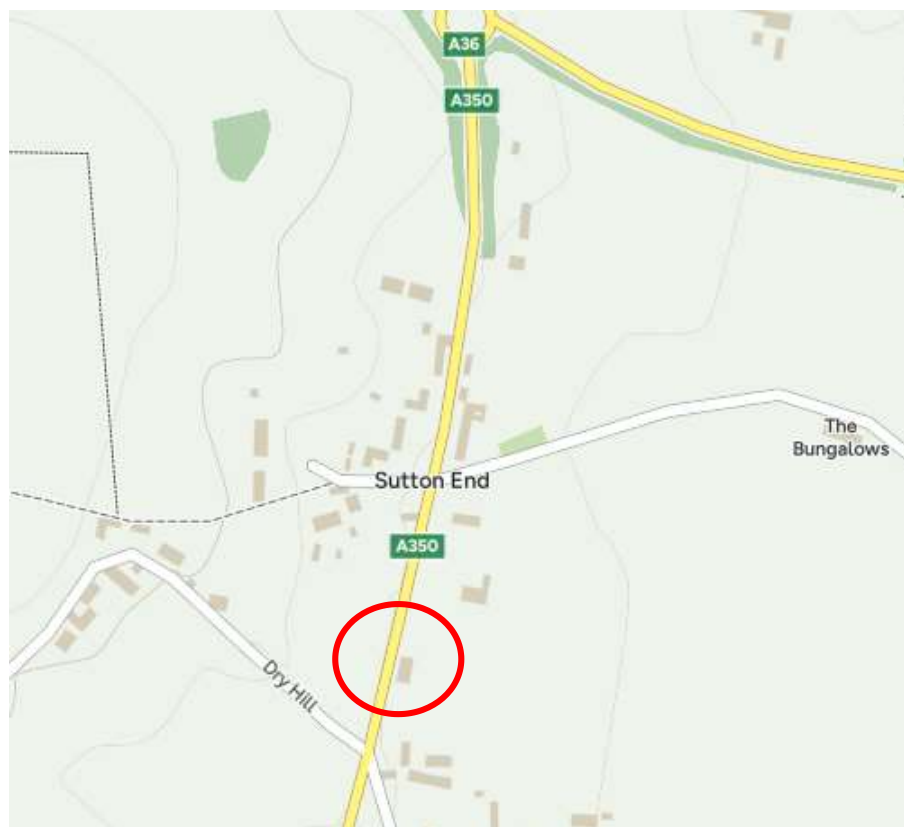


Figure 1a/b: Maps to show approximate location Crockerton Green (top) and Timber Cottage (bottom)

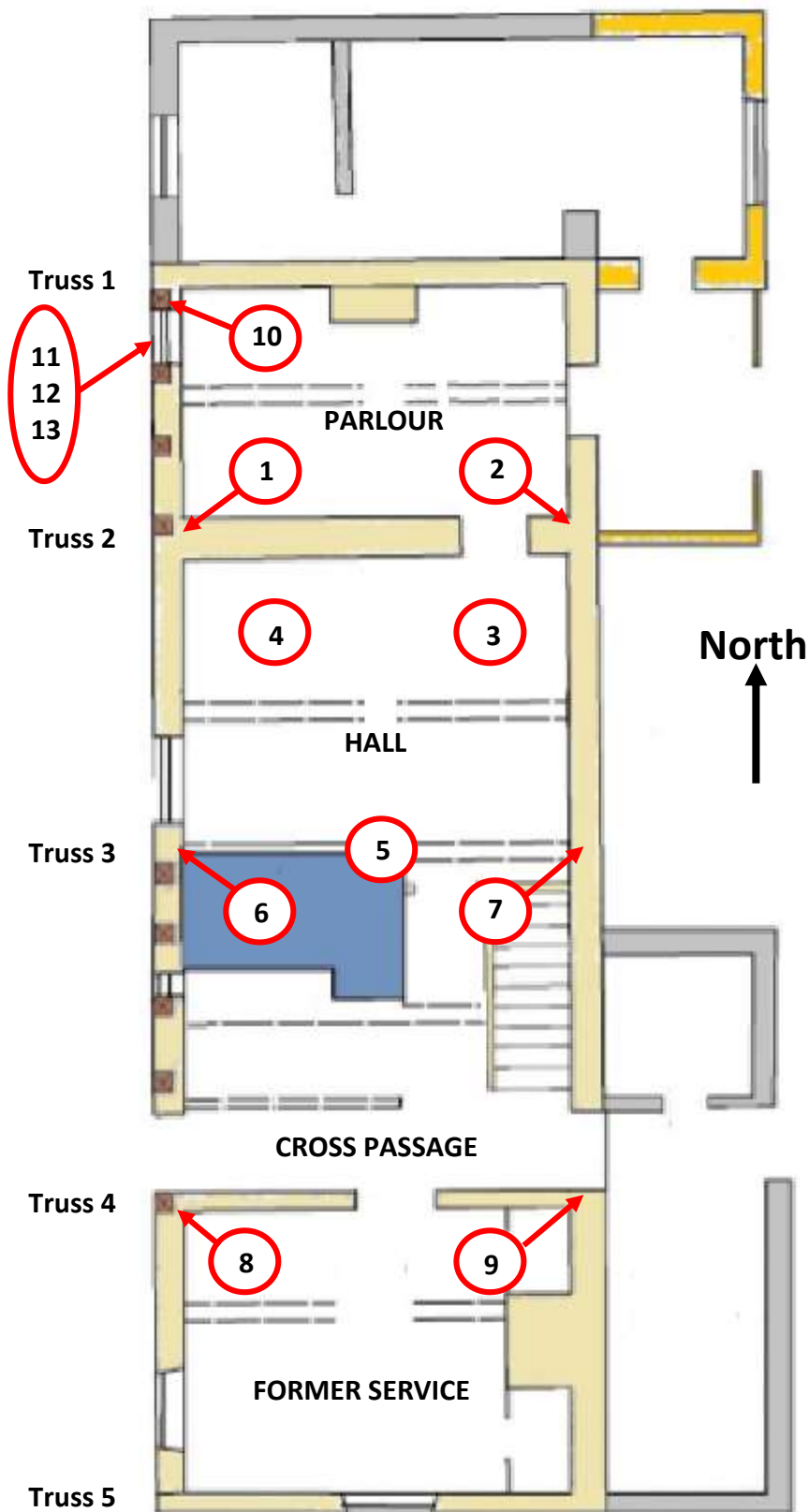


Figure 2: Plan (at ground floor level) to show approximate locations of the sampled timbers (see Table 1 and Figs 3a–d) (after original survey drawing by Sidney Blackmore)

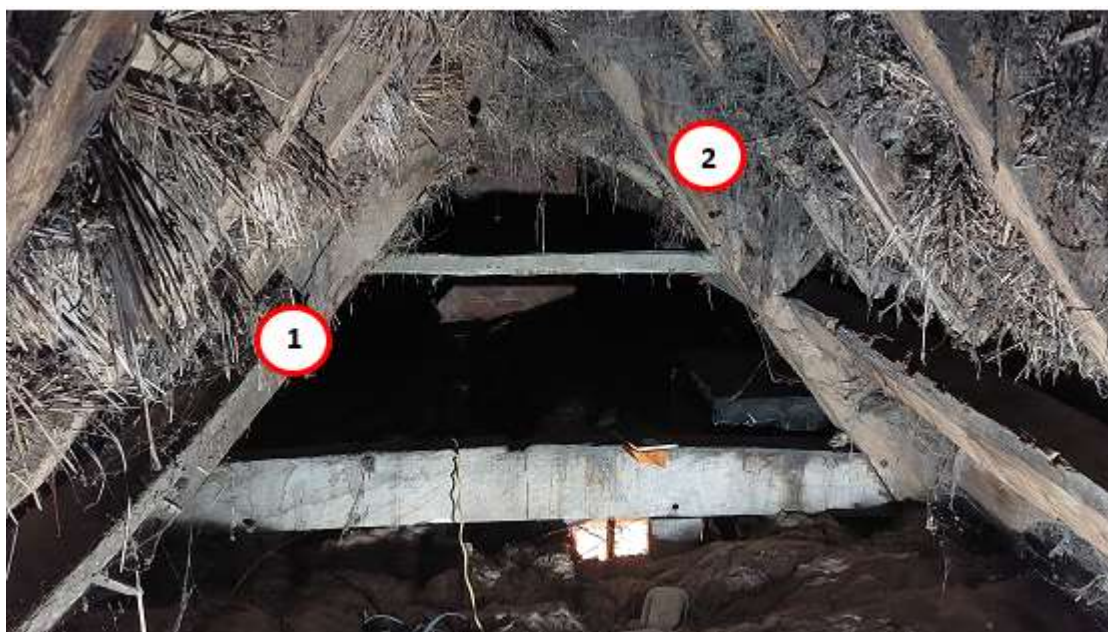


Figure 3a: Annotated photograph to show sampled timbers to truss 2 (from north) (viewed looking north) (see Table 1 and Figure 2)

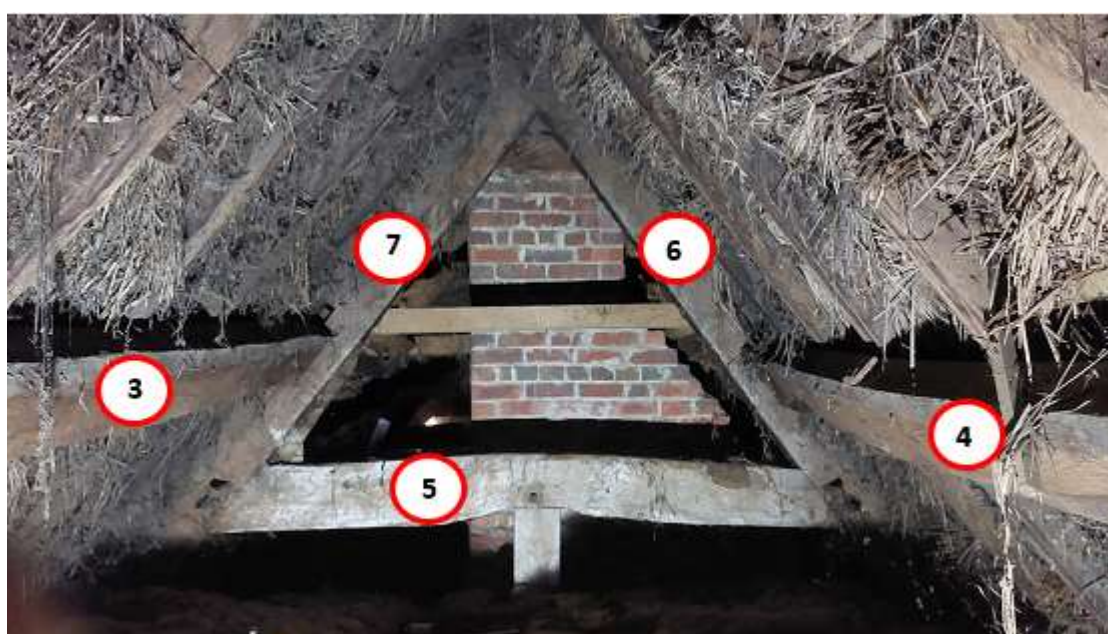


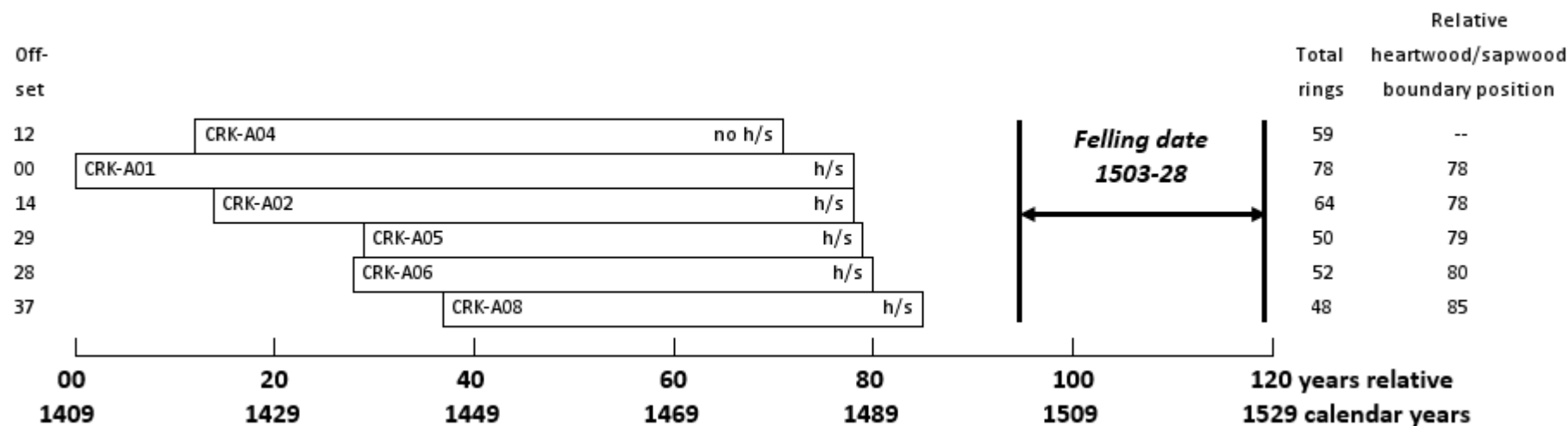
Figure 3b: Annotated photograph to show sampled timbers to truss 3 (viewed looking south) (see Table 1 and Figure 2)



Figure 3c: Annotated photograph to show sampled timbers to truss 4 (viewed looking south) (see Table 1 and Figure 2)



Figure 3d: Annotated photograph to show sampled timbers to bay 1 (from north) looking west (towards the road frontage) (see Table 1 and Figure 2)



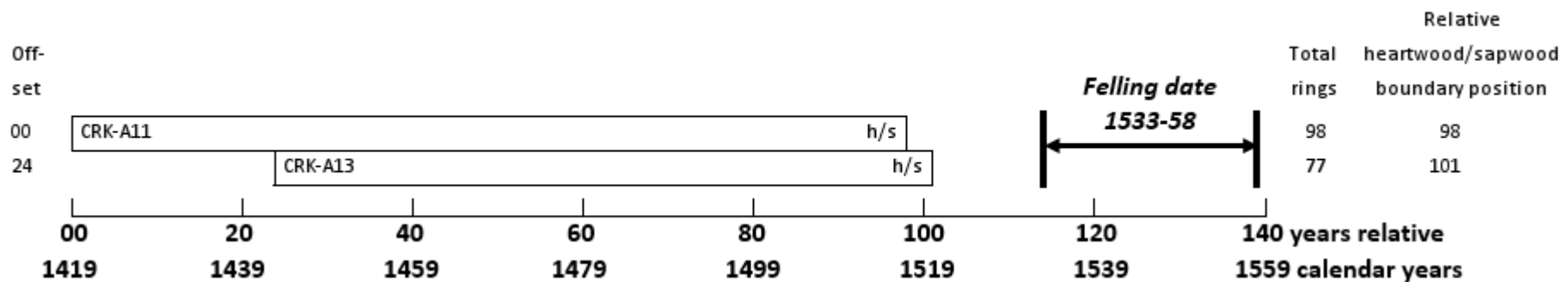
blank bars  = heartwood rings

h/s = heartwood/sapwood boundary, i.e., only the sapwood rings are missing

Figure 4: Bar diagram of the samples in site chronology CRKASQ01

The six constituent samples of site chronology CRKASQ01 are shown here in the form of 'bars' at positions where the pattern of their growth rings cross-match with each other, the similarity being caused by the trees used for the beams sharing common periods of growth which overlap with each other, and having grown in the same woodland as each other. The data of the measured rings widths of the samples have been combined to form a 'site chronology' which has then been dated by comparison with the 'reference chronologies' (see Table 2).

There is very little difference in the relative position and date of the heartwood/sapwood boundary (h/s) on the five samples that retain it, this suggesting that the timbers were felled at the same time as each other. The 'average' heartwood/sapwood ring of the five samples is dated 1588. Allowing for a minimum/maximum of 15 to 40 sapwood rings would give these timbers an estimated felling date range of some point between 1503 at the earliest and 1528 at the latest.



blank bars  = heartwood rings

h/s = heartwood/sapwood boundary, i.e., only the sapwood rings are missing

Figure 5: Bar diagram of the samples in site chronology CRKASQ02

The two samples of site chronology CRKASQ02 are again shown in the form of 'bars' at positions where the pattern of their growth rings again cross-match with each other. The data of the measured rings widths of these samples have also been combined to form a site chronology which has then been dated by comparison with the reference chronologies (see Table 3).

Again there is little difference in the relative position and date of the heartwood/sapwood boundary, this again suggesting that the timbers were felled at the same time as each other. The average heartwood/sapwood ring of the two samples is dated 1518. Allowing for a minimum/maximum of 15 to 40 sapwood rings would give these timbers an estimated felling date range of some point between 1533 at the earliest and 1558 at the latest.