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**Tree-Ring Analysis of Timbers from the Church of St George of  
England, Toddington, Bedfordshire**

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## **Tree-Ring Analysis of Timbers from the Church of St George of England, Toddington, Bedfordshire**

Dr Martin Bridge

### **Summary**

A dendrochronological study of oak timbers from the upper stages of the tower of this church has shown that the present roof structure is built from trees most likely felled in the period AD 1401-22. This places the work in the period when the Peyvre family were still Lords of the Manor, and before the succession of the Broughtons in AD 1429, who were thought to have been responsible for it. A single timber from the belfry floor is of similar date, and if considered part of the same batch of timbers, would narrow the likely felling period to AD 1401-15.

The wallplates on which the roof sits come from an earlier period, AD 1336-68, and may represent either re-used timber, or the presence of an earlier roof, which had to be replaced relatively early in its life. Closer investigation of these timbers *in situ* may be able to answer this question.

### **Keywords**

Dendrochronology  
Standing Building

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## **Introduction**

The church was consecrated on St George's Day AD 1222, the same year in which St George became the Patron Saint of England, and it remains one of only four churches in the country dedicated to St George of England (Matthews nd unpubl).

This grade I listed cruciform church (NGR TL 010289; Fig 1) has some fabric dating from the twelfth century, and a crossing tower with thirteenth-century crossing arches. The roofs of both chancel and nave are fifteenth-century in origin. The date of the present tower is uncertain. Before the work was begun it was felt that the lower sections of the tower could well be a very early structure, and there was some feeling that timbers from an earlier structure could have been re-used at higher levels. It is known that substantial rebuilding of the church, possibly including the upper stages of the tower, took place under the patronage of the Broughtons, who became Lords of the Manor in AD 1429.

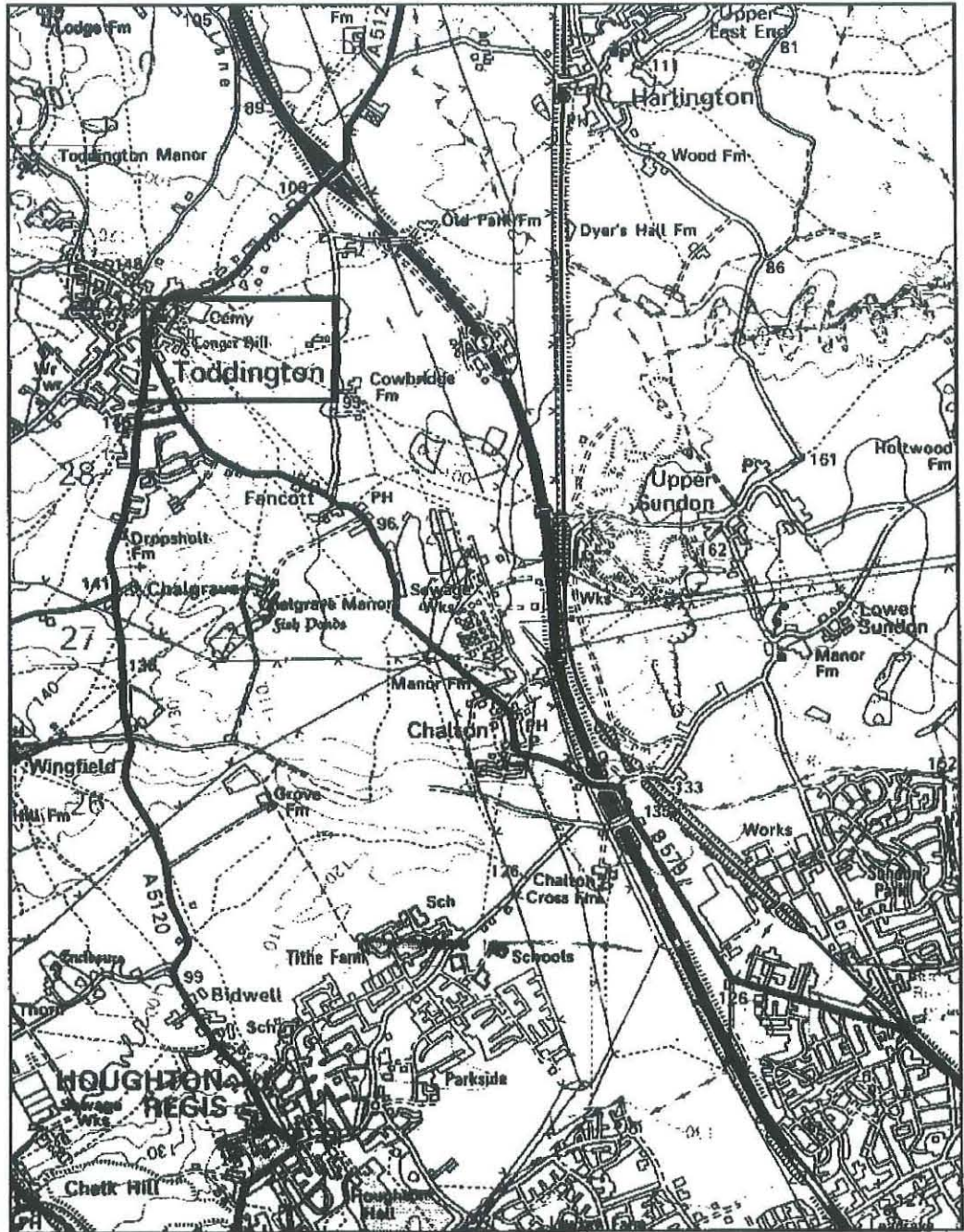
An urgent request from the English Heritage Regional Team architect, Malcolm Starr, to take the opportunity of sampling timbers at various levels in the tower, whilst access was facilitated during repair work, was the starting point for the work reported here. This dendrochronological study forms part of a more broadscale historical investigation being carried out during restoration works, and its conclusions may be refined in the light of those studies.

A recording team and the church architect (Mrs Pam Ward) were on-site before the dendrochronological study was undertaken, and had made careful observations that fed into the choice of timbers sampled.

## **Methodology**

The site was visited in March AD 2000. Although the original brief was to sample timbers from the roof, the belfry floor, the ringing-chamber floor, and the clock-chamber floor, after careful on-site study and consultation with the church architect and archaeologist, permission was sought from English Heritage to amend the brief, removing the clock-chamber and ringing-chamber floors, and adding a nave tie accessible from the clock-chamber. The reasoning behind this was that it was agreed after closer inspection of these lower floors that they were almost certainly of nineteenth-century origin, and that access for sampling would require either lifting of the wooden floor covering, or internal scaffolding in the main body of the church. Both options would have been too disruptive and were felt to be unlikely to yield any valuable information. The nave tie, accessible through a small hatch in the clock-chamber (Fig 2), was added because the formation of the roof of the nave was thought to relate to changes in the tower, and although it was only a single timber, a date for this substantial beam (with evident sapwood) could have been valuable in the interpretation of the history of the tower. Sampling of other nave roof timbers was not possible on this occasion, and would require a major scaffolding to allow access.

The timbers from the roof and belfry floor were assessed for their potential use in dendrochronological study. Oak timbers with more than 50 rings, traces of sapwood, and accessibility were the main considerations in the initial assessment. Those timbers judged to be potentially useful were cored using a 15mm auger attached to an electric drill. The cores were glued to wooden laths, labelled, and stored for subsequent analysis. The cores were prepared for measuring by sanding using an electric belt-sander with progressively finer grit papers down to 400 grit. Any further preparation necessary, eg where bands of narrow rings occurred, was done



**Figure 1:** Map to show the general location of St George's Church, Todington, Bedfordshire

manually. Only samples with more than 45-50 rings were measured and used in subsequent analyses as sequences with fewer than this number of rings rarely give reliable crossmatching. Suitable samples had their tree-ring sequences measured to an accuracy of 0.01 mm using a specially constructed system utilizing a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC. The software used in measuring and subsequent analysis was written by Ian Tyers (1999a).

Ring sequences were plotted to allow visual comparisons to be made between sequences on a light table. This activity also acts as a measure of quality control in identifying any errors in the measurements when the samples crossmatch. Statistical comparisons were made using Student's *t*-test (Baillie and Pilcher 1973; Munro 1984). The *t*-values quoted below were derived from the original CROS program (Baillie and Pilcher 1973). Those *t*-values in excess of 3.5 are taken to be indicative of acceptable matching positions provided that they are supported by satisfactory visual matches, and give consistent matching positions.

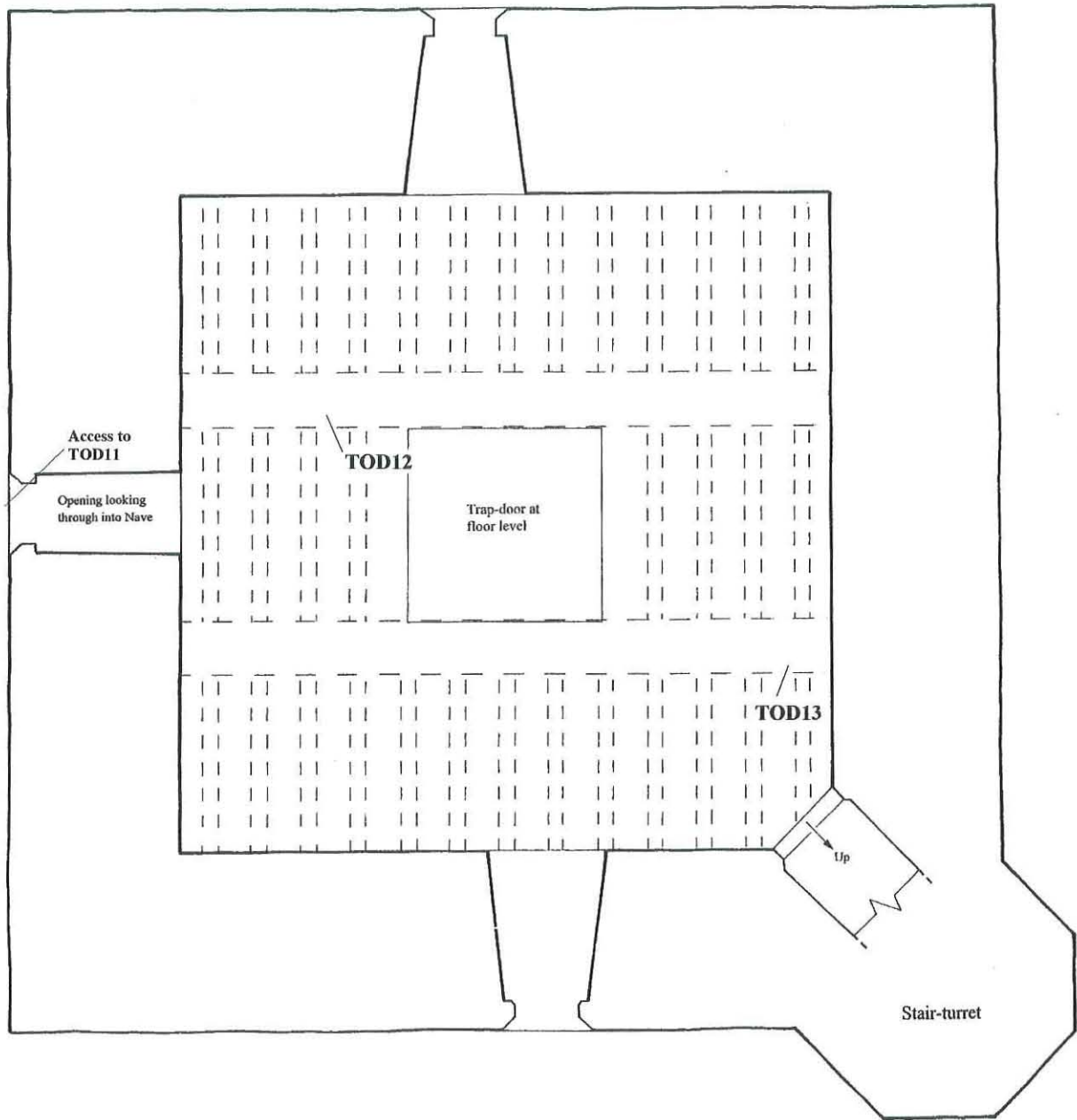
When crossmatching between samples is found, their ring-width sequences are meant to form an internal site mean sequence which is then compared with a number of reference chronologies (multi-site chronologies from a region) and dated individual site masters in an attempt to date it. Individual long series which are not included in the site mean(s) are also compared with the database to see if they can be dated.

The dates thus obtained represent the time of formation of the rings available on each sample. Interpretation of these dates then has to be undertaken to relate these findings to the construction date of the phase under investigation. An important aspect of this interpretation is the estimate of the number of sapwood rings missing. In this instance, the sapwood estimates are based on those proposed for this area by Miles (1997), in which 95% of samples are likely to have from 9 to 41 sapwood rings. Where bark is present on the sample the exact date of felling of the tree used may be determined.

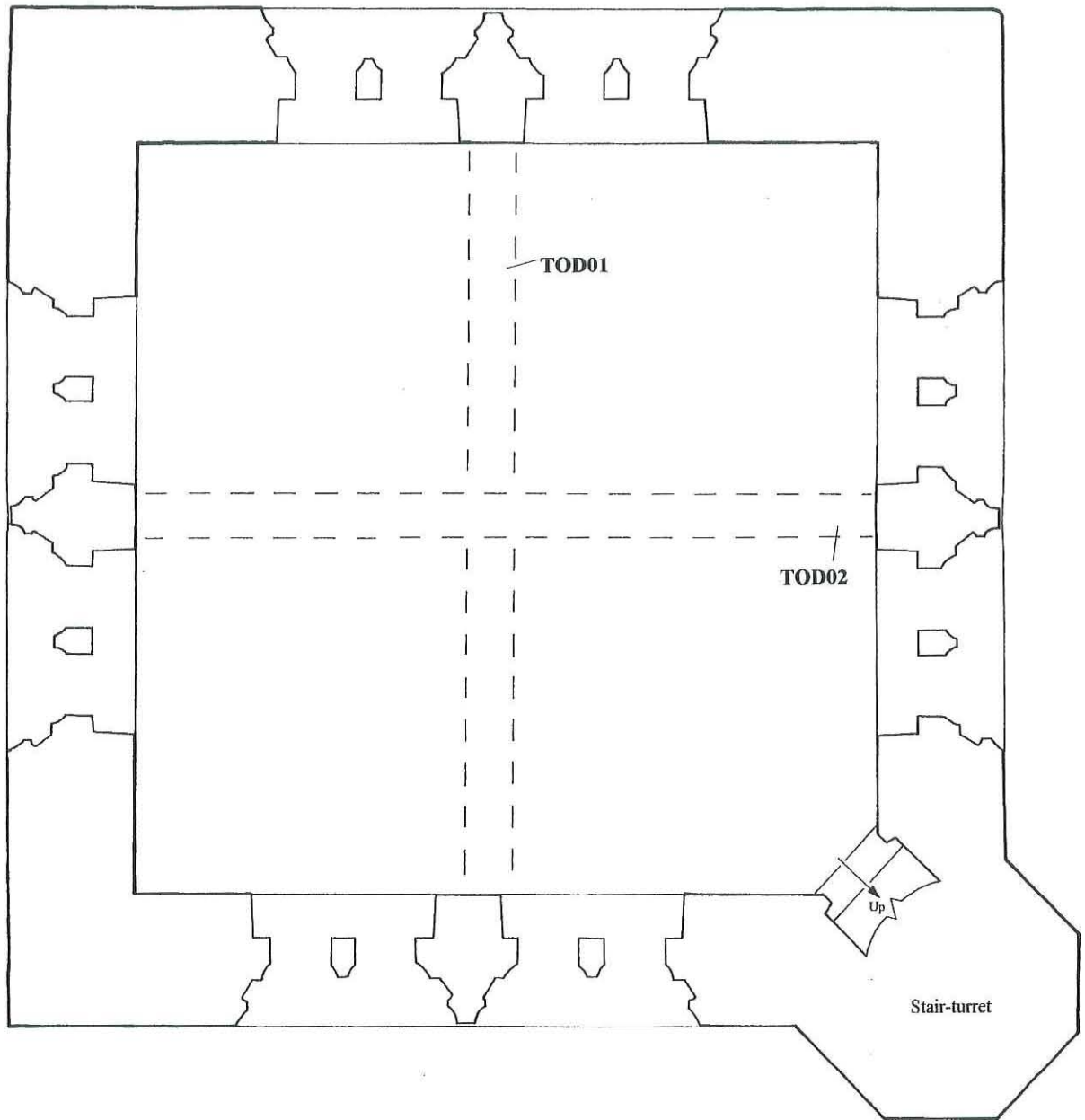
The dates derived for the felling of the trees used in construction do not necessarily relate directly to the date of construction of the building. However, evidence suggests that, except in the re-use of timbers, construction in most historical periods took place within a very few years after felling (Salzman 1952; Hollstein 1965).

## **Results**

All the timbers sampled were oak (*Quercus* spp.). Details of their locations and other information derived from the samples are presented in Table 1. Positions of samples within the tower are illustrated in Figures 2 and 3. No drawings are available of the roof structure. Whilst the roof phase is well represented, few timbers were available for other phases because of the lack of rings in the timbers. Crossmatching was found between a number of the samples (Table 2), being highest between the two wallplate timbers from the roof. Sample TOD04 showed good visual agreement with other series, except in the early years. For this reason, the series was edited to remove the first 20 years, resulting in an amended series (TOD04r), which showed good crossmatching with other timbers (Table 2). Series TOD02 failed to match well against other timbers, but dated independently at the position shown. Series TOD03 had an additional 22 rings (including 2 sapwood rings) which had broken from the main core. The break was not a clean one, and it is possible that some rings are missing, therefore only an 'after 1398' date is given because it is not clear how many rings are missing.



**Figure 2:** Plan of the belfry floor in the clock chamber, showing the approximate locations of samples taken for dendrochronology



**Figure 3:** Plan of the belfry showing the position of the roof timbers above sampled for dendrochronology

**Table 1:** Oak (*Quercus* spp.) timbers sampled from. h/s = heartwood-sapwood boundary; sap = sapwood rings

Sample number	Origin of core	Total no of years	Average growth rate (mm yr <sup>-1</sup> )	Sapwood details	Date of sequence AD	Felling date of timber AD
TOD01	North-south upper beam in tower roof	146	1.08	h/s	1240 - 1385	1394 - 1426
TOD02	East-west lower beam in tower roof	74	2.83	h/s, + 7 sap	1319 - 92	1401 - 33
TOD03	Central vertical post to tower roof	108	1.18	+ 22 rings including 2 sap	1262 - 1369	<i>circa</i> 1398 - 1430
TOD04	Common rafter 1, north-east quarter	66	0.88	h/s, + 22 sap rings broken off	1288 - 1372	<i>circa</i> 1394 - 1413
TOD05	North principal rafter	131	1.07	h/s	1260 - 1390	1399 - 1431
TOD06	Common rafter 3, north east quarter	118	1.12	h/s	1264 - 1381	1390 - 1422
TOD07	Common rafter 5, north-east quarter	<40	unmeasured	-	undated	unknown
TOD08	North wallplate	97	1.35	-	1226 -1322	after 1331
TOD09	South principal rafter	92	1.07	h/s	1295 - 1386	1395 - 1427
TOD10	East wallplate	94	1.56	h/s	1234 - 1327	1336 - 68
TOD11	Eastern nave tie	56	2.80	h/s?	undated	unknown
TOD12	North beam, belfry floor	141	1.80	h/s	1234 - 1374	1383 - 1415
TOD13	South beam, belfry floor	122	1.61	h/s	undated	unknown

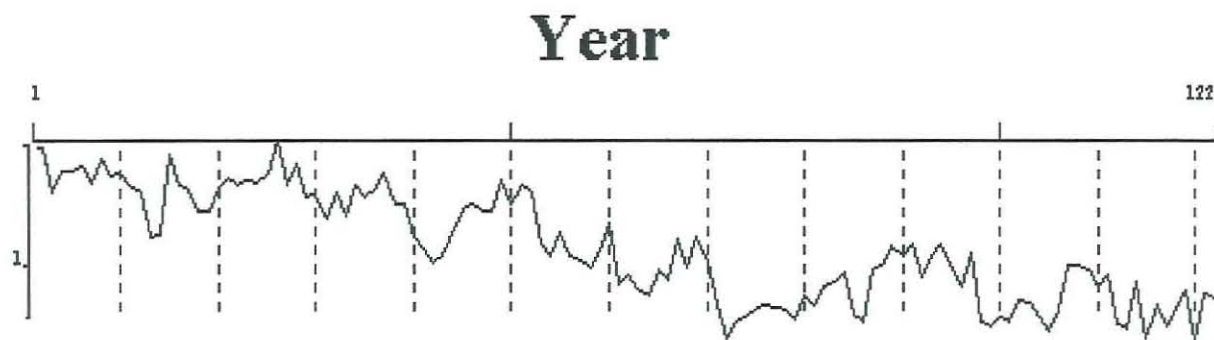


Two of the series with more than 50 rings failed to match either the other site timbers, or give consistent matches with reference data. These were TOD11, the only sample from the nave roof, and TOD13, the southern beam of the two bell chamber floor beams.

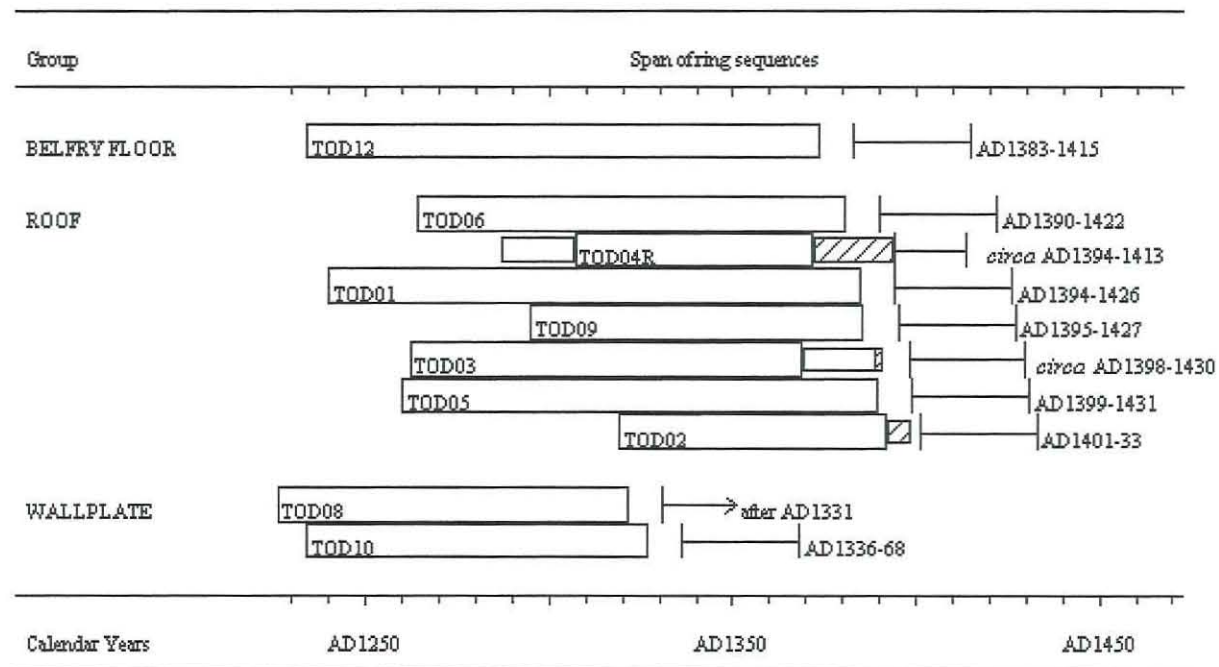
The crossmatching series, illustrated in their relative positions of overlap in Figure 5, were combined into a site chronology, TODDNGTN, which was dated against a range of regional and site chronologies (Table 3). The ring-width data for the site chronology is presented in Table 4.

**Table 3:** Dating of the oak site chronology TODDNGTN. The upper section contains regional chronologies, the lower section contains individual site chronologies

Dated reference or site master chronology	TODDNGTN AD 1226 - 1392	
	<i>t</i> -value	Overlap (yr.)
Oxon93 (Miles pers comm)	11.4	167
London1175 (Tyers pers comm)	9.4	167
Southern England (Bridge 1988)	7.6	167
Kent88 (Laxton and Litton 1989)	7.1	167
Chicksands Priory, Bedfordshire (Howard <i>et al</i> 1998)	8.5	167
Twynning, Gloucestershire (Tyers 1996)	7.7	142
Winterbourne, Gloucestershire (Miles 2001)	7.0	106
Thetford, Norfolk (Howard <i>et al</i> 2000)	6.9	156
Castle Acre, Norfolk (Tyers 2000)	6.9	120
Steyning, West Sussex (Miles 1994)	6.6	163
New Inn, Oxford (Miles and Haddon-Reece 1996a)	6.5	161
Borden, Kent (Litton <i>et al</i> 2000)	6.5	108
High Halden, Kent (Bridge 1987)	6.3	94
Upminster, Essex (Tyers 1997)	6.2	117
Odiham, Hampshire (Miles and Haddon-Reece 1996b)	6.2	167
Ware Priory, Hertfordshire (Howard <i>et al</i> 1997)	6.1	167
Marriots, Norfolk (Tyers 1999b)	6.1	93
Ford, West Sussex (Bridge 2000)	6.0	107
West Gate Street, Gloucester (Tyers and Wilson 2000)	5.9	167
Dunmow, Essex (Bridge 1999)	5.5	62
Fyfield, Essex (Bridge 1998)	5.3	96



**Figure 4:** Plot of series TOD13. The ring-width (mm) is shown on a logarithmic scale



**Figure 5:** Bar diagram showing the relative positions of overlap, and the likely felling dates, of the dated timbers from the tower of St George's Church, Toddington, Bedfordshire. The hatched sections represent sapwood and the narrow bars represent unmeasured rings

## **Interpretation and Discussion**

The lower floors of the tower (the ringing-chamber and clock-chamber floors) were not included in this study for the reasons outlined above. The single sample from the magnificent nave roof failed to date. The roof is thought to be fifteenth-century on stylistic evidence, and there is evidence of an earlier roofline still to be seen on the west wall of the tower. The series was not very long (56 years) and as a single representative of a structure, its failure to date is not particularly surprising. It was felt worth attempting however, as a more precise date for this roof could be relevant to alterations to the tower.

The well-replicated site chronology gives strong crossmatches with a range of data, firmly establishing its date range to the period AD 1226-1392. Within the samples there is clearly a group formed by the roof timbers which as a single group could be considered as having a likely felling period in the range AD 1401-22. The northern floor beam from the bell-chamber floor (TOD12) gives very good crossmatches with these timbers (Table 2), and also has a similar felling date range. It might also be considered on these grounds to be part of the same batch of timbers, although there is no structural evidence to link the roof and belfry floor. If included in this group, it reduces the likely felling date range to AD 1401-15. Sadly, the second (southern) beam from the belfry floor did not date, despite having a long ring-width series. This series showed a number of sudden growth declines throughout its length (Fig 4), possibly resulting from management of some type. This dating evidence is of interest since it places the work in the period when the Peyvre family were still Lords of the Manor, and it had been thought likely that the tower roof was part of refurbishment works carried out by their successors, the Broughton family, who inherited the title in AD 1429.

The two samples from wallplates to the present roof appear to be from an earlier period to the remaining roof timbers, the most likely felling period for them being AD 1336-68. This could indicate either the re-use of timbers from elsewhere as wallplates to the present roof structure, or that the roof had to be replaced after a relatively short period and that the original wallplates were retained. More careful examination of the structure, perhaps combined with any historical records, may throw further light on this observation.

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