The Church of Holy Trinity, Hagworthingham:
Dating the Construction of its Bell-Tower Frame

D. W. Pearson

Hagworthingham is a small Lincolnshire village, situated on the south edge of the Wolds, a few miles east of Horncastle along the road to Skegness. The church of Holy Trinity is a fine medieval building with extensive Victorian refurbishment. The chancel, nave, porch, aisle and organ transept are in good order, but sadly only the foundations now remain for much of its thick-walled western tower, which collapsed in 1972. Prior to this date the tower contained a wooden structure which supported a bell-frame and a peal of eight bells. According to local legend, these were the 'wild bells' referred to by Tennyson in his poem In Memoriam which he started writing in 1833 while living at nearby Somersby.

Shortly before the demolition of the tower in 1981, the wooden bell-tower frame was recorded by the Royal Commission on the Historical Monuments of England (RCHM(E)) and the timbers sampled by members of the Nottingham University Tree-Ring Dating Laboratory. This paper discusses the dendrochronological results and compares the findings with the architectural and documentary evidence available.  

Much of the Spilsby Sandstone outer fabric of the church is the product of Victorian refurbishment, carried out by James Fowler of Louth in 1859. No detailed records of this work have been found. However, the south arcade, the lower levels of the tower and the westernmost part of the nave north wall are of medieval date. A church at Hagworthingham was recorded in Domesday Book, so building presumably began on the site in Saxon times. The coarse sandstone rubble with small areas in herringbone pattern in the north wall and the adjacent pilaster buttress are probably of Norman or Early English date. The capitals of the south arcade are in Early English style.

![Fig. 1. Holy Trinity Church, Hagworthingham from the south-west, c.1896-1900 (Lincolnshire Archives Office).](image)

Fig. 2. West side of the Hagworthingham bell-tower showing the timber structure. (N. Cooper, RCHM(E), 1981)

![Fig. 2. West side of the Hagworthingham bell-tower showing the timber structure. (N. Cooper, RCHM(E), 1981).](image)

The tower itself is known from old photographs (Fig. 1), and from plans and photographs taken at the time of demolition by RCHM(E) (Fig. 2) and W. Rodwell. It comprised two stages and was buttressed on three corners. The lower stage was faced internally and externally with sandstone blocks and a core of rubble and mortar. The middle upper levels of this stage were heavily restored, especially on the west and north faces with alternating courses of stone being replaced by three courses of brickwork. Above the string course the second stage comprised a rubble core but was almost entirely faced in brick. The belfry lights are recorded as being the work of Fowler (1859) and he was probably also responsible for some of the brick repairs. The door between the nave and the tower is now blocked, but the small door in the northern wall still stands in its original form. Both doors had dressings of Ancaster limestone, which Rodwell ascribed to a sixteenth-century style.

The timber structure (Fig. 3) inside the tower comprised two main parts. The sub-structure stood on two sill beams and formed a simple wooden tower. This supported a complex bell-frame, where the eight bells were hung. The sub-structure was formed by four upright posts (P1-P4) set in the outer ends of the two sill beams (B1 and B2). These posts supported two horizontal members (B9 and B10) on top of which rested five timbers (B11-B15) which together formed a platform for the bell-frame. The structure was further strengthened by rails and braces. Some of these timbers were clearly part of a later restrengthening, since several were of pine and because in places the timbers were very crowded. In particular, the braces B15-26, the beams B7 and B8 and the post P5 were clearly later additions. The sub-structure was independent of the stone tower, apart from the beams B7 and B8 which were keyed into the brick of the upper stage (the addition of these two beams was a factor in the final demise of the tower).
Fig. 3. Perspective reconstruction of the bell-tower frame, not to scale. (M. V. Clark).
The bell-frame was a complex structure, mounted on the bell-frame platform. It had clearly seen additions and rearrangements, probably as the number of bells hung in the frame increased. All but one of the eight bells were inscribed with a date. The treble and tenor were made in 1824, three were cast in 1836, one in 1856, and one in 1862. The uninscribed bell has been dated on stylistic grounds by Dawson to about 1520. Of course, the casting date of a bell may not reflect its date of hanging in the bell-frame. However, the church inventory of 1552 listed only three bells for Hawgworthingham, so it is likely that the nineteenth century bells were additions rather than replacements (see below).

Elphick has produced a developmental typology for bellframes in St. Mary's Church in Nottingham. Whilst it is difficult to apply this typology to the complex frame at Hawgworthingham, some of the trusses are similar in form to Elphick-type C, or maybe Z, but others are unlike anything described by Elphick. According to Brooke, the lack of a central post in the truss would date it after the late fifteenth century, and Elphick argues that the use of curved braces indicates a date earlier than the late seventeenth century. Most of the Hawgworthingham trusses conform to this pattern, but it may be unwise to be too categorical about such an unusual frame especially given the inadequate recording when the tower was demolished.

**Documentary Evidence**

Letters survive from Bishop Oliver Sutton of Lincoln to the dean of Horncastle in 1290 and 1291, in which he demanded funds to be raised for the construction of a bell-tower ('campanilis'). A third letter in 1298 requested further funds to be raised so that the tower could be completed; it seems likely therefore that the stone tower which collapsed in 1972 was mainly of thirteenth-century construction.

The surviving church accounts for Hawgworthingham extend no earlier than the late eighteenth century. A churchbook covering earlier periods is lost, probably in 1819. However, in 1784 Sir Joseph Banks copied extracts from this book, and these were published in 1888. The extracts refer mainly to bills and payments for the church for the years of the reign of Henry VIII. In four separate years (1531, 1537, 1538 and 1539) work is listed on the tower ('steple'). The material is not precise, but mentions 'boards' being laid, 'thacking' (thatching or roofing), work done by 'Yelers', and finally an order to pay 'Thomas Rughby for the steple'. It is very difficult from this to determine exactly what construction work occurred, but the sums of money involved ranged from ten shilling to ten pounds. It is certainly possible that these payments related to major work on the bell-tower.

The second body of documentary evidence is the early nineteenth century church accounts and associated church documents. A fascinating story of squabbles between local dignitaries and the other parishioners is revealed over a decision to raise money for three new bells for the church. To quote from the accounts for 1803:

...one hundred and seven pounds fifteen shillings and seven pence due... on account of the purchase of three new bells of the adding thereto three old bells, and of twining (them)... and there being made to strike in different places so as to make together... a peal of six bells, and of the hanging of the said six bells in the steeple...

Many parishioners complained bitterly at the cost and refused to contribute. One would expect many churchmen to have been made to the bell-frame at this time, and that the additional weight of bells would have required the whole tower to be strengthened. This would have applied even more so when the 1824 bells were installed, though this event was not recorded in the accounts.

The final item of relevant documentary evidence is a report provided by Taylor's Bellfoundry who inspected the tower in 1887. The inspector commented that the frame was in a 'terrible state' and that the bells were out of tune. Repairs were recommended and the parish council minutes for 1898 record that 21 shillings was raised for this purpose.

To summarise, the wooden tower had a complex constructional history. The tower is probably late thirteenth century, and one might have expected some of the timbers to date to this period. It is unlikely however that any of the bell-trusses is of a form that might have been constructed at this time, though some of its timbers may have been reused from this earlier period. The large sill beams, BI and B2, of the sub-structure appear to have been reused, since the thickness of the mortices of no apparent function in the final structure. It seems likely that some features of the bell-frame, and perhaps also the sub-structure, date to the sixteenth, seventeenth or eighteenth centuries, when new bells were added and work was done to have occurred on the tower. In particular, the evidence of the church accounts points to some of the timbers dating to the sixteenth century. The secondary restrengthening of the sub-structure probably dates to one of these periods.

By dating the timbers with an accurate scientific method such as dendrochronology, one hopes to clarify the chronology of the tower.

**The Dendrochronology**

Dendrochronology is a discipline which enables the dating of historical timbers. In this country work has mainly been confined to dating oak, mainly because it is a wood very well-suited to the technique, and fortunately it is the most common species to be found in medieval buildings.

The underlying principle of the method, is that a timber can be dated from the pattern of widths of its annual growth rings. The width of the annual rings of oak trees varies from year to year according to the climate during the growing season. Over a period of time this results in a sequence of annual rings with a more or less unique pattern of widths. As a result, one timber from a building may be matched with another from the same locality if each shows the same, or a similar, pattern of ring widths. By comparing ring widths from a whole series of buildings of overlapping dates a master sequence or chronology can be formed. Master chronologies for oak stretching back from the present day to medieval times and earlier have been constructed for various parts of the British Isles. The East Midlands master sequence built-up by the Nottingham University Tree-Ring Dating Laboratory extends back to the ninth century. It includes data from timbers in buildings in Leicester, Nottinghamshire, Lincolnshire and South Derbyshire.\

Once a master chronology has been established for a region, timbers from other buildings can be dated by matching their pattern of ring-widths (sequence) with that master. The matching was originally done visually but nowadays it is done using statistical methods on a computer. Due to ‘noise’ in the data a successful match is most likely to occur if four or more contemporary samples are available from a site, and if the average sequence formed from these samples is at least 80 rings in length. Each match produces a value (called a t-value) which indicates the statistical confidence in the result. Those matches with a very low t-value (less than 3.0) are definitely not reliable, whilst those with a high t-value (greater than 4.5) are of great significance. Matches with intermediate t-values are considered to be tentative, and should be used with caution.

If bark is present on a dated timber its felling date can be established to within a year after the date of the final ring. This is referred to as a complete sample. (Even without the presence of bark, it is often possible to identify a complete sample because of a distinctive wane edge on the outside of the timber, where bark has been removed). If the sample is not complete an estimate of the felling date can also be given. This is because the outer 30 or so rings, the sapwood, of a growing oak are usually lighter in colour and easily recognisable. If one or more sapwood rings are present on a sample then, by estimating that there would have been about 30 sapwood rings in all, the felling date of the tree can be estimated. (To allow for possible variations in the
number of sapwood rings it is good practice to give a range for the felling date: 15 to 50 sapwood rings is a reasonable estimate and includes about 95% of all mature oaks). The boundary between the sapwood and the interior wood, the heartwood, is referred to as the heartwood-sapwood transition (HST).

Of the remaining twelve samples, nine formed four small groups of two or three matching samples, and three did not match with any other sample at all. No dates could be obtained for these isolated samples, and dates for the small groups are mainly not very reliable, since each comprised less than four samples, although they will be discussed. They were averaged to give sequences: SQ2, SQ3, SQ4 and SQ5, with 134, 78, 83 and 70 rings respectively.

SQ1 matched very strongly with the East Midlands master (with a high t-value of 9.4) with the last measured ring of the sequence dated to 1533. Three of the samples in this sequence were judged to be complete. Two of these samples each had one outermost ring that was too unclear to be measured, and these were dated to 1532 and 1533 respectively. The third complete sample had two outer unclear rings that could not be measured, and the last of these was dated to 1533. So a felling date of 1532-5 is implied for these timbers. However, since one sample at least had a ring that could definitively be dated to 1533, a felling date of 1533-35 can be assigned to all the samples in the group. The uncertainty (of three years) is probably due to problems in counting unclear outer rings.

The samples of this sequence were from both the sub-structure and the bell-frame. Apart from the beams and braces that were clearly part of a later restrengthening phase, all the timbers of the sub-structure dated as part of SQ1 or did not date at all. In all, twenty-two timbers from the sub-structure can be dated to 1533-5. Interestingly, this includes the two large sill beams, B1 and B2, for which a late thirteenth century date had been anticipated. Six timbers from the bell-frame were included in sequence SQ1.

Only one of the other four sequences could be dated at all confidently. SQ2 and SQ5 both produced tentative dates (with t-values of 3.3 and 3.6 respectively) in the seventeenth century. The last ring for SQ2 was dated to 1625, and that for SQ5 to 1614. None of the samples in these sequences were complete, but the presence of some sapwood enabled felling dates of 1650-1 (95% certain 1653-70) and 1631-2 (95% certain 1616-51) to be estimated. Both sequences were based on samples from timbers in the bell-frame only.

SQ3 gave a tentative date of 1808 (t-value of 4.2) and an estimated felling date of 1836 (95% certain 1821-56). One of its two samples was from the bell-frame and the other was from one of the restrengthening braces of the sub-structure. This is the only dendrochronological evidence available for the date of this late modification to the timber tower.

SQ4 matched reasonably strongly with the master chronology (t-value of 5.8), with the last ring dated to 1881. The sapwood present enabled an estimated felling date of 1900-1 (95% certain 1885-1920) to be offered for the two small timbers concerned, both from the bell-frame.

Conclusions

The strong dendrochronological evidence and the support provided by Banks's transcripts, makes it seem fairly certain that the wooden tower at Hagworthingham was constructed in the 1530s. The documents alone would have led one to expect that only minor alterations had occurred at this date. The majority of the timbers of the sub-structure, and six out of the fourteen dated timbers from the bell-frame, can be assigned to this period. It was probably at this same time that new dressings were given to the doorways. A sixteenth century date is in keeping with the type of trusses most common in the bell-frame: the Elphick-type C or Z truss (see above) can, on the Hagworthingham dendrochronology be dated to the sixteenth century, since samples from timbers u and v were both included in sequence SQ1.

Furthermore, the sub-structure shows many common features with that of the nave bell-tower at White Notley. This was dated to the reign of Henry VII (1485-1509) by Hewett.16 It is surprising that none of the timbers were survivals from the thirteenth century work, but probably only masonry remains from that early construction.
Fig. 5. Bar diagram from SQI.
Dating the undoubted additions and modifications to the wooden tower is more difficult. Such changes provided only a few samples for tree-ring analysis, and some of the alterations were made with wood unsuitable for dating (either not oak or timbers with few rings). Dendrochronology alone gives some evidence for changes in the seventeenth century, and restrengthening the tower in the period 1821 to 1856. However, documentary evidence is much fuller in explaining dating changes to the tower during the early nineteenth century. Alterations occurred in order to incorporate three new bells in 1803, and two more in about 1824. These changes were dramatic, and resulted in a bell-tower that first became unworkable, and then became dangerously unstable; the repairs of about 1900 were, ultimately, insufficient.

This project has illuminated both the great potential of dendrochronology, and some of its limitations. Due to the large number of good quality samples available, a construction date for this timber tower can confidently be put forward. A structure that on the basis of some of the documentary evidence may have been dated to the thirteenth century, has conclusively been shown to originate in the sixteenth century. However, few suitable samples were available to help to clarify the later phases of the bell-tower, so for this one must rely on other evidence.

The type of timber sub-structure shown at Hagworthingham and at White Notley can now be assigned to the early sixteenth century, and it has been confirmed that Elphick-type C and Z bell-trusses were in use at this time. Further dendrochronological studies, would do much to help to interpret the chronology of bell-tower and bell-truss types in the East Midlands and throughout England.

Acknowledgements
I would like in particular to express my thanks to Dr. R. R. Laxton for the advice he gave and the time he spent in reading through this paper. I am also grateful for the assistance provided by C. D. Litton, W. G. Simpson, and R. Howard, of the Nottingham University Tree-Ring Dating Laboratory.


NOTES