Dendrochronological
Consultancy Limited

Report 640

The tree-ring analysis of a panel painting: *Mater Dolorosa, by the Master of the Holy Blood*

by Ian Tyers, October 2013

ian@dendro.co.uk

Tree-ring analysis of a panel painting:

Mater Dolorosa, by the Master of the Holy Blood

Dendrochronological Consultancy Report 640, by Ian Tyers, October 2013.

Summary

Analysis of the tree-ring sequences from the 2 boards in this *Mater Dolorosa* panel provided a likely usage date for the panel of after *c.* 1503. These 2 boards were derived from a single tree sourced from the eastern Baltic.

Tree-ring dating

Tree-ring dating or dendrochronology is an independent dating technique that utilises the pattern of ring widths within a timber to determine the calendar period during which the tree grew. From England and elsewhere in north-western Europe there are a large number of oak (*Quercus*) ring-width reference chronologies against which new sequences can be tested. The geographical and temporal coverage of these ring-width reference chronologies is extensive and it is possible to produce a series of strong regional chronologies for most of the northern, central and western parts of the continent. If suitable ring sequences can be obtained, it is possible to provide dates for many art-historical objects for which the date has hitherto been unknown or uncertain. It is not intended here to provide comprehensive details of the method as there is an extensive body of literature upon the subject. Details of the technique are given in Schweingruber (1988). The Dendrochronological Consultancy tree-ring laboratory follows the methodology and working practises recommended in English Heritage (1998) these are summarised below.

It is necessary that enough rings are obtained from any one timber in order to be able to find reliable cross-correlation with other tree-ring sequences. For oak the minimum acceptable number of rings is 50 rings.

Since not all timbers contain datable sequences, it is appropriate to measure sequences from each suitable timber in any object for which a date is sought.

The date of a tree-ring sequence must not be confused with the date of usage of a tree. The felling year of the tree can only be determined by obtaining sequences that have complete sapwood and either bark or identifiable bark-edge. Such timbers, that also have enough rings, are infrequently seen on panels. This is probably because the removal of the sapwood was a standard part of panel construction. Most dendrochronological studies of panel paintings can thus provide a *felling date range* or a *terminus post quem* date for a panel.

The date of felling of a tree is not necessarily the date of use of a board. Panels can provide tree-ring dates significantly earlier than the expected usage date where the panel remained in storage between construction and use, or the panel was re-used some considerable time after its first use. The process of converting boards into panels of particular sizes could involve the removal of outer rings from each board and the transport of imported timber may have taken an unusual length of time.

Dendrochronological analysis is at its most useful when the question relates to identifying a year <u>after</u> which a panel must date. But even under these circumstances it requires interpretations of some sort to convert the dates of the rings in a panel into a likely felling or usage date.

Dendrochronology is potentially not so useful in a situation where the question relates to identifying if a panel is from <u>before</u> a certain date, since there are a variety of circumstances in which normal assumptions are not valid. Situations where tree-ring dating is not appropriate to use include unusually small panels, or panels which are re-used.

It is not clear, despite extensive academic discussion, whether the seasoning of boards prior to construction of panels was normal practise. Since panels were made in a variety of locations and over an extended period there may in any case be differences of practise. Most tree-ring evidence, along with practical evidence based on rates of drying of thin boards, suggests there was either no intentional seasoning or a very short seasoning period.

Trees put their new growth on the outside of their trunk, just under the bark. The years of a series of tree-rings therefore runs from the oldest which are those nearer the centre through to the most recent which are nearer the outside.

The external cross-matching *t* table (Table 2) lists examples of matches for the composite data from the 2 boards in this panel against reference series. This table shows that there is independent corroboration for the dating given. The details of which data match best are (to some extent) irrelevant except if very high correlations had indicated these boards were derived from the same tree as used for a board in another panel. This correlation list is not exhaustive, since this sequence matches many other reference series at the same dating position.

The standard method of reporting correlation between tree-ring sequences employed throughout European dendrochronology is by use of coefficients calculated using the CROS algorithm of Baillie and Pilcher (1973). This algorithm produces *t* values. A *t* value of between -3.0 and 3.0 is normally found for each non-matching position of overlap between any two sequences. Values of between 3.0 and 5.0 have some statistical relevance and may reflect the correct dating position. Values between 5.0 and 10.0 are usually reliable indicators of synchronous sequences.

Mater Dolorosa, by the Master of the Holy Blood
DCL reference OS874

This panel was examined at Houghton, Norfolk, in September 2013. It was *c.* 309mm wide & *c.* 455mm high. It was constructed from 2 oak (*Quercus*) boards aligned horizontally. The boards were labelled A and B from the top (Figure 1). The boards were *c.* 14mm thick. There was no sapwood present at the edges of these boards, this allowed a *terminus post quem* date to be produced from the analysis of this panel.

An initial examination identified that both boards contained enough rings for analysis. Annual ring width sequences were measured on a computer based measuring system. The individual ring widths were measured to an accuracy of 0.01mm. Complete sequences of rings were obtained from the left edges of both boards (Table 1). The measured series included the last complete rings present on the left edges. Examination of the grain on the back of the panel suggests no or few additional rings are present at the right edges of these boards. The most recent outermost rings are the most important for constraining the date for this panel.

Results

The 2 measured board series were initially compared with each other and were found to cross-match significantly (*t* value 11.35). These sequences are sufficiently similar that it is reasonable to conclude that they were derived from a single tree (Figure 2). The 2 series were combined into a single composite tree-ring sequence. This composite series was then compared with a set of European master tree-ring chronologies. These comparisons involved the examination of each possible position of overlap between the composite board series and each of the reference sequences, this search was undertaken by computer. These comparisons identified a series of statistically significant correlations between the composite board sequence and more than one of the master reference sequences at the same absolute dating position. This position was checked visually using standard tree-ring plots to confirm that the matches were reliable.

The checking process then proceeded to separately test this series at its dating position against a large number of independent sequences of similar date and origin. This process was used to confirm that the identified dating position exhibited statistically significant correlations against sufficient independent tree-ring data that the result can be regarded as reliably replicated. These checks proved satisfactory and identified both the source of the timber and the dates of the sequences within boards A & B.

The origin of the boards

The matches between the board series and the reference data are with a number of chronologies derived from the eastern Baltic area of Europe. The sub-group of Baltic material that they match best is from current evidence most probably from Poland or the countries east or north-east of Poland (Haneca *et al* 2005; Fraiture 2009). The board series also matched data from a number of other objects previously identified by dendrochronology as being derived from the same area (Table 2). This area is thus the most likely source region for these boards. This is not an unexpected outcome given both that there was an extensive trade in oak planking from the eastern Baltic region throughout the period from the 14th to mid-17th centuries and that these boards are straight grained, and slow growing, unlike the characteristics of contemporaneous oak boards derived from western Europe (Tyers 2010).

The date of the felling of the boards

The interpretation of the date of these boards are shown on Figure 3 in the form of a bar diagram. The absence of sapwood allows the minimum number of sapwood rings, 8 years for the eastern Baltic boards, to be used to calculate the earliest likely felling dates for these boards. The most recent measured heartwood rings date to 1495 from board A, and 1492 from board B. The boards of this panel were therefore derived from a single tree certainly still growing in 1495. Assuming typical minimum amounts of sapwood were originally present then this tree was probably felled after *c*. 1503.

The maximum width of usable timber without sapwood derived from examination of other imported Baltic oak boards used in 16th and 17th century panels shows the vast majority are between *c.* 250mm & *c.* 325mm wide (see Figure 4). The lower board from this panel is therefore a typical size for an eastern Baltic board (it is 303mm wide). The comparative data suggests that this board is unlikely to have been trimmed from a wider board. This suggests it is appropriate to interpret the result using typical maximum sapwood counts, and a minimal allowance for trimming. Such a calculation would indicate felling could have occurred between *c.* 1503 & *c.* 1535.

The panel has clearly been modified since the vertical edges have bevels with a completely different patina to the rest of the panel, and one of these bevels cuts through a peg in the joint. The use of horizontal boards in a portrait format panel is relatively rare. It seems likely that this scene was originally part of a landscape format panel. The outermost rings are all aligned towards the joint in the panel so the dates of the last rings obtained from the tree-ring analysis have not been affected by any modification.

Conclusion

The tree-ring analysis of this panel has identified that the 2 boards of this panel were derived from a single tree which was still growing in 1495. Applying standard estimates for missing sapwood indicated that these boards are likely to have been felled after *c.* 1503. The analysis has identified that these boards originally grew somewhere in the eastern Baltic area of Europe.

The analysis of the tree-ring sequences from this panel has provided strong evidence for the date, and source, of the boards forming the support. However, the painting need not be co-eval with the date of production of the support. A dendrochronological study is of interpretative value when integrated with other technical and art-historical studies.

Acknowledgements

The analysis of this panel was funded by Kiffy Stainer-Hutchins who kindly provided the working space necessary to carry out the analysis, supplied the image used in this report and provided discussion of the result.

References

Baillie, M G L & Pilcher, J R, 1973 A simple crossdating program for tree-ring research, *Tree Ring Bulletin*, **33**, 7-14

English Heritage, 1998 *Dendrochronology: guidelines on producing and interpreting dendrochronological dates*, English Heritage

Fraiture, P, 2007 *Les supports de peintures en bois dans les anciens Pays-Bas méridionaux de 1450 à 1650 : analyses dendrochronologiques et archéologiques*, PhD Thesis University of Liège

Fraiture, P, 2009 Contribution of dendrochronology to understanding of wood procurement sources for panel paintings in the former Southern Netherlands from 1450 AD to 1650 AD, *Dendrochronologia*, **27**, 95-111

Groves, C, 2002 *Dendrochronological analysis of Bowhill, Exeter, Devon*, Centre for Archaeol Rep, **23/2002**

Haneca, K, Wazny, T, van Acker, J & Beeckman, H, 2005 Provenancing Baltic timber from art historical objects: success and limitations, *Journal of Archaeological Science*, **32**, 261-71

Schweingruber, F H, 1988 *Tree Rings*, Kluwer Academic Publishers

Tyers, I, 2000 *Tree-ring analysis of panelling from Otley Hall, Otley, Suffolk*, ARCUS Rep, **550**

Tyers, I, 2001 *Tree-ring analysis of a panel painting: The Ashmolean 'Battle of Pavia'*, ARCUS Rep, **572g**

Tyers, I, 2009a *The tree-ring analysis of 10 panel paintings from Eton College*, Dendro Co Rep, **158**

Tyers, I, 2009b *The tree-ring analysis of a panel painting: The Temptation of St Anthony*, Dendro Co Rep, **282**

Tyers, I 2010 Aspects of the European Trade in Oak Boards to England 1200-1700 in *Trade in Artists Materials, Markets & Commerce in Europe to 1700* (J Kirby, S Nash and J Cannon), 42-9

Figure 1. The construction of the *Mater Dolorosa* panel, front. The overall dimensions, the approximate joint location, the individual board widths and their directions of growth are also shown, photo supplied by Kiffy Stainer-Hutchins.

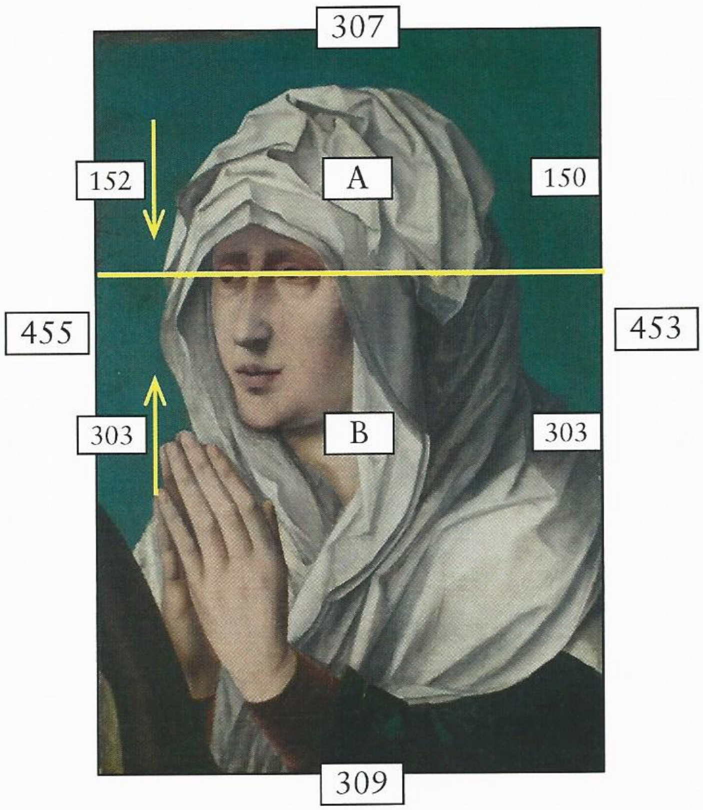

Figure 2. A diagram showing the synchronised sequences from board A (black), and board B (red) from the *Mater Dolorosa* panel. The overall similarity of their medium term growth trends and the presence of the same individual narrow years indicates that these are derived from the same tree (t value 11.35).

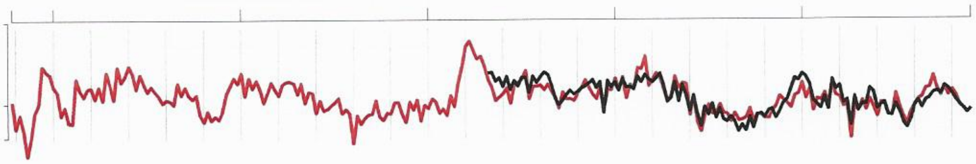

Figure 3. A bar diagram showing the positions of the dated ring sequences obtained from the *Mater Dolorosa* panel. The measured sequences were identified as eastern Baltic oak boards (white bars), which contain only heartwood. The interpretations based on the minimum likely number of missing sapwood rings are also shown.

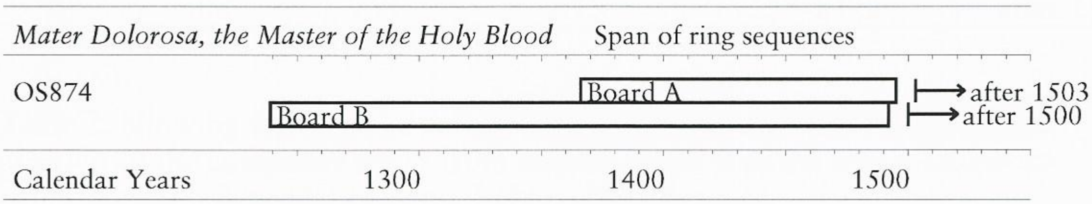

Figure 4. Illustrating the strong bias towards *c.* 250-325mm wide eastern Baltic oak boards seen in the NPG's Tudor and Stuart panel paintings. The widest board in the *Mater Dolorosa* panel is therefore of a typical width.

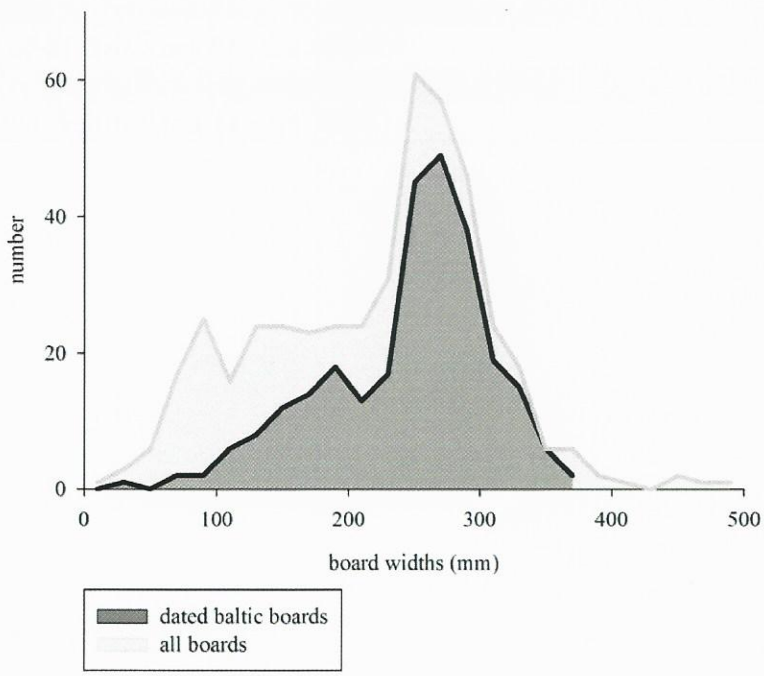

Table 1. Details of the boards from the *Mater Dolorosa* panel.

Board	Width (mm)	Rings	Growth rate (mm/yr)	Date span of measured rings	Interpreted date
A	150-152	130	1.17	1366-1495	after 1503
B	303	254	1.19	1239-1492	after 1500

Table 2. Showing illustrative *t* values (Baillie & Pilcher 1973) for the dated position of the composite series from boards A and B of the *Mater Dolorosa* panel against independent eastern Baltic reference series.

	OS874 boards AB 1239-1495
Suffolk, Otley Hall wall panelling (Tyers 2000)	7.09
Henry VII arched top Eton (Tyers 2009a)	5.97
Landscape with St Jerome Bles, Namur (Fraiture 2007)	5.94
Temptation of St Anthony (Tyers 2009b)	5.87
Devon, Exeter Bowhill ceiling boards (Groves 2002)	5.83
Battle of Pavia Ashmolean (Tyers 2001)	5.54