Dendrochronological analysis of an English chest: Contributing to knowledge about wood supply and chest production in 16th century England

Domínguez-Delmás, M.; Bridge, M.; Visser, A.S.Q.

DOI
10.1016/j.dendro.2021.125828

Publication date
2021

Document Version
Final published version

Published in
Dendrochronologia

Dendrochronologia 67 (2021) 125828

Contents lists available at ScienceDirect

Dendrochronologia

journal homepage: www.elsevier.com/locate/dendro

ORIGINAL ARTICLE

Dendrochronological analysis of an english chest: Contributing to knowledge about wood supply and chest production in 16th century England

Marta Domínguez-Delmás [a,b,c,*], Martin Bridge [d], Arnoud S.Q. Visser [e]

[a] History of Art Department, University of Amsterdam, BG2 Turfdraagsterpad 15-17, 1012XT, Amsterdam, the Netherlands
[b] Conservation and Science Department, Rijksmuseum, Ateliergebouw, Hobbemastraat 22, 1071ZC, Amsterdam, the Netherlands
[c] DendroResearch, 6707JG, Wageningen, the Netherlands
[d] Institute of Archaeology, University College London, G1A 31-34 Gordon Square, WC1H 0PY, London, United Kingdom
[e] Institute for Cultural Inquiry, Utrecht University, Transcomplex Trans 10, 3512JK, Utrecht, the Netherlands

ARTICLE INFO

Keywords:
Non-invasive dendrochronology
Tree-ring dating
Timber provenance
English furniture
Marks on Wood

ABSTRACT

Historic furniture has a great ethnographic and historical value, as styles and designs responded to specific uses, fashion trends and the social status of the buyer or the commissioner. Placing it in an exact chronological and geographical production context increases our knowledge about preferences for materials, designs, and woodworking practices for household commodities. Here we present the results of dendrochronological research carried out on an English chest from a private collection. The chest is of a hybrid construction, with boarded sides and back, and a joined front with four carved linenfold panels. It had been described as made of Baltic oak and dating to the mid-16th century, a crucial transition period for which only a few early chests have been analysed. Our results demonstrate, however, that the wood from the lid, side boards and back originates from the south of England. Heartwood/sapwood border in the left side board has allowed an estimated felling date for the tree of between 1520 and 1552. *Terminus post quem* dates of the rest of the elements pre-dating this interval indicate that the chest was likely made in the second quarter of the 16th century, as initially described. Three linenfold panels show typical features of Baltic wood, whereas the fourth one has different characteristics and could have been made with English oak, but the lack of access to the tree-ring patterns hampers verifying this hypothesis. Mixture of provenances suggests a production workshop in London, although other town in the south with a major timber market cannot be discarded. The construction features are described, and two distinct marks found in the chest are discussed in the regional context of its production. To allow the compilation and inventory of such marks, the 'Marks on Wood' community has been created in Zenodo and is presented here.

1. Introduction

Historic furniture objects such as cabinets, chairs, tables and chests were common household items and can be found nowadays in museums, palaces, ecclesiastic and vernacular historic buildings, and also in households of private collectors. Their styles and designs responded to specific uses, as well as to regional (and sometimes international) fashion and the social status of the buyer or the commissioner (Chinnery, 1979; Klein et al., 2014; Liu et al., 2019). Therefore, historic furniture has a great ethnographic and historical value, and placing it in an exact chronological and geographical production context increases our knowledge about preferences for materials, designs, and woodworking practices for household items in different regions through time.

The attribution of furniture objects to a workshop or a historical period is usually based on stylistic features, type of joinery and/or ironwork. Dendrochronological research can contribute to support or refute stylistic attributions by providing an exact date and provenance for the wood. Trade routes and production centres can sometimes be inferred, and artistic styles and woodworking techniques can then be framed in a specific spatiotemporal context. In the Netherlands for example, dendrochronological research on historical art objects from various museums allowed identifying a shift in the source of the wood

* Corresponding author at: Postbus 94551, 1090GN, Amsterdam, the Netherlands.
E-mail addresses: m.dominguezdelmas@uva.nl, m.dominguez@dendroresearch.com (M. Domínguez-Delmás), martin.bridge@ucl.ac.uk (M. Bridge), A.S.Q.Visser@uu.nl (A.S.Q. Visser).

https://doi.org/10.1016/j.dendro.2021.125828
Received 15 January 2021; Received in revised form 13 March 2021; Accepted 22 March 2021
Available online 31 March 2021

from the Baltic towards Germany in the mid-17th century (Jansma et al., 2004), furnishing with material evidence historical accounts about the reorganisation of Dutch timber trade in northern Europe after 1648 (e.g. Buis, 1985; de Vries and van der Woude, 1997). In Austria, Klein et al. (2014) carried out dendrochronological research in furniture and coopered vessels and provided insights into the woodworking practices, and the time taken for seasoning and storing the timber preceding the construction of the objects, concluding that little wood was removed during manufacturing, and that seasoning and storage time must have been less than 10 years.

2. Dendrochronological research on chests

In Europe, extant chests can be traced back to the middle ages, representing the oldest most abundant type of furniture that has survived to the present (Pickvance, 2020). However, their stylistic attribution can be problematic, as styles travelled with artists and wood could be reused from other items, making it often difficult to ascertain the construction period and place (Chinnery, 1979; Pickvance, 2015, 2018). To our knowledge, in addition to the aforementioned studies of Jansma et al. (2004) and Klein et al. (2014), which also included some chests made of oak in the Low Countries (*Quercus* sp.) and conifers in Austria (predominantly *Picea abies*), tree-ring studies have been carried out on chests in Germany, Norway and England. In Germany, results of 55 chests dated by Leuschner (mostly oak) provided an exact chronology for the constructive and stylistic features, as well as insights into the wood supplying areas (Albrecht, 1997; Von Stülpnagel, 2000). Of these, three were from the early 15th century, the others all being earlier, mostly of 14th century origin, using wood from northern Germany. In Norway, the research revealed that only the medieval chests had decorative carvings, and that the wood originated from the central part of the country (Thun and Alsvik, 2009; Thun and Svarva, 2016).

In England, several art-historical studies involving chests were carried out in the early 20th century (Lewer and Wall, 1913; Roe, 1902, 1929), and an unpublished list of 293 chests compiled in the county of Suffolk in the 1920s became a starting point for (Sherlock, 2008), who carried out a large study that included dendrochronological dating. His study states that there is no contemporary reference to the manufacture of a medieval church chest, only their bequest, purchase, repair and use, although nothing is said about how the trade in chests was organised. Concurrently, Miles and Bridge (2008) dated several chests held at Westminster Abbey in London, ranging in date from the late-12th to the mid-15th century.

The dendrochronological work undertaken at Westminster Abbey, and for Sherlock's book, led to the review of dated chests in England (Bridge and Miles, 2011 and references therein), which details the dates of 34 chests, 28 of which are earlier than the sixteenth century (made predominantly with Baltic wood), four being of early sixteenth century (noting a return to the use of English wood around this time) and the remaining two dating to the second half of the 17th century (made with wood from the Welsh borders). Further studies by (Pickvance, 2012, 2015, 2018, 2020) have been carried out on medieval chests combining stylistic and constructive features with dendrochronology, and providing invaluable insights into chest production in late medieval England. With that, England is one of the most prolific regions for dendrochronological studies on this type of object, closely behind Germany, and still, a prominent gap remains for mid-16th century chests.

Here, we present the observations and results gathered through the dendrochronological analysis of an English chest made of oak, with the aim of contributing to the knowledge base of English chest production. The chest was initially described as dating to the 16th century and made of Baltic oak, which seemed unlikely at first glance, given the wide tangential boards that form the main structure, and which were an uncommon timber product in the Baltic region (Wazny, 2005). Our specific objectives were therefore to establish the date and provenance of the wood, and by inference, identify the area where the chest was made. Two distinct marks found in the chest are also discussed in the regional context of its production, and a possible use for this furniture object is proposed.

3. Material and methods

3.1. The chest: elements, structural description and marks

The chest under scrutiny was purchased in 2019 by a private collector from an antiquarian based in Essex, England. The antiquarian had formerly acquired it from a private collector living near Hastings in East Sussex, who had owned it for over 50 years. The antiquarian's description read:

"Henry VIII oak carved linenfold chest, the panelled front with four framed linenfold panels, with plain nailed on spandrels attached to a boarded body with cut out sides, made with Baltic timbers. Date: Circa 1530–1550".

The chest is of a hybrid construction (Chinnery, 1979, p. 421), with boarded sides and back, and a joined front with four carved linenfold panels (Fig. 1). The front is nailed to the boarded carcase, connected to the sides with rebate joints. The total height is 74 cm at the front (including the lid), 72.5 cm in the middle (measured on the side, due to the warping of the lid), and 73 cm at the back. A detailed description of each element is provided:

- The front is made of four linenfold panels, three of them clearly made of radially processed boards from slow-grown trees (the multiseriate rays are visible in the longitudinal section, where also thin rings can be observed), whereas the fourth, left one, was processed tangentially from a relatively faster-grown tree (Fig. 2a). The linenfold panels are framed by two horizontal rails joined by tongue and groove and iron nails (four on each side) to two vertical stiles (Fig. 2b), with three 'muntins' between the panels (see terminology in Chinnery, 1979, p. 115). The stiles are fixed by wooden pegs to the side boards. The front has two fractures on the left side, which seem to have been caused by damage rather than structural strengths.
- The left side board was processed tangentially and represents half the width of a tree, the part closest to the pith being oriented towards the front of the chest (Fig. 2c). In the opposite side, sapwood remains attached in the lower part (Fig. 2d). The board is 40.5 cm wide, 71 cm high at the front and 69 cm at the back, with a thickness is 2.5 cm. The transverse section at the top presents a very rough surface (Fig. 2e).
- The right side board is also tangentially processed, measuring 41 cm wide, 70.5 cm high at the front and 70 at the back. With 1.8 cm thickness is visibly thinner than the left one. In this one, however, the pith runs approximately through the middle (Fig. 2f). A single circle of 14 cm diameter is drawn on the outer part of this leg (Fig. 2g). Tool traces are also present on that outer surface. The transverse surface at the top is also very rough, and it has two iron nails inserted on it, which currently do not have an obvious function. Both side boards seem to be original, as they are slightly degraded at the bottom (more so towards the back), indicating that they have not been trimmed.
- The back of the chest is composed of a large board processed tangentially, in which the pith runs approximately through the middle (Fig. 2h). Remnants of sapwood can be observed in the upper part. It has tool marks like those present on the right leg. An additional narrow rail closes off the back on the lower part.
- The lid is made of a single tangentially processed board c. 128 cm long, 46 cm wide, and 2.5 cm thick on average, and it is warped downwards. The box of the chest is 119 cm long, and 44 cm wide (considering front and back boards), hence the lid extends over about 5 cm on each side. It has the same tool marks as the other elements (Fig. 2i), which were probably caused by scrapping with a plane.
- The bottom consists of four thin radial boards, which are joined by V groove joints. The left one has a partial mark carved in the underside

Fig. 1. Chest with linenfold panels.

side (Fig. 2j). Such thin bottom boards suggest that the chest was not meant to hold a heavy load.
- The spandrels seem to be original, having the function to support the front panel and connect with the side boards (Fig. 2k).

3.2. Dendrochronological analysis

Non-invasive dendrochronological research was carried out on the lid, the large back board, the side boards and the right spandrel. Digital photographs of overlapping sections were taken from the exposed end-grain of the side boards (upper part), back (left and right side) and right spandrel (right side). Given that the surfaces were rough, and the visualisation of the tree rings was partially hampered by the wax or varnish that was covering the wood, photographs were also taken on the surfaces representing the tangential/radial sections of the side boards, the back and the lid (Fig. 3a). Additionally, the underside part of the side boards was cleaned with scalpel blades and photographed, in order to reach the outermost rings, which in the case of the left side board reached the heartwood/sapwood border. The bottom boards were investigated at the back, where the end-grain was accessible. The transverse edge of the three widest boards was cleaned with a scalpel and photographed (Fig. 3b). The smallest one was discarded because it contained less than 10 tree rings. All the photographs included either a ruler or measuring tape, therefore tree-ring widths obtained from transverse ends represent absolute values, whereas the ones taken from radial/tangential section are relative values due to the distortion of the ring widths in that section.

Tree rings were measured from the photographs using CooRecorder&CDendro v. 9.0.1 April 19, 2017 (Larsson, Cybis Elektronik & Data AB), and crossdating between the series and with European reference chronologies was carried out with PAST4 v. 4.3.1025 (SCIEM) and RingMaster (C. Bridge, unpublished) following standard procedure for oak (Baillie, 1982). Provenance maps were produced with QGIS 3.4 Madeira (QGIS Development Team, 2019).

4. Results and discussion

4.1. Construction features and function of the chest

The framework is soberly decorated with scratch-stock carvings. In the top rail the scratched mouldings run out before the muntin joints. The linenfold decoration presents three symmetrically arranged, formalised drapes in each panel, separated by two carved rods. This style took its inspiration from the folding and drapery of the fabric of clothes and hangings. Originating in northern France in the second half of the 15th century on wall-panels, linenfold designs soon appeared in England. Used during the first half of the 16th century, they became increasingly rare after 1560 (Chinnery, 1979). The shape of the chest, with the bottom made of very thin boards and lifted 22.5 cm from the ground, implies that it was meant to store clothes, household linen, or foodstuff, rather than heavy-weight books.

The combined use of boarding and panelling is typically associated with the middle of the sixteenth century. This period witnessed the steady increase of joining in response to a growing demand for interior decoration and more refined woodwork. Joining and panelling offered specific advantages over boarding (Chinnery, 1979). Connecting pieces of wood with nails inevitably led to splitting due to the natural shrinking of timber. The use of thinner panels within a frame held together by mortice-and-tenon joints offered a more flexible construction, preventing timber from splitting, while also considerably reducing the weight of the piece.

The fact that joinery gained in importance during the sixteenth century is reflected in competition and legal disputes between furniture guilds at the time. In London, the carpenters were the oldest furniture-making trade to organize themselves into a guild, with ordinances going back to the early 14th century, receiving its first royal Charter in 1477. The joiners and makers of panelled work (also called 'ceilers') gradually formed their own group, resulting in a fully separate trade that received its first Charter in 1570/1 (Chinnery, 1979, p. 109). With their separation from the Carpenters' Company the joiners successfully secured the exclusive right to the use of mortice-and-tenon joints.

Such archival sources can help to place individual pieces in a particular production context, but do not offer conclusive evidence for dating. The legal disputes are equally revealing of the official rules as of the unofficial habit to ignore them. London, moreover, was not representative of the rest of the country. Yet although the separation between carpenters and joiners did not take place everywhere, a similar development in other cities suggest a national trend (Louw, 1989).

4.2. Date and provenance of the wood

The comparison of the tree-ring series obtained from each element revealed an excellent visual and statistical match between the back and the left side board, indicating that they originate from the same tree (Fig. 4). The three boards from the bottom also originate from one tree. Those tree-ring series were averaged into mean curves representing individual trees, and were compared again with the rest of the series, but no good matches were found (all produced tBP$<$2.7). In contrast, crossdating with oak reference chronologies from central and northern Europe resulted in the dating of all elements except the spandrel with English chronologies (Table 1). The average tree-ring series for the back and left side boards shows strong affinities (tBP between 6.5 and 7.5) with historical chronologies to the west and south-west of London (Fig. 5a). Similarly, the average series from the bottom boards shows a

Fig. 2. Construction features. a) front of the chest with the linenfold panels (numbers indicate: 1, rails; 2, stiles; and 3, muntins); b) tongue-and-groove join of the horizontal top rail to the right vertical stile; c) left side board, tangentially processed; d) heartwood/sapwood boundary is present on the lower back of the board; e) the transverse end at the top of the board is rough and unpolished, no nails are present; f) right side board, with a rough unpolished transverse end at the top (two nails are present but not in view here); g) circle of 14 cm diameter carved with compass; h) the back is made out of a wide tangential board and a narrow rail closing up the lower part; they are attached to the side boards with metal nails; i) tool marks on the inner side of the lid resulting from scraping the surface with a plain; j) partial mark on the underside of the left bottom board; k) right spandrel, which is fixed to the right side board with metal nails.

comparable distribution of matches, although these are less strong (Fig. 5b). The right side board however, has distinct stronger matches with sites near London, and one site to the north-east of London (Fig. 5c). Lastly, the lid shows stronger matches with sites along the Thames, west of London, and the strongest match with a site to the north-east of the city (Fig. 5d). Historical sites in London itself are often left out of the dendroprovenancing analysis, as from an early date (at least since the late 13th century; Galloway et al., 1996) London was pulling in timber resources from a wide hinterland. Moreover, it is not wise to concentrate on a single outstanding match (e.g. the site to the north-east of London in Fig. 5c) given that, although it is generally considered that these individual sites probably represent locally grown timber, any one of them could have used wood from elsewhere. One therefore must look at the overall trend of matches shown. The diversity of sites around London showing good matches for the different timbers suggests different sources, an idea that is reinforced by the lack of strong inter-correlations between the series of these elements.

Given that the measurement of the left side board reached the

Fig. 3. Tree-ring acquisition. a) One of the parts of the chest (inner side of the lid) where tree rings were photographed in the transverse/radial section dendrochronological research; these measurements produced relative values; c) detail of the preparation with scalpel knives in the transverse end of the bottom middle board, were the V groove joint can be observed. These measurements represent absolute values.

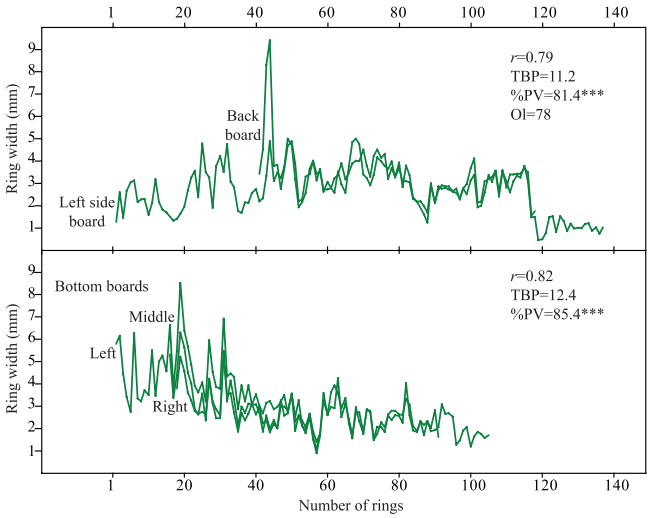

Fig. 4. Visual and statistical match between elements found to derive from two individual trees; a) back and left side board; b) bottom boards (average values); statistical values obtained from PAST4 v. 4.3.1025 (SCIEM); *r*, correlation coefficient; TBP, Student's t value applied after normalisation of the series according to (Baillie and Pilcher, 1973); %PV: percentage parallel variation (Eckstein and Bauch, 1969). Asterisks represent the significance level of the % PV: *, $p < 0.01$; **, $p < 0.05$; ***, $p < 0.001$.

heartwood/sapwood boundary, it is possible to estimate the felling date of the tree within a range of years. Sapwood observations on living oaks and timbers in Southern England converge in a range of 9–41 sapwood rings within the 95% confidence interval (Miles, 1997). In this way, considering that the left side board has 137 tree-rings that end on the heartwood/sapwood boundary in 1511, we can estimate within a 95% probability range that the tree was felled between 1520 and 1552 (Table 1). Although the rest of the elements lack sapwood, none of the *terminus post quem* dates surpasses this estimated felling range. Therefore, it is safe to assume that the rest of the trees were also cut within those years.

4.3. Production time and place

The lack of cracks in the wide boards indicates that they were dry when the chest was assembled. Therefore, a few years (1–5 for example) should be added to the estimated felling date of the tree. This leads to a likely construction year in the second quarter of the 16th century up to the 1550s, as the antiquarian had described.

The fact that English oak was used for the structure implies that the chest was made in England. The different provenance of the elements of English oak within South England in opposite directions from London (two trees showing clusters of best matches to the southeast of the city, and the other two to the northeast; Fig. 5) suggests that the wood was gathered in this city. During the 13th and 14th centuries, London was supplied of wood products for fuel by woodlands in its surrounding counties (Middlesex and Surrey, to the W and SW; Hertfordshire, Buckinghamshire and Essex, respectively located to the N, NW and NE of the city; and some areas of Kent, to the SE) (Galloway et al., 1996). While larger timber for construction was also supplied from those areas, Surrey seems to have been by far the largest supplier (Galloway et al., 1996, p. 465).

Observations obtained from three of the linenfold panels suggest that Baltic oak was used in their construction. They are carved on radially processed slow-grown oak boards, a type of timber-product typically derived from wainscots produced in the south-eastern Baltic until the mid-17th century, which were exported to western Europe through Gdansk (Wazny, 2005, 2002). Although it is reasonable to assume that the wood used for these linenfold panels has a Baltic origin, only the dendrochronological analysis of those panels would allow us to confirm or refute this assumption. For this, the chest would have to be disassembled in order to gain access to the end grain in the linenfold panels, which is currently not a plausible option. The fourth panel (left one) is not as radial as the others nor made on such a slow-grown oak wood, which indicates that it was made with wood from a different provenance. Dendrochronological research on English panel paintings has provided evidence of the presence of Baltic wood in English workshops in the 15th and 16th centuries (Cooper, 2011; Hillam and Tyers, 1995), and was also used in furniture, wall panelling and doors (Bridge, 2016). According to (Chinnery, 1979, p. 155) "'wainscots' and 'clapboards' were brought in [to England] through London, Bristol and the North Sea ports". Therefore, the mixture of oak in the chest from different parts of southern England and the Baltic points towards a production centre in a major city with a big timber market, where wood from those areas was imported. London seems the most plausible option, although the production in a regional workshop in the south of England cannot be excluded, especially if we consider that the three linenfold panels of suspected Baltic origin could have been reused from another piece of furniture produced in London or elsewhere years earlier.

4.4. The circle and the mark

The circle on the right side board was made with a compass, as indicated by the indent in its centre. The chronology of this circle cannot be established, but circles and other symbols (concentric circles, X-shaped marks, daisy wheels, etc) were used for protective purposes since the Middle Ages (Easton, 2016). Known as apotropaic symbols, these marks were often placed on doors, windows, and fireplaces, as those were the parts of the house that connected the inside with the outside

Table 1
Dendrochronological results of the researched elements, showing best statistical match with site and regional chronologies. N, number of tree rings; SW: sapwood (h/s: heartwood/sapwood boundary); *t*BP, Student's t value after Baillie and Pilcher (1973) showing results with site and regional chronologies; Ol, overlap; *r*, correlation coefficient; Tree-ring data from the chest is openly available (Domínguez-Delmás, 2021).

Structural element	Dendro code	N	Pith	SW	Begin date	End date	Estimated felling date **	*t*BP (Ol) Site/Regional	*r* Site/ Regional	Chronology*** Site/Regional
Back	10	78(12)*	–	–	1415	1492	Via 1-2T	6.43 (78)/5.83 (78)	0.60/0.57	BSNGSTK1 (1)/HANTS02 (2)
Left side board	20	137	c.20	h/s	1375	1511	Via 1-2T	7.30 (137)/8.36 (137)	0.54/0.59	HMPTNCT4 (3)/HANTS02 (2)
Lid	30	117	+	–	1317	1433	After 1442	6.94 (88)/7.99 (117)	0.61/0.60	THXTDCH (4)/ANGLIA16 (5)
Right side board	40	90	–	–	1371	1460	After 1469	6.56 (90)/4.62 (90)	0.58/0.45	LISTON (6)/SCENG (7)
Bottom; right board	51	88	–	–	1422	1509	Via 5-6-7T	6.37 (88)/5.01 (88)	0.58/0.48	CHDESQ01 (8)/HANTS02 (2)
Bottom; middle board	61	76	–	–	1420	1495	Via 5-6-7T	6.85 (76)/5.31 (76)	0.63/0.54	MOTISFNT (9)/HANTS02 (2)
Bottom; left board	71	58	c.10	–	1405	1462	Via 5-6-7T	4.13 (58)/<3.50	0.50/-	MOTISFNT (9)
Right spandrel	81	42	–	–	–	–	–	–	–	–
Average back & left side boards	1-2T	137	c.20	h/s	1375	1511	Between 1520 and 1552	6.94 (129)/8.35 (137)	0.53/0.59	SYDMNTN1 (10)/HANTS02 (2)
Average bottom boards	5-6-7T	105	c.10	–	1405	1509	After 1518	6.38 (105)/5.36 (105)	0.54/0.47	EXTON (11)/HANTS02 (2)

* In brackets: number of additional rings towards the outside that can be seen but cannot be measured.
** Estimates based on (Miles, 1997) for Southern England and a 95% confidence interval. A Bayesian sapwood estimate can be calculated when considering the mean ring width, but the combination of relative and absolute ring-width measurements in this chest precludes this option in our case.
*** Reference chronologies: (1), Miles et al. (2007); (2), Miles (2003); (3), Miles and Bridge (2013); (4), Bridge (2005); (5), Bridge, unpublished; (6), Bridge et al. (2019); (7), Wilson et al. (2012); (8), Arnold and Litton (2003); (9), Miles (1996); (10), Miles et al. (2005); (11), Miles and Haddon-Reece (1995).

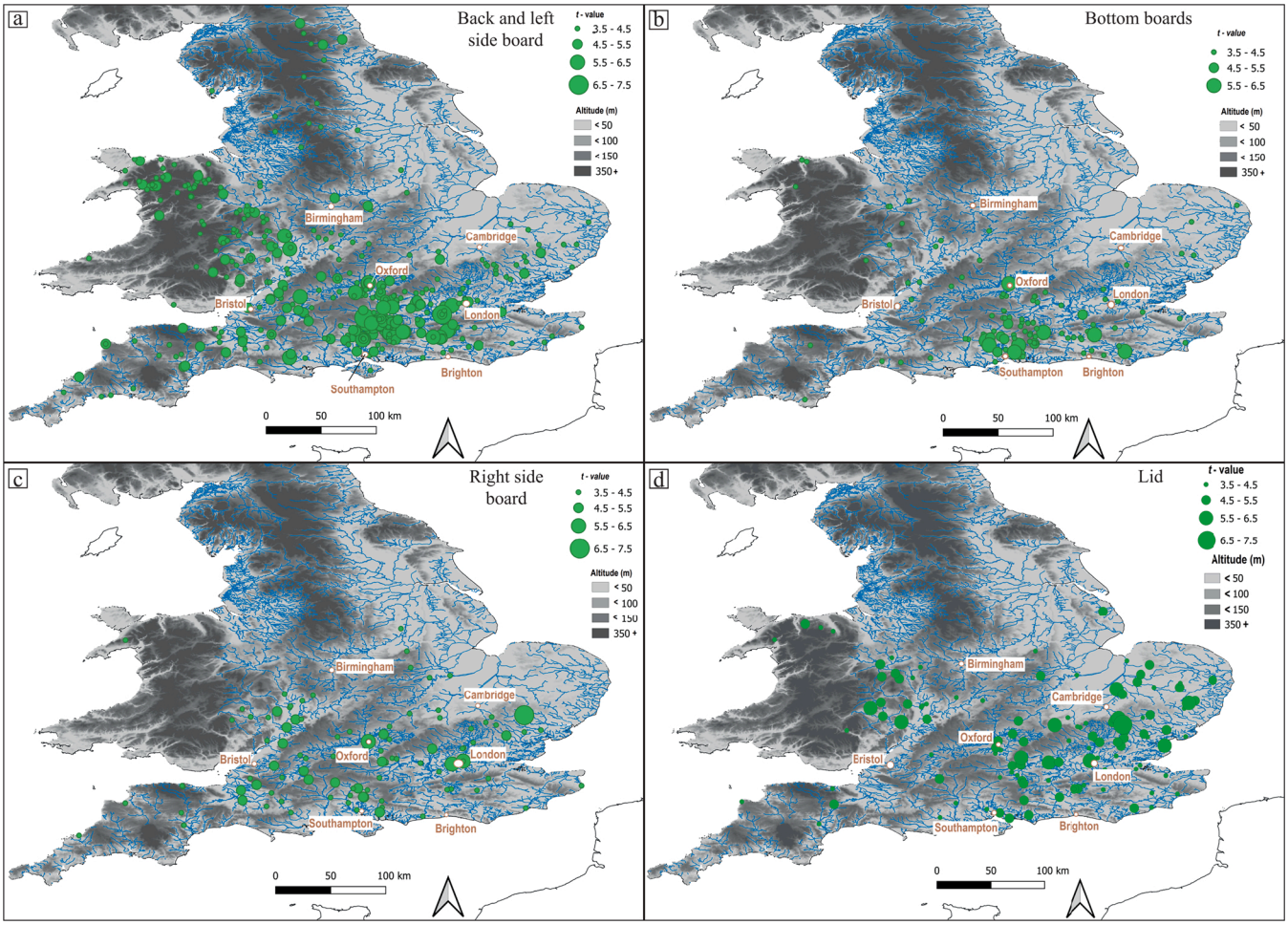

Fig. 5. Provenance maps illustrating the statistical crossdating results (*t*-values as applied by Baillie and Pilcher, 1973) of the series from the trees with site chronologies. a) provenance map of the tree used for the back and left side board (a); b) provenance of the tree used for the bottom boards; c) right side board; d) lid. Each dot represents a site chronology and bigger dots indicate higher *t*-values.

world (Angus, 2018; Hoggard, 2019). Apotropaic marks such as single circles and hexafoils are also found in chests (Easton, 2016), and although their use in medieval furniture could be merely ornamental, their disposition in later pieces suggests an apotropaic meaning. Given that the position and depiction of such a single circle on this chest seems to lack an ornamental purpose, its meaning as a protective symbol cannot be dismissed.

The mark on the underside of the bottom left board is clearly a partial one, implying that the board must have had bigger dimensions. The full board could have been part of a door or a wall or ceiling panel, and could have been cut in three pieces to make the bottom of this chest. Although it is known that timber was sometimes reused in furniture, it is not clear whether this was done due to wood shortage or economy reasons (Chinnery, 1979). The type of mark depicted is sometimes associated to ownership of the wood (see for other examples Rief, 2005; Zunde, 2011). Given that it was applied on the wood after the trunk was processed into a board, it is likely that the carpenter marked it with the letters or symbols from the buyer.

4.5. 'Marks on Wood' Zenodo community

Marks are often found in the wood from works of art and in timbers from historic buildings and had different purposes: numerals were used to indicate the position of each timber in a given roof structure (e.g. Domínguez-Delmás et al., 2018; Haneca, 2015; Haneca and van Daalen, 2017; James, 2018); quality stamps were used by the guild of Saint Luke in Antwerp to indicate that panels complied with the regulations they established (e.g. Gérard and Glatigny, 2005; Van Damme, 1990; Wadum, 1998) panel maker's signed their works stamping their symbols in the back of the panels (e.g.Koopstra, 2010; Wadum and Streeton, 2012); apotropaic symbols were used for protection (Easton, 2016) and traders and owners' marks were drawn on logs that had to be transported over long distances (e.g. Rief, 2005; Zunde, 2011). Currently, photographs or annotations depicting such marks and symbols are scattered through published and unpublished literature, and the lack of a database that compiles them hinders the possibility to identify parallels and establish a chronology for all those symbols.

To facilitate the compilation, transnational comparison and future cataloguing of such marks and symbols found on wood from the cultural heritage we have created the 'Marks on Wood' community in Zenodo. Zenodo (European Organisation for Nuclear Research and OpenAIRE, 2013) is a free open-access repository managed by the CERN in Switzerland, which can host and archive different kinds of files, including photographs. For each upload, the author can select whether minting a Digital Object Identifier (DOI), or linking the upload to an existing one (case of images that are already included in published literature). This enables the citation of the images or the published works, and facilitates searchability through existing platforms (Mendeley, PubMed, CrossRef, etc.). Instructions for upload into this Zenodo community can be found in the supplementary material as well as on the Marks on Wood community (https://www.zenodo.org/communities/marksonwood/).

5. Concluding comments and outlook

Our research has shed light on the production time and place of a mid-16th century chest of hybrid construction, which most likely served as storage for clothes and/or linens. Although the antiquarian had provided an accurate estimation of the production time between 1530–1550, we have demonstrated that the wood originated from southern England, with probably only three of the linenfold panels having a Baltic origin. Nearly all the chests so far dated in England have been of much earlier dates, therefore our research represents a valuable contribution to the study of chests in the transition period between nailed-boarded and joined-panelled chests. Further research on other 16th century chests could reveal the exact spatiotemporal range of this transition and provide more accurate information about the regional production centres and the use of local versus imported timber resources. A growing corpus of empirical data will eventually facilitate a diachronic comparison of styles, woodworking techniques and timber supply.

The possible apotropaic purpose of the circle on the right side board remains unresolved, but by highlighting it here we seek to encourage publication of more furniture objects and timbers presenting such marks. The Marks on Wood community that we have created in Zenodo will provide visibility to this type of marks, as well as to a wider range of marks on wood that remain unpublished or are currently scattered through literature. With this community, we hope to expand the network of examples and, in this way, work towards a future reference database for transnational comparative studies.

Data availability

The tree-ring dataset of the chest is openly available on Mendeley Data repository (https://doi.org/10.17632/fp3cwbc9jj.1).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We are grateful to Professor Chris Pickvance for his valuable comments on this chest and the fruitful discussion, and to the editors and the anonymous reviewers for their helpful suggestions. MDD has received funding from the Dutch Research Council (grant number 016. Veni.195.502).

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.dendro.2021.125828.

References

Albrecht, T., 1997. Truhen, Kisten, Laden, Vom Mittelalter Bis Zur Gegenwart Am Beispiel Der Lüneburger Heide. Michael Imhof Verlag, Petersberg.
Angus, B., 2018. The apotropaic "Witch posts" of early modern yorkshire: a contextualization. Mater. Relig. 14, 55–82. https://doi.org/10.1080/17432200.2017.1418477.
Arnold, A.J., Litton, C.D., 2003. Tree-ring analysis of timbers from Chiddingly Place, Chiddingly, East Sussex. Centre Archaeol. Rep. 14.
Baillie, M.G.L., Pilcher, J.R., 1973. A simple crossdating program for tree-ring research. Tree-Ring Bull. 33, 7–14.
Bridge, M.C., 2005. Tree-ring analysis of timbers from the church of St John the Baptist, Thaxted, Essex. Centre Archaeol. Rep. 35.
Bridge, M., 2016. Progress in british dendrochronology. Archaeol. Int. 58–62. https://doi.org/10.5334/ai.1910.
Bridge, M., Miles, D., 2011. A review of the information gained from dendrochronologically dated chests in England. Reg. Furnit. 25–55.
Bridge, M.C., Miles, D., Cook, R., 2019. Tree-ring date lists. Vernacular Archit. 50, 105–111.
Buis, J., 1985. Historia Forestis: Nederlandse Bosgeschiedenis; Deel 2, Houtmarkt En Houtteelt Tot Het Midden Van De Negentiende Eeuw, 1985th ed. Landbouwhogeschool, Wageningen en HES Uitgevers B.V., Utrecht.
Chinnery, V., 1979. Oak furniture. The British Tradition. Antique Collectors' Club Ltd.
Cooper, T., 2011. Interpreting evidence from dendrochronology. A case study from research on 16th-century British panel paintings. In: Fraiture, P. (Ed.), Tree Rings, Art, Archaeologyt, Archaeology. Proceedings of a Conference. Royal Institute for Cultural Heritage, Collection Scientia Artis 7. Brussels, pp. 299–312.
de Vries, J., van der Woude, A., 1997. The First Modern Economy: Success, Failure, and Perseverance of the Dutch Economy, 1500–1815. Cambridge University Press, Cambridge. https://doi.org/10.1017/CBO9780511666841.
Domínguez-Delmás, M., 2021. Tree-ring dataset of a mid-16th century English chest [WWW document]. Mendeley Data. https://doi.org/10.17632/fp3cwbc9jj.1.
Domínguez-Delmás, M., van Daalen, S., Alejano-Monge, R., Wazny, T., 2018. Timber resources, transport and woodworking techniques in post-medieval Andalusia

(Spain): insights from dendroarchaeological research on historic roof structures. J. Archaeol. Sci. 95, 64–75. https://doi.org/10.1016/j.jas.2018.05.002.
Easton, T., 2016. Apotropaic symbols and other measures for protecting buildings against misfortune. In: Hutton, R. (Ed.), Physical Evidence for Ritual Acts, Sorcery and Witchcraft in Christian Britain. Palgrave MacMillan, New York, pp. 39–67. https://doi.org/10.1057/9781137444820_3.
Eckstein, D., Bauch, J., 1969. Beitrag zur Rationalisierung eines dendrochronologischen Verfahrens und zu Analyse seiner Aussagesicherheit. Forstwissenschaftliches Cent. 88, 230–250.
Galloway, J.A., Keene, D., Murphy, M., 1996. Fuelling the city: production and distribution of firewood and fuel in London's region, 1290-1400. Econ. Hist. Rev. 49, 447–472.
Gérard, A., Glatigny, J.-A., 2005. Etude des caisses des deux retables anversois de musée national du moyen age - Thermes de cluny à Paris. In: Van de Velde, C., Beeckman, H., Van Acker, J., Verhaeghe, F. (Eds.), Constructing Wooden Images: Proceedings of the Symposium on the Organization of Labour and Working Practices of Late Gothic Carved Altarpieces in the Low Countries. Brussels 25–26 October 2002. VUB Press, pp. 265–290.
Haneca, K., 2015. Historisch Bouwhout UIT VLAANDEREN : import UIT NOODZAAK? Bull. KNOB 3, 158–169.
Haneca, K., van Daalen, S., 2017. The roof is on fire! A dendrochronological reconstruction of the restoration of the Basilica of our Lady in Tongeren (Belgium). Dendrochronologia 44, 153–163. https://doi.org/10.1016/j.dendro.2017.05.001.
Hillam, J., Tyers, I., 1995. Reliability and repeatability in dendrochronological analysis: tests using the Fletcher archive of panel-painting data. Archaeometry 37, 395–405. https://doi.org/10.1111/j.1475-4754.1995.tb00752.x.
Hoggard, B., 2019. Magical House Protection: The Archaeology of Counter-Witchcraft. Berghahn, New York.
James, D., 2018. Carpenters' assembly marks in timber-framed buildings. Vernac. Archit. 49, 1–31.
Jansma, E., Hanraets, E., Vernimmen, T., 2004. Tree-ring research on Dutch and Flemish art and furniture. In: Jansma, E., Bräuning, A., Gärtner, H., Schleser, G. (Eds.), TRACE - Tree Rings in Archaeology, Climatology and Ecology, Vol. 2; Proceedings of the DENDROSYMPOSIUM 2003, May 1st – 3rd 2003. Utrecht, the Netherlands. Schriften Des Forschungszentrums Jülich, Reihe Umwelt, pp. 139–146.
Klein, A., Nemestothy, S., Kadnar, J., Grabner, M., 2014. Dating furniture and coopered vessels without waney edge - reconstructing historical wood-working in Austria with the help of dendrochronology. Dendrochronologia 32, 90–96. https://doi.org/10.1016/j.dendro.2013.11.002.
Koopstra, A., 2010. De Antwerpse "witter ende paneelmaker" Melchior de Bout (werkzaam 1625/26-1658): leverancier van "ready-made" panelen voor de Parijse markt. Oud Holl. – J. Art Low Ctries. 123, 108–124. https://doi.org/10.1163/003067212X13397495480826.
Lewer, H.W., Wall, J.C., 1913. The Church Chests of Essex. Talbot, London.
Liu, M., Liu, X., Wu, Z., Lv, J., 2019. Comparative study of furniture styles from the qing dynasty. Bull. Transilv. Univ. Braşov Series II. https://doi.org/10.31926/but.fwiafe.2019.12.61.1.6, 1.
Louw, H.J., 1989. Demarcation disputes between the english carpenters and joiners from the sixteenth to the eighteenth century. Constr. Hist. 5, 3–20.
Miles, D.H., 1996. The tree-ring dating of Mottisfont Abbey, Romsey, Hampshire. Anc. Mon. Lab. Rep. 23.
Miles, D., 1997. The interpretation, presentation, and use of tree-ring dates. Build. Landsc. J. Vernac. Archit. Forum 28, 40–56.
Miles, D.H., 2003. Dating buildings and dendrochronology in hampshire. In: Roberts, E. (Ed.), Hampshire Houses 1250 – 1700: Their Dating and Development. Hampshire County Council, Southampton, pp. 220–226.
Miles, D., Bridge, M., 2008. Tree-ring Dating of the Chests and Fittings. Westminster Abbey, London.
Miles, D.H., Bridge, M.C., 2013. Tree-ring dates. Vernacular Archit. 44, 98–102.
Miles, D.H., Haddon-Reece, D., 1995. List 64 – Tree-ring dates. Vernacular Archit. 26, 60–74.
Miles, D.H., Worthington, M.J., Bridge, M.C., 2005. Tree-ring dates. Vernacular Archit. 36, 87–101.
Miles, D.H., Worthington, M.J., Bridge, M.C., 2007. Tree-ring dates. Vernacular Archit. 38, 120–139.
Pickvance, C., 2012. Medieval domed chests in Kent: a contribution to a national and international study. Reg. Furnit. 105–147.
Pickvance, C., 2015. The slow arrival of renaissance influence on english furniture: a study of the 1519 Silkstede, Shanklin and the 1539 Garstang, cirencester chests. Reg. Furnit. 29, 101–130.
Pickvance, C., 2018. The Canterbury Group of Arcaded Gothic Early Medieval Chests: a Dendrochronological and Comparative Study. Antiq. J. 98, 149–185. https://doi.org/10.1017/S0003581518000562.
Pickvance, C., 2020. Regional differences in Medieval chest construction: a dendrochronological and comparative study of the Buxted, Sussex, and Hindringham and Walcott, Norfolk pin-hinged clamped chests. Reg. Furnit. Soc. 34, 1–50.
QGIS Development Team, 2019. QGIS geographic information system. Open Source Geospatial Foundation Project.
Rief, M., 2005. Engraved marks on baltic wainscot boards. In: Van de Velde, C., Beeckman, H., Van Acker, J., Verhaeghe, F. (Eds.), Constructing Wooden Images: Proceedings of the Symposium on the Organization of Labour and Working Practices of Late Gothic Carved Altarpieces in the Low Countries. Brussels 25–26 October 2002. VUB Press, pp. 127–146.
Roe, F., 1902. Ancient Coffers and Cupboards;: Their History and Description From the Earliest Times to the Middle of the Sixteenth Century. Methuen & co, London.
Roe, F., 1929. Ancient Church Chests and Chairs in the Home Counties Round Greater London. Lyon Press, London.
Sherlock, D., 2008. Suffolk Church chests. Suffolk Institute of Archaeology and History.
Thun, T., Alsvik, E., 2009. Dendrochronological dating of four chests: a surprising result. Dendrochronologia 27, 71–74. https://doi.org/10.1016/j.dendro.2008.07.004.
Thun, T., Svarva, H., 2016. Dendrochronological analysis of 19 Norwegian grain chests. Dendrochronologia 37, 89–95. https://doi.org/10.1016/j.dendro.2015.12.009.
Van Damme, J., 1990. De antwerpse tafereelmakers en hun merken : identificatie en betekenis. Jaarb. Van Het K. Museum Voor Schone Kunsten Antwerpen, pp. 193–236.
Von Stülpnagel, K.H., 2000. Die Gotischen Truhen Der Lüneburger Heideklöster: Entstehung - Konstruktion - Gestaltung. Cloppenburg Museumsdorf, Cloppenburg.
Wadum, J., 1998. The Antwerp brand on paintings on panel. In: Hermens, E. (Ed.), Looking Through Paintings. The Study of Painting Techniques and Materials in Support of Art Historical Research. Archetype Publications, pp. 179–198.
Wadum, J., Streeton, N., 2012. History and use of panels or other rigid supports for easel paintings. In: Stoner, J.H., Rushfield, R.A. (Eds.), Conservation of Easel Paintings. Routledge Series in Conservation and Museology, pp. 49–114.
Wazny, T., 2002. Baltic timber in Western Europe - an exciting dendrochronological question. Dendrochronologia. https://doi.org/10.1078/1125-7865-00024.
Wazny, T., 2005. The origin assortments and transport of baltic timber. In: Van de Velde, C., Beeckman, H., Van Acker, J., Verhaeghe, F. (Eds.), Constructing Wooden Images: Proceedings of the Symposium on the Organization of Labour and Working Practices of Late Gothic Carved Altarpieces in the Low Countries. Brussels 25–26 October 2002. VUB Press, Brussels, pp. 115–126.
Wilson, R., Miles, D.H., Loader, N.J., Melvin, T., Cunningham, L., Cooper, R., Briffa, K., 2012. A millennial long March-July precipitation reconstruction for southern-central England. Clim. Dyn. 40, 997–1017. https://doi.org/10.1007/s00382-012-1318-z.
Zunde, M., 2011. New dendrochronological, historical and archaeological evidence of long-distance floating of timbers to Riga. In: Fraiture, P. (Ed.), Tree Rings, Art, Archaeology. Proceedings of a ConfeRence. Royal Institute for Cultural Heritage, pp. 125–135 collection Scientia Artis 7.