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A DOOR IN USE IN TALLINN APPEARED TO BE OVER 600 YEARS OLD

INTRODUCTION

Dendrochronology – the study of tree rings – is the most precise and accurate scientific technique for dating wooden cultural heritage and has already been used for dating purposes for more than a century.[1] In Europe, dendrochronological dating is practiced predominantly on oak.[2] In general, the more elements from a timber structure that can be examined the better, i.e. the higher the sample replication, the higher the chances that tree-ring analysis will be able to provide a reliable estimate for the felling date of trees used in any particular structure. In Estonia for instance, this was exemplified

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1 Andrew Ellicott Douglass, 'Dating Our Prehistoric Ruins: How Growth Rings in Trees Aid in Establishing the Relative Ages of the Ruined Pueblos of the Southwest', *Natural History*, 21 (1) (1921), 27–30.

2 Aoife Daly, *Timber, Trade and Tree-rings: A Dendrochronological Analysis of Structural Oak Timber in Northern Europe, c. AD 1000 to c. AD 1650*. PhD Dissertation (Esbjerg: University of Southern Denmark, 2007), 270ff. Kristof Haneca, Katarina Čufar, Hans Beeckman, 'Oaks, Tree-Rings and Wooden Cultural Heritage: A Review of the Main Characteristics and Applications of Oak Dendrochronology in Europe', *Journal of Archaeological Science*, 36 (2009), 1–11. See: https://doi.org/10.1016/j.jas.2008.07.005 [accessed 10.06.2021].

by dendrochronological research on a 13th century cog.[3] However, many valuable and ancient objects are made of a limited number of wooden elements that in turn can originate from a single tree. This could potentially hamper successful tree-ring dating of such objects. Nevertheless, dendrochronological dating of objects composed of a limited number of wooden elements, such as painting panels, sculptures, violins and doors has proven successful and has become a common practice all over the world.[4] This is the case in Estonia in particular where, for example wooden book covers from the 14th century and old shipwrecks have been dated.[5]

Recently, in Tallinn, a massive internal door in Bremen Tower in the Old Town wall drew the attention of historians. The appearance of the door – the patina of the wood, the metalwork of the former prison door – suggested this might be a very old and well-preserved interior element of the fortification building. Bremen Tower was first mentioned in the list of tower supervisors of Reval (Tallinn) for AD 1410–1414. The most authoritative researcher of the fortifications of medieval Tallinn, Rein Zobel, concludes that this multifunctional

3 Maili Roio, Lembi Lõugas, Alar Läänelaid, Liina Maldre, Erki Russow, Ülle Sillasoo, 'Medieval Ship Finds from Kadriorg, Tallinn', *Arheoloogilised välitööd Eestis = Archaeological Fieldwork in Estonia*, 2015 (2016), 139–158; Maili Roio, Lembi Lõugas, Alar Läänelaid, Erki Russow, 'Shipwrecks from Underground Kadriorg', *Estonian Cultural Heritage: Preservation and Conservation 2013–2017 (19–23)*, ed. by Anneli Randla (Tallinn: Estonian Academy of Arts, 2017). See: https://www.muinsuskaitseamet.ee/sites/default/files/content-editors/trykised/Estonian%20Cultural%20Heritage.Vol.2.2013-2016.pdf [accessed 10.06.2021].

4 Dieter Eckstein, 'Wood Science and Art History – Interdisciplinary Research Illustrated from a Dendrochronological Point of View', *Constructing Wooden Images*, ed. by Carl Van de Velde, Hans Beeckman, Joris Van Acker, Frans Verhaeghe (Brussels: Brussels University Press, 2005), 19–26. See: https://lib.ugent.be/catalog/rug01:002768594 [accessed 10.06.2021]; Samuli Helama, Alar Läänelaid, Maija Santala, Ari Tanhuanpää, 'Dendrochronological Dating of Wooden Artifacts by Measuring the Tree Rings Using Magnifying Glass and Photography Assisted Method: An Example of a Dutch Panel Painting', *Archaeological and Anthropological Sciences*, 8 (1) (2016), 161–167. See: https://doi.org/10.1007/s12520-014-0222-3 [accessed 10.06.2021]; Micha Beuting, 'Dendro-organology? The Dendrochronological Method Applied to Musical Instruments', *Tree Rings, Art, Archaeology*. Proceedings of an International Conference: Brussels, Royal Institute for Cultural Heritage, 10–12 February 2010 (Bruxelles: Royal Institute for Cultural Heritage, 2011), 273–283. Alar Läänelaid, Aoife Daly, Kristina Sohar, 'What Wood Tells us. On Dendrochronological Research Methodology', *Rode Altarpiece in Close-Up* (Tallinn: Eesti Kunstimuuseum – Niguliste muuseum, 2016), 115–135.

5 Alar Läänelaid, Tomasz Ważny, 'Re-Bound Book Covers from the Island of Piirissaar, Estonia', *Baltic Journal of Art History*, 14 (2017), 141–153. See: 10.12697/BJAH.2017.14.07 [accessed 10.06.2021]; Roio, Lõugas, Läänelaid, Russow, 'Shipwrecks from Underground Kadriorg'.

FIG. 1. THE DOOR, AN INTERIOR DOOR IN BREMEN TOWER IN TALLINN. PHOTO: HENRY KUNINGAS.

(defence and prison) horseshoe-shaped tower was built between 1400 and 1410.[6] This date has been generally accepted.[7]

Doors and doorframes have been the subject of dendrochronological examinations, especially in Great Britain.[8] Therefore, in order to explore the potential of the door in Bremen Tower for tree-ring analysis and hence to determine its age, a collaboration with dendrochronological experts was set up.

MATERIAL AND METHODS

The subject of this examination is an interior door in Bremen Tower that is exceptionally well preserved because it was not, over the course of centuries, affected by water infiltration or fire. Historical research on the building shows that the door had served to close off a city prison. It is made of thick wooden boards and equipped with massive iron hinges and a large iron lock (Fig. 1). It consists of three vertical oak planks. The dimensions of the door are impressive: height ca 160 cm, width ca 80 cm and thickness ca 6.5 cm (Fig. 2). The wooden boards were assembled very precisely in relation to the doorway and to each other.

Although the finishing of each board is similar, intensive use has given the 1st board more scratches, also it is notable that the inner part of the 1st board has considerably more inscriptions than the other boards.

A cross section (transverse plane) of the individual timbers is essential for tree-ring analysis in order to allow a clear registration of the tree-ring pattern. The only possibility for that was to lift

6 Rein Zobel, *Walls and Towers of Tallinn* (Tallinn: Estonian Encyclopaedia Publishers, 1996), 93ff; Rein Zobel, *Tallinn (Reval). Keskaegsed kindlustused* (Tallinn: Eesti Kunstiakadeemia, 2011), 287.

7 Rein Zobel, 'Bremeni torn', *Eesti arhitektuur 1. Tallinn* (Tallinn: Valgus, 1993), 20–21; Villu Kadakas, '15th Century Wall Towers of Tallinn Lower Town: Dating of the Horseshoe Form Towers', *Building a Castle – Preparing for War or Keeping the Peace?*, ed. by Nils Engberg, Vivian Etting, Lars Meldgaard Sass Jensen, Claus Sørensen, Dorthe Wille-Jørgensen. Proceedings of a symposium held in Vordingborg, Nyborg, 24–28 August 2015 (Bonn: Dr. Rudolf Habelt GmbH, 2018), 51–64.

8 Alison Arnold, Robert Howard, 'The Old Farmhouse, Incott Farm, Sampford Courtenay, Okehampton, Devon: Tree-Ring Analysis of Timbers', *English Heritage Research Department Report Series*, 33 (2008), 27ff; Alison Arnold, Robert Howard, 'Linnels Mill, Hexhamshire Low Quarter, Hexham, Northumberland: Tree-Ring Analysis of Timbers', *English Heritage Research Department Report Series*, 32 (2013), 33ff; Martin Bridge, Daniel W. H. Miles, 'Dendrochronologically Dated Doors in Great Britain', *Regional Furniture*, XXVI (2012), 73–103; Daniel W. H. Miles, Martin Bridge, 'The Tree-Ring Dating of the Early Medieval Doors at Westminster Abbey, London', *Centre for Archaeology Report*, 38 (2005), 52.

FIG. 2. THE DIMENSIONS OF THE WOODEN DOOR AND THE BOARDS. THE THICKNESS OF THE BOARDS VARIES BETWEEN 62 AND 65 MM. ANNOTATIONS BY ANDRES UUENI.

FIG. 3. THE BOTTOM END OF THE DOOR. THE WIDEST BOARD, THE 1ST BOARD, IS ON THE LEFT ABOVE. THE SECTION TO THE RIGHT OF THE SPLIT CONTAINS FIVE SAPWOOD RINGS. THE DOOR IS 807 MM WIDE. PHOTO: ANDRES UUENI.

the door from its hinges. The bottom ends of the planks were then polished with fine grade sandpapers in order to highlight the tree-ring boundaries and to ensure a high-quality registration of the ring-width pattern. Finally the ends of the planks were digitised using macro photography (Fig. 3, Archaeovision OÜ).

The digital images allowed for accurate registration of the ring-width patterns using CooRecorder/CDendro (Cybis Dendrochronology). On each board two radii were measured and, if necessary, repeated until for each ring-width pattern measurement errors could be excluded. This was especially important when extremely narrow rings were encountered on the widest board and on the two other boards where

the ring widths were distorted in sections near a twig. Finally, ring-width series were computed for each board and were cross-matched in TSAP-Win (Rinntech) (Fig. 4).

The series was then compared to a set of about 70 absolutely dated reference chronologies, composed of individual ring-width series originating from archaeological timbers, art-historical objects or ancient timber structures in historical buildings, made of oak (*Quercus robur*, *Q. petraea*). Comparison between the individual series and reference chronologies was performed in TSAP-Win, relying on several similarity indices such as the *Gleichläufigkeit* (Glk, percentage of year-to-year common changes in two time series, with level of significance), correlation coefficient (%CC), *t*-value (TV), *t*-value of Baillie-Pilcher (TVBP), *t*-value of Hollstein (TVH), and cross-date index (CDI). These similarity measures are computed on each possible position of the individual series throughout the reference chronologies. As a final quality check, all positions with high and significant similarities were examined visually. The precision of dating was determined on the basis of the remnants of sapwood.

RESULTS

The widest of the door planks was cut radially from the trunk, with pith location nearly in the centre, while the two other planks were cut tangentially very close to the pith (Fig. 3). Fortunately, the widest board proved to contain a strip of sapwood facing the next board, which was essential in order to obtain high dating precision.[9]

The widest board contained 202 annual rings, the second board contained 77 rings and the third board 166 rings. According to crossdating and visual matching, the three ring-width series could be positioned relative to each other, where the longest series proved to extend beyond the range of the two others (Fig. 4). The crossdated series of the three boards were averaged into a single ring-width series for the door, labelled as *2eqbrn01*, with length 202 years.

Comparison with the set of absolutely dated reference chronologies revealed that the ring-width chronology of the door was most similar

9 Dieter Eckstein, *Dendrochronological Dating, 2. Handbooks for Archaeologists* (Strasbourg: European Science Foundation, 1984), 55.

to Daugava River oak chronology[10] (overlap 192 years, Glk 66%, TVBP = 5.5, TVH = 5.6, CDI = 36) and East Pomerania oak chronology[11] (average of 205 oak series, AD 990–1985, Fig. 5) at the position where the last year of the door series is AD 1392 (Table 1). In this position the series overlap by 202 years, their Glk is 64% at the highest significance level, TVBP = 4.0, TVH = 4.6 and CDI = 28. The same date with lower similarity was shown by the so-called Baltic 1 oak chronology.[12] In addition, it was found that the Tallinn door chronology shows high similarity with an object chronology composed of series from late medieval sculptures from the Gaasbeek altarpiece, made and curated in Belgium. Tree-ring research revealed that this altarpiece was manufactured from imported Baltic oak.[13] Mean tree-ring series of dendrochronologically dated doors made from Baltic material from approximately the same time did not show similarity with the series of the Bremen Tower door.[14] The tree-ring series of the dated medieval cog and the book covers made from oak did not show any similarity with the door series.[15]

There was a stripe of five lighter sapwood rings at the outer edge of the widest board of the door and probably no waney edge.

10 Bulat F. Khasanov, Aleksey A. Karpukhin, Nikolai A. Krenke, Maria M. Pevzner, Olga A. Tarabardina, Dmitry D. Vasyukov, Maxim V. Yermokhin, Arkady B. Savinetsky, 'Long Oak Tree-Ring Chronologies from the Central Russia and Their Potential for Dating', *Tree-Ring Research*, 77 (2) (2021), 53–62, see: https://doi.org/10.3959/TRR2020-5 [accessed 10.08.2021].

11 Tomasz Ważny, *Aufbau und Anwendung der Dendrochronologie für Eichenholz in Polen*. PhD Dissertation (Hamburg: Hamburg University, 1990); Tomasz Ważny, *Wazny - East Pomerania - QURO - ITRDB POLA006* (1996), see: https://www.ncdc.noaa.gov/paleo-search/study/5214 [accessed 10.06.2021].

12 John M. Fletcher, 'Tree-Ring Analysis of Panels, Paintings and Chests', *Dendrochronology in Europe*, ed. by John M. Fletcher, *BAR International Series*, 51 (1978), 303–306; John M. Fletcher, 'Dating of Art-Historical Artefacts', *Nature*, 320 (1986), 466, see: https://www.nature.com/articles/320466a0 [accessed 10.06.2021]; Jennifer Hillam, Ian Tyers, 'Reliability and Repeatability in Dendrochronological Analysis: Tests Using the Fletcher Archive of Panel-Painting Data', *Archaeometry*, 37 (1995), 395–405, see: https://doi.org/10.1111/j.1475-4754.1995.tb00752.x [accessed 10.06.2021].

13 Kristof Haneca, Ria De Boodt, Valérie Herremans, Hilde De Pauw, Joris Van Acker, Carl Van de Velde, Hans Beeckman, 'Late Gothic Altarpieces as Sources of Information on Medieval Wood Use: A Dendrochronological and Art Historical Survey', *IAWA Journal*, 26 (2005), 273–298, see: https://doi.org/10.1163/22941932-90000116 [accessed 10.06.2021]; Kristof Haneca, Tomasz Ważny, Joris Van Acker, Hans Beeckman, 'Provenancing Baltic Timber from Art Historical Objects: Success and Limitations', *Journal of Archaeological Science*, 32 (2005), 261–271, see: https://doi.org/10.1016/jas.2004.09.005 [accessed 10.06.2021].

14 Miles, Bridge, 'The Tree-Ring Dating of the Early Medieval Doors at Westminster Abbey, London'.

15 Roio, Lõugas, Läänelaid, Maldre, Russow, Sillasoo, 'Medieval Ship Finds from Kadriorg, Tallinn'; Läänelaid, Ważny, 'Re-Bound Book Covers from the Island of Piirissaar, Estonia'.

FIG. 4. SERIES OF RING WIDTHS OF THE THREE BOARDS OF THE DOOR. THE LONGEST SERIES IS DRAWN IN RED. THE HORIZONTAL AXIS SHOWS CALENDAR YEARS, THE VERTICAL AXIS RING WIDTHS IN MEASURING UNITS.

TABLE 1. SIMILARITY OF THE BREMEN TOWER DOOR AVERAGE SERIES 2EQBRN01 WITH THREE REFERENCE CHRONOLOGIES. TBP – T-VALUE BAILLIE-PILCHER.

FIG. 5. AVERAGE RING-WIDTH SERIES OF THE DOOR 2EQBRN01 AT SYNCHRONOUS POSITION WITH EAST POMERANIA OAK CHRONOLOGY. HORIZONTAL AXIS – CALENDAR YEARS, VERTICAL AXIS – RING WIDTHS IN MEASURING UNITS.

DISCUSSION

For successful dating, long reference chronologies have to be available. Today, numerous tree ring datasets worldwide are available in the International Tree-Ring Data Bank.[16] These tree-ring series can serve as chronological references that help to find the age of tree-ring series from a certain region or country. For this study, we used nearly 70 averaged tree ring series (ring-width chronologies) from Europe as reference data. As the door under investigation is located in Estonia, it would be logical to use Estonian references for dating. Unfortunately, at present, the oak chronology for Estonia, composed from 162 cores of living trees from 12 sites, extends back only to AD 1646.[17] Assuming an earlier origin of the door, the existing Estonian oak chronology is too short for dating. However, the Estonian oak chronology based on living trees shows high teleconnection, i.e. similarity between the chronologies from distant sites, with Finnish, Latvian, Lithuanian and even northern Polish oaks[18] and therefore reference chronologies from these regions can be used for dating instead. Fortunately, a chronology from subfossil oaks found along the Daugava (Zapadnaya Dvina) River has recently become available,[19] which, along with published Baltic oak chronologies composed of tree-ring series from art-historical objects[20] and series from historical timber constructions and archaeological wood in East Pomerania oak chronology[21] (AD 996–1985) provides a reference framework for dating wooden cultural heritage in Estonia. Similarly, the above-

16 *International Tree-Ring Data Bank* (ITRDB), see: https://www.ncdc.noaa.gov/data-access/paleoclimatology-data/datasets/tree-ring [accessed 10.06.2021].

17 Kristina Sohar, *Oak Dendrochronology and Climatic Signal in Finland and the Baltic States*. PhD Dissertation (Tartu: University of Tartu Press, 2013).

18 Kristina Sohar, Adomas Vitas, Alar Läänelaid, 'Sapwood Estimates of Pedunculate Oak (*Quercus robur* L.) in Eastern Baltic', *Dendrochronologia*, 30 (1) (2012), 49−56, see: https://www.sciencedirect.com/science/article/pii/S1125786511000750 [accessed 10.06.2021]; Kristina Sohar, Alar Läänelaid, Dieter Eckstein, Samuli Helama, Jaak Jaagus, 'Dendroclimatic Signals of Pedunculate Oak (*Quercus robur* L.) in Estonia', *European Journal of Forest Research*, 133 (2014), 535–549, see: https://link.springer.com/article/10.1007/s10342-014-0783-9 [accessed 10.06.2021].

19 Khasanov, Karpukhin, Krenke, Pevzner, Tarabardina, Vasyukov, Yermokhin, Savinetsky, 'Long Oak Tree-Ring Chronologies from the Central Russia and Their Potential for Dating'.

20 Hillam, Tyers, 'Reliability and Repeatability in Dendrochronological Analysis: Tests Using the Fletcher Archive of Panel-Painting Data'.

21 Ważny, *Aufbau und Anwendung der Dendrochronologie für Eichenholz in Polen*; Ważny, *Wazny - East Pomerania - QURO - ITRDB POLA006*.

mentioned Gaasbeek oak chronology consists of Baltic oak series.[22] It is known that due to timber shortage in western Europe from the 13th century, transport of Baltic timber had begun, particularly of oak boards, planks, so-called wainscots, clapboards etc. During the late medieval period and up to ca 1650, a massive timber trade took place from the southern Baltic ports, mainly through Gdansk, to western Europe.[23] Baltic oak yielded a timber of high quality originating from trees that grew slowly and regularly in primary forests. The trees were felled during the winter months, split while the timber was still green, and then stored in the forests until spring melted the frozen rivers. The rivers provided a waterway infrastructure for transport to Hanseatic port cities. The forest products were then reloaded to sea-going vessels and after a few weeks of sailing they reached North Sea ports. Therefore, it is justified to use references from outside Estonia to date the door chronology, and from the region along big rivers like the Daugava (Zapadnaya Dvina) and using Polish or so-called Baltic oak chronologies. Indeed M. Zunde has evidence that timber was floated to Riga along the Daugava River, the most direct evidence being the holes for rafting in the ends of timbers.[24] Previously, T. Ważny has shown the origin of Baltic timber floated along the Vistula River to Gdansk.[25] However, it should be clear that similarity indices (TVBP and TVH) for the Tallinn door and reference chronologies are relatively low. Especially when compared to many other dating reports of historical oak series where TVBP can reach

22 Haneca, De Boodt, Herremans, De Pauw, Van Acker, Van de Velde, Beeckman, 'Late Gothic Altarpieces as Sources of Information on Medieval Wood Use: A Dendrochronological and Art Historical Survey'; Haneca, Ważny, Van Acker, Beeckman, 'Provenancing Baltic Timber from Art Historical Objects: Success and Limitations'.

23 Tomasz Ważny, 'The Origin, Assortments and Transport of Baltic Timber', *Constructing Wooden Images*, ed. by Carl Van de Velde, Hans Beeckman, Joris Van Acker, Frans Verhaeghe (Brussels: Brussels University Press, 2005), 115–126; Tomasz Ważny, Dieter Eckstein, 'Der Holzhandel von Danzig/Gdańsk – Geschichte, Umfang und Reichweite. Holz als Roh- und Werkstoff', *European Journal of Wood and Wood Industries*, 45(12) (1987), 509–513, see: https://doi.org/10.1007/BF02611458 [accessed 10.06.2021].

24 Māris Zunde, 'New Dendrochronological, Historical and Archaeological Evidence of Long-Distance Floating of Timbers to Riga', *Tree Rings, Art, Archaeology*. Proceedings of an International Conference: Brussels, Royal Institute for Cultural Heritage, 10–12 February 2010 (Bruxelles: Royal Institute for Cultural Heritage, 2011), 125–135.

25 Ważny, 'The Origin, Assortments and Transport of Baltic Timber'; Tomasz Ważny, 'Dendro-provenancing between the Baltic Sea and the East Mediterranean', *Tree Rings, Art, Archaeology*. Proceedings of an International Conference: Brussels, Royal Institute for Cultural Heritage, 10–12 February 2010 (Bruxelles: Royal Institute for Cultural Heritage, 2011), 99–105; Ważny, Eckstein, 'Der Holzhandel von Danzig/Gdańsk – Geschichte, Umfang und Reichweite. Holz als Roh- und Werkstoff'.

FIG. 6. END GRAIN OF BOARD NO. 3, SHOWING RING DISTORTIONS DUE TO TWIGS IN THE WOOD. PHOTO: ANDRES UUENI.

7 or 8.[26] This suggests that the timber of the door has a provenance other than the Baltic oak chronologies. As the so-called Baltic oak was actually exported from southern Baltic ports, the oaks could have grown anywhere in the hinterland, for example in Belarus or Ukraine.[27] In any case, the origin of the Baltic oak series that were used to compose the Gdansk-Pomerania or Baltic 1 chronologies was hundreds of kilometres east- and southward from Tallinn. When the city of Tallinn needed a durable door for a prison, it is unlikely that they bought the door boards from any other Hanseatic town in the south because oak was available in forests near Tallinn. A prison door would not have necessarily been made from high-quality oak planks, and the lower quality of the door boards is seen from several twigs in these boards (Fig. 6). It is notable that only the widest

26 Cf. Miles, Bridge, 'The Tree-Ring Dating of the Early Medieval Doors at Westminster Abbey, London'; Roio, Lõugas, Läänelaid, Maldre, Russow, Sillasoo, 'Medieval Ship Finds from Kadriorg, Tallinn'.

27 Tomasz Ważny, 'Baltic timber in Western Europe – an exciting dendrochronological question', *Dendrochronologia*, 20 (3) (2002), 313–320, see: https://www.sciencedirect.com/science/article/pii/S1125786504700260 [accessed 10.06.2021]; Ważny, 'The Origin, Assortments and Transport of Baltic Timber'; Māris Zunde, 'Wood export from Medieval Riga and possibilities for dendrochronological dating', *Dendrochronology and Environmental Trends*. Proceedings of the International Conference 'Eurodendro-98', Kaunas, Lithuania (Kaunas: Kaunas Vytautas Magnus University, 1999), 67–74; Zunde, 'New Dendrochronological, Historical and Archaeological Evidence of Long-Distance Floating of Timbers to Riga'.

plank has cracked while other planks have no cracks that would be characteristic for rapid drying, which might imply use of seasoned timber. Thus it is probable that the door was made from locally grown oak. This fact could explain its low similarity with the typical Baltic oak references. We should also bear in mind that the door could have been produced from planks made from trees growing in parkland, thus containing more individual tree-ring patterns. We were not able to date the door with a local Estonian reference because this local oak chronology does not yet extend back to the 14th century. It is possible that the tree ring series of the door from the Bremen Tower represents the first dated local oak series from that century. This presents a challenge to find more oak series either from Tallinn or neighbouring countries and to further develop a local chronology and eventually add the Tallinn door ring-width series to the existing and most recent part of the Estonian oak chronology.

So far, the most recent ring on the Tallinn door dates to last formed ring present on this object. However, for the historical interpretation of this architectural feature, the felling date of the tree that provided the timbers for this door should be estimated. The dendro date 1392 notes the calendar year when the last preserved annual ring grew. However, we do not know how many tree rings were cut off when the board was made. Fortunately, five sapwood rings are preserved, which allows a more precise estimate of the felling date. Sohar et al.[28] demonstrated that oaks growing in the eastern Baltic region have between 6 and 19 sapwood rings (95% confidence interval) whereas oaks growing in Poland have between 7 and 24 sapwood rings (90% confidence interval).[29] Thus in the case of local oak 1 to 14 sapwood rings are absent (with 95% probability), but in the case of Polish oak 2 to 19 sapwood rings are absent (with 90% probability). The date of the last sapwood ring under the bark would be either 1393–1406 (95% probability) or 1394–1411 (90% probability), respectively. These periods overlap greatly. Taking into account the accepted construction date of Bremen Tower as between AD 1400 and 1410 and the strong construction of the door, it is clear that it is original and bespoke for the new tower prison in the first decade of the 15th century.

28 Sohar, Vitas, Läänelaid, 'Sapwood Estimates of Pedunculate Oak (*Quercus robur* L.) in Eastern Baltic'.

29 Ważny, *Aufbau und Anwendung der Dendrochronologie für Eichenholz in Polen*.

It is remarkable that there are very few cracks in the door boards. Only the widest board, No. 1, has a visible crack in the middle. This may be because dried timber was used to make the prison door, giving increased durability. However, the possible usage of dry wood does not affect the accuracy of dating the door.

CONCLUSIONS

Dendrochronological investigation established that an internal door at the former prison in Bremen Tower in Tallinn was made of three oak boards near the turn of the 14th and 15th centuries. The dendrochronological date of the door fits neatly with documentary sources which date the building of the tower to the AD 1400–1410 period, making this door therefore an original feature of the building.

Alar Läänelaid, Aoife Daly, Tomasz Ważny, Kristof Haneca, Andres Ueni, Kristina Sohar: A Door in Use in Tallinn Appeared to Be Over 600 Years Old

Keywords: Bremen Tower; door; dendrochronology; oak; tree rings

SUMMARY

In a medieval tower in the Tallinn Old Town wall there is a wooden internal door that was suspected of being rather old. The age of the door was determined using dendrochronology. It was possible to measure tree rings from the lower ends of the oak planks of the door. Matching the ring-width series with oak references from northern Europe revealed that the door was over 600 years old, and still in place in medieval Bremen Tower in Tallinn, Estonia. The ring-width series of the door was most similar to oak chronology from the Daugava River. However, this does not mean that the door timbers originate from that region. At present, we do not possess Estonian oak chronologies extending back to that time. Thus, the provenance of the oak for this door remains undecided. The dendrochronological date of the door, AD 1394–1411, can be confirmed and can be narrowed by documentary evidence to AD 1400–1410.

CV

Alar Läänelaid, PhD (b. 1951) is Associate Professor *emeritus* in Landscape Ecology at the University of Tartu, Estonia. He has dendrochronologically dated a number of architectural objects, wrecks, violins as well as painting panels and sculptures.

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Tomasz Ważny, PhD (b. 1957) is Professor in Centre for Research and Conservation of Cultural Heritage, Faculty of Fine Arts, Nicolaus Copernicus University in Toruń, Poland. His major research interest is located in dendrochronology and its applications with dendroarchaeology and dendroprovenancing methods in particular.

Kristof Haneca, PhD (b. 1976) is a heritage researcher working at Flanders Heritage Agency in Belgium. He is specialised in dendrochronology, wood species identification and radiocarbon dating.

Andres Ueni, (b. 1974) has worked in different memory institutions, designing, developing information systems and led many cultural heritage digitization and documentation projects, focusing on imaging and survey measurement technologies. In 2014 Andres was a co-founder of Archaeovision LLC (archaeovision.eu) and since then he has been also a researcher in the Estonian Academy of Arts (EAA). Currently Andres is a PhD candidate in EAA, focusing on cultural heritage 3D documentation and multi-spectral imaging.

Kristina Sohar, PhD (b. 1983) is a research fellow in physical geography at the University of Tartu, Estonia. Her research focuses on dendrochronological dating as well as climate change from tree rings.