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WHEN DENDROCHRONOLOGY CORROBORATES ART HISTORY

Tone Marie Olstad[1,*] Jan Michael Stornes[1] and Thomas Seip Bartholin[2]

[1] *The Norwegian Institute For Cultural Heritage Research (NIKU), Storgata 2, NO-0105, Oslo, Norway*
[2] *The National Museum of Denmark, Environmental Archaeology and Materials Science, Frederiksholms Kanal 12, DK-1220 Copenhagen, Denmark*

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Abstract

The paper deals with the use of dendrochronology for dating and linking a small group of late medieval triptychs in Norway. After a short introduction to dendrochronology, the triptychs are described as well as the photographic dendrochronological examination method used in the project. The results of the dendrochronological examination correspond with the dating given to the triptychs by art historians.

Keywords: dendrochronology, polychrome sculpture, medieval art, comparative dating

1. Introduction

This article aims at examining the art historians' dating, and where possible the suggested provenance, of a selection of imported late-medieval triptychs in Norway, using dendrochronology.

In 1936 the Norwegian art historian Eivind Engelstad published a book with the results of his research on late-medieval polychrome wooden objects in Norway [1]. The publication includes a catalogue of 174 late-medieval polychrome ecclesiastical art objects still kept in Norwegian churches and museums. The dating and provenance in his catalogue is, even today, only questioned for a minority of the art objects. Polychrome medieval sculptures, with no written documented attribution or dating, are in general dated or given a provenance by art historians. Examination of the decorative layers on a polychrome artefact may add information to the art historians' dating and provenance, by identifying the painting technique and the applied materials. A dendrochronological examination can potentially date an object very precisely, give provenance, and link together elements made with wood originating from the same tree. The cooperation between various professions is invaluable as it

[*]E-mail: tone.olstad@niku.no

gives a possibility to confirm or correct former art historical views, and to make more acute evaluations of other similar objects.

2. The Lekagroup triptychs

2.1. Historical characterization

Four triptychs (Figure 1), named after the churches in Norway where they still are kept, were selected and examined in this study. The Røst, Leka and Hadsel triptychs have a rectangular shape, while Ørsta is rounded on top. The central part, the caisse or corpus, in Røst, Leka and Hadsel is divided into three niches with a sculpture placed in each niche. The niches are crowned by an open-worked carved arcade. The undivided corpus of the Ørsta triptych comprises a Crucifixion scene. Røst, Leka and Ørsta still have their painted wings. The Hadsel triptych is the biggest, at 190 cm high and 161 cm wide, while the ones from Røst and Leka are the smallest, at 114 cm high and 113 cm wide (wings closed).The art historian Engelstad was the first to recognize a connection between the four triptychs. In his opinion they belonged to a small group of altarpieces, which he named the Lekagroup and gave a North Holland provenance, but claiming that only some of these might have been made in the same workshop [1].The definition of the group was based on formal and stylistic similarities of the caisses, the wing paintings and the sculptures in the triptychs. He dated them to the first quarter of the sixteenth century, closer to the period's last part. The Dutch art historian Jaap Leeuwenberg supported Engelstad, and claimed a stronger link between the Ørsta triptych and the group than Engelstad had proposed [2]. Leeuwenberg pointed at a connection between the Lekagroup and the so-called 'Master of the female head in stone from Utrecht' [2]. The link between the 'Master' and the Lekagroup was strengthened by collaborative research in connection with the exhibition *Ontsnapt aan de Beeldenstorm* 2012-2013 in Museum Catharijne convent, Utrecht [3].

2.2. Conservation and examination of the four triptychs

The triptychs from Røst, Leka, Hadsel and Ørsta churches were examined and treated in the conservation studio at the Norwegian Directorate for Cultural Heritage (*Riksantikvaren*) and at Norwegian Institute for Cultural Heritage Research (NIKU) in the period 1982-2012. The treatment of the triptych from Røst church began in 1982, while Ørsta, the final triptych to be treated, was returned to its church after treatment in 2012. None of the conservation projects were research projects, but conservators examining the triptychs have searched for information that could connect the triptychs to a certain production area or workshop.

The wood used in the four triptychs, Røst, Leka, Hadsel and Ørsta, was recognized as Baltic oak, on account of engraved marks that can be related to wood sorting and shipping through Gdansk in Poland [4, 5].

(a)

(b)

(c)

(d)

Figure 1. The Lekagroup triptychs: (a) the triptych from Leka after treatment in 2001. The original paint layer dominates the surfaces, but secondary paint layers adds to the total impression of the piece. Only small parts of the paintings on the wings are overpainted. Notice the similarity between the Leka and Røst altarpieces. Photo: Birger Lindstad © Riksantikvaren. (b) The altarpiece from Røst after treatment in the 1980s. Secondary paint layers still hide the remains of the original paint, except for the paintings on the wings where the secondary paint was removed in the 1942. The decorative 'lattice work' in the arched fronts of the niches is secondary, as is also the lower part of the predella. Notice the similarity between the Leka and Røst altarpieces. Photo: Morten Thorkildsen © Riksantikvaren. (c) The altarpiece from Ørsta after treatment in 2012. The central part is repainted in the 19th century, parts of this secondary paint was removed in 1958-59. There is no information on the repainting process and we do not know how much of the original mediaeval paint scheme is represented in today's secondary paint scheme; except that gold dominated the central part and today's paint on the Calvary hill reflects the original paint scheme. The paintings on the wings are the original paintings. Photo: Birger Lindstad © Riksantikvaren. (d) The altarpiece from Hadsel after treatment in 2006. The secondary paint layer gives a fairly good idea of the original paint scheme. The wings, and most of the decorative elements on the canopies are lost. Photo: Birger Lindstad © Riksantikvaren.

There are similarities in the dimensions, joints, and how the wood has been worked. The elements making up the caisse or corpus are each made from one quarter-sawn board and not glued. The back walls of Leka, Røst and Ørsta are vertical quarter-sawn boards connected with the same kind of tongue and groove joint, while the back wall of Hadsel is made with a frame and panel

construction. The architectural design and the construction inside the corpus in the Røst, Leka and Hadsel triptychs are quite similar. Hadsel differs somewhat both in construction and design. All four triptychs had wings originally. The surviving wings in Røst, Leka and Ørsta are a frame and panel construction. The dimensions and design of the preserved wings are exactly the same for the Røst and Leka triptychs, and very much the same for the Ørsta triptych [6].

The sculptures in Røst and Leka and two of the sculptures in the Ørsta triptychs are made of oak 'blocks' glued together from two planks. The planks for the Leka sculptures have probably only been about 23 cm wide, as the outer part of the widest sculpture (Saint Michael) has been added on to get the necessary width. The sculptures of Saint John and the Virgin Mary in Ørsta are each made from two planks. The total width of the planks for the sculptures must have been 22-23 cm, as there is a narrow addition to the width on the Virgin Mary sculpture. Saint Katarina in Hadsel is made from a 'block' of three planks, while the back and the underside of the Virgin Mary and Saint Stefanus in Hadsel show that additional material was added to the 'block' after the carving of the sculptures was begun. There is no indication in the paint layer that these sculptures had been painted and used in another triptych before they were enlarged for use in the Hadsel triptych [6, p. 174]. The joints between the planks in the oak sculptures are, despite having been kept in unfavourable climatic conditions in the churches for many years, still very good.

Although no definitive evidence has been found, the conservators concluded that the Røst and Leka triptychs were probably produced in the same workshop. They are almost identical in size, dimension, shape and construction. The triptych from Ørsta is linked to Leka and Røst through size, the similarity of the representation of the Virgin Mary in the paintings on the wings, as well as the similarity between the sculptures in the three altarpieces; a connection also pointed out by the art historian Dagmar Preising (Suermondt-Ludwig-Museum, Aachen) when she visited Ørsta and Leka churches in 2011.The Hadsel triptych does not have the same obvious connection to the Leka, Røst or Ørsta triptychs. But like Leka and Røst, it seems to have been fabricated in a workshop with a certain serial production. The findings of the conservation projects support Engelstad's claim of a common workshop for the triptychs from Leka and Røst, but appear to refute the existence of one defined Lekagroup, even if there are links between the triptychs [1, p. 143; 6, p. 175-177].

2.3. State of knowledge prior to the dendrochronological examination

Art historians have dated the triptychs to the first quarter of the sixteenth century, probably closer to the period's last part, and ascribed them a North Holland provenance. The wood used was recognized as Baltic oak due to engraved marks found in all the examined altar pieces. The conservators' examinations have added to the art historians' arguments for including Ørsta in the so-called Lekagroup, and for the claim that Leka and Røst were most probably made in the same workshop. The question was if the

dendrochronological examination would add to or correct the existing information about the dating and the provenance of the triptychs.

3. Photographic dendrochronological method

3.1. Dendrochronology – a short introduction

Dating by dendrochronology is based on the principle that trees from the same climatic area produce tree ring widths that reflect the variation of summer temperatures. The felling year of a tree can thus be found by measuring the tree ring widths and searching for the same variations in a dated master series developed for the same area. The method is described by a number of authors [7-11] and has been applied to built structures and art objects. The optimal result of a dendrochronological investigation gives the felling year for the tree the object is made from. This requires that the last developed tree-ring under the bark is preserved. Sapwood tree-rings found on the object yields the second best result as a time span for the felling year can, at least for oak, be suggested statistically based on the knowledge of the average number of sapwood rings. Dendrochronological examination of artefacts gives, when the bark is not preserved, at least a terminus post quem for the making of a wooden object by giving the estimated felling year for the tree that provided the wood used in the object [10]. The results of a dendrochronological examination may also connect works of art, since boards originating from the same tree may link different paintings or sculptures to the same artist or workshop [12-14].

In Europe there are several individuals/institutes that have contributed to the development of tree-ring dating methods and their dissemination, and for Norway in particular the National Museum in Denmark has been of major importance. The dendrochronological laboratory at the Norwegian University of Science and Technology (NTNU, University Museum) is the centre for tree-ring dating in Norway, and one of the centre's main scientific partners is the Norwegian Institute for Cultural Heritage Research (NIKU). Tree-ring dating work in Norway has from its beginnings in the 1980s been concentrated on buildings made from pine [15, 16]. Dating artefacts, as opposed to buildings, started in Norway in the 1990s as collaboration between Museum of Cultural History at the University of Oslo, NTNU and NIKU. The methods used for dating planks made from Scots pine (*Pinus sylvestris*) in stave churches were then tested on smaller objects, including altar frontals and architectural details [17]. NIKU, in cooperation with NTNU, dendro-dated a polychrome oak sculpture in 2006 – which was a first in Norway [5, p. 73; 17].

3.2. Methodology

The method is based on measuring the tree ring widths on photo prints. The method was established in Norway in 2002 to be able to do dendrochronological investigations of wall tiles in the stave churches, where no

corroboration was allowed. The recording of the radii for dendrochronological processing could be done on the surface of the pine boards. For oak wood, however, the method can only be applied on the end grain, so in the case of the triptychs this meant the bases of the sculptures and the edges of some of the planks in the caisses. The growth ring widths must be measured with a precision of 1/100 of a millimetre. This demanded preparation of a measurement path on the endwood where the surface is smoothened in a ca. 15mm-wide area across the wood so the radii may be recorded and documented. Preparation of such a path is traditionally done by scalpel, razor blades or sanding paper, or by micro abrasion with spherical glass particles [13; K. Haneca and J.V. Acker, *Dendrochronological research on WCHO's in Flanders (Belgium)*, Presentation, COST action IE 0601 Tervuren, 2007, http://ottimari.agr.unifi.it/~uzielli/Tervuren_proceedings/Haneca.pdf]; laser cleaning has also been used [18]. In this project surface smoothing was generally done using a spokes have with an industrial razor blade, adjusted for the purpose. This plane shaved off just a few tenths of a millimetre of the surface, and so heightened the contrast between the growth rings while minimizing intervention in the object. The contrast between the growth rings was increased by adding chalk to the measurement path, while taking care to avoid chalking the sapwood where this was present. The prepared measurement path was scanned with a regular flatbed scanner. This is very useful as a pre-photo check of the radii and supplementary to photography. The final photographing of the finished path was done using a digital SLR camera, with a 60 mm macro objective, macro blitz and additional photo light. Printed photos with a glossy surface were used for the dendrochronological examination. All photos and digital files (Raw/JPG), as well as prints, were named and systematized in a way that makes future use of the information possible. Processing tree ring information collected from the objects is done using the CATRAS database solution, which is based on the measurement of tree ring widths with an accuracy of 1/100 mm and statistical calculations to correlate the sample with a master series or with another, contemporary sample, since the final dating depends on a visual comparison of the possible synchronous samples/series [19].

The photo-dendrochronological method was chosen because the authors were familiar with it, and because it can be used in situ – making transportation of the objects unnecessary. It does not demand expensive equipment, and is thus a low cost method even when the cost of working hours is high. The information may be further processed back home. It is not a non-destructive method, but the measurement path represents a minimum intervention compared to coring, and the paths are made on surfaces not visible in the reassembled triptych. It has the advantage that the measuring path and the photos may be re-examined. The use of computer tomography, which under certain conditions is a non-destructive method, was not an option for this work. Use of a medical or industrial scanner demands cut samples, or small objects, and – even had these things been feasible – a more generous financial framework than this project had [18].

4. Results and discussion

As many as 40 of the selected 44 elements in the four triptychs could be dated against the standard Baltic master chronologies Baltic1 and Baltic2, chronologies based on paintings from Leiden as well as other Dutch paintings, and a chronology based on ecclesiastical art from Eidersstedt in Schleswig-Holstein. (The references to the chronologies are: Tyers, Eckstein and Wrobel. The applied master chronologies, Tyers, Eckstein and Wrobel are developed by laboratories in Northern Europe. They are not published, but are a common source shared among professionals.) The applied chronologies identified the Baltic area as the provenance of the wood, but could not pinpoint a specific geographical growth area [20].

Guild regulations demanded that sapwood should be removed from the wood before use [21]. Therefore, assuming that these regulations had been followed, a calculated number of sapwood rings has to be added to the last detected growth ring to determine the terminal post quem date for the felling year of the tree. And any removal of heartwood would additionally affect the estimate of missing annual rings [22]. The procedure of determining the felling year by adding missing annual rings is not standardized. The estimated number of sapwood rings that should be added depends both on the number of sapwood rings relative to the tree age, as well as the provenance of the wood [12, 22]. Kuniholm [23] refers to published sapwood estimates for various geographical areas, including Baltic wood. For Baltic wood his reported sapwood estimates for the number of annual rings to be added are 15(+9-6) and 15(+4-2) rings. Haneca recommends 15(9-24) [24]. Only wood retaining some sapwood can be given a fairly certain felling year. Where all the sapwood has been removed, the estimate is a post quem date for the felling of the tree.

Table 1. Overview of the information gained from the dendrochronological examination.

Triptych	**No. of examined elements**	**Dating of last annual ring in the youngest examined element in the triptychs**		**No. of elements which could not be dated**	**Estimated felling year of the tree for the youngest element in the triptych based on estimation of 20 sapwood annual rings**
		Sculptures	**Caisses/Wings**		
Røst	6	1484	Examination not possible	0	1504
Leka	14	1475	1493 (Caisse)	0	1515
Ørsta	12	1485	1486 (Caisse)	3	1510
Hadsel	12	1503	Examination not possible	1	1516 (sapwood preserved)

In this project the general estimate of missing sapwood rings to be added was 20. The dating of the last annual ring for the youngest wooden part in the four examined triptych varies between 1475 (Røst) and 1503 (Hadsel). The corresponding felling year was estimated to range between 1504 (Røst) and 1516 (Hadsel) (Table 1). The latter had seven sapwood annual rings preserved, which

gives the most precise felling year. It seems that the craftsmen had tried to use the full width of the planks, and taken off as few annual rings as possible – even if the sapwood had been removed in most cases. This observation corresponds with the conservators' conclusion that the triptychs were made by craftsmen with considerable knowledge of wood technology, who minimized material use and work where possible.

The felling year does not date the artefact. Time for transporting the wood from the forest to the workshop, the potential seasoning of the wood and the time for making the object need to be added (Table 2). Baltic wood could be transported from the forest through Gdansk to Antwerp in about a month [13]. Panels that were to be mounted in a frame, or glued together, need to be seasoned, which may be the reason why research done on seasoning is mainly concentrated on wood used in panel paintings [11]. The drying of wood for use in a panel painting is shown by D. Eckstein to last about a year, while Haneca says 5+/-3 years [24, 25]. An eventual drying period for wood to be used in sculptures is more difficult to estimate; it is easier to carve in fresh wood, but when the material for a sculpture is glued from two or more pieces the wood is probably dried before the pieces are glued together. Eckstein has documented that sculptors preferred to work in freshly cut oak [25] even if medieval guilds prescribed the use of seasoned wood [24].

Table 2. The estimated dating of the triptychs based on added years (caused by removed wood, transport, production) to the last annual ring in the youngest examined element in the triptych.

Triptych	**Dating of last annual ring in the youngest examined element in the triptychs**		**Estimated felling year of the tree for the youngest element in the triptych** →	**Estimated felling year + transport, and seasoning of wood (3 years) [24]** →	**Estimated felling year + production time according to documented projects (2.5 years) [26]** →	**Dating of triptychs corrected for wood from same trees found in different triptychs**
	Sculptures	**Caisses**				
Røst	1484		1504	1507-1508	About 1511	
Leka	1475	1493	1515	1518-19	About 1522	Same felling year as Ørsta, about 1522
Ørsta	1485	1486	1510	1513-1514	About 1517	
Hadsel	1503		1516 (7 sapwood annual rings present)	1519-1520	About 1523	

Lynn F. Jacobs has looked at the requested production period in the contracts for commissioned sales of altarpieces. The time needed for the production of an altarpiece depends on several factors. It is not said if one of the premises for the production period is that the wood needed is at hand and ready to use. In the contracts she has examined there is a variation from six months to two and a half years. In one project the local carver was allowed 5-6 years to finish the work [26]. De Boodt refers to the altarpiece from Bouvignes, where both the felling year and the installation year of the altarpiece is known, and suggests an interval between the felling year and the finished art object of from 3

to 4 years [13]. There are research findings and contemporary documentation that help us estimate the interval from the dating of the last annual ring to the date of a finished product. There is, however, a lack of coherence in the available information regarding the addition of sapwood rings and length of the seasoning or production period.

This means that there is a degree of uncertainty when the dating of an artefact is based on dendrochronological examination, as long as there is no written documentation to support the dating.

It is virtually certain – based both on a very significant statistical correlation and on the striking visual similarity displayed by the annual ring-width variations in the various samples – that wood originating from the same tree is to be found in different elements in the same artefact in two of the examined triptychs.

In the Hadsel triptych, wood from the same tree was found in elements in the Virgin Mary and Stefanus sculptures, and the wood in another element in the Stefanus sculpture is from the same tree as elements in the Saint Katarina sculpture. In the Røst triptych, wood from the same tree was found in two of the sculptures. In the Ørsta altarpiece, the two sides of the caisse are from the same tree. More interesting is the fact that wood from the same tree is found in the Leka and Ørsta triptychs. One board in the back wall of the caisse in the Leka triptych is from the same tree as two boards in the back wall of the caisse in the Ørsta triptych. The connection between the two triptychs is confirmed by the fact that wood from the same tree is used in all the sculptures in the Leka triptych and in the Virgin Mary sculpture in the Ørsta triptych (Figure 2).

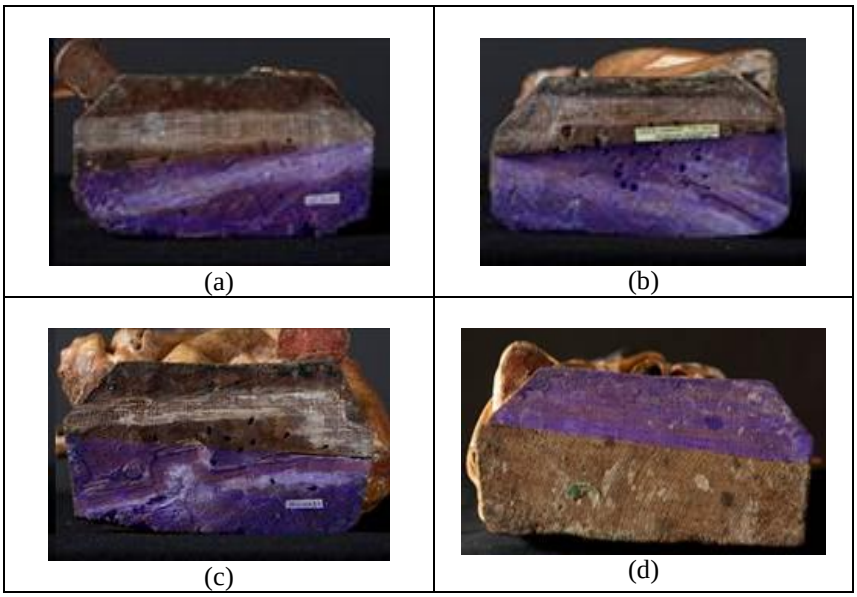

Figure 2. The wood marked blue originates from the same tree. The image sequence (a-c) are the undersides of the three sculptures in the Leka triptych, while image (d) is the underside of the Maria sculpture in the Ørsta triptych. Photos: NIKU 2012 ©NIKU.

The results of the dendrochronological examination must be viewed together with the results from other examinations of the objects. The art historians' idea of a common workshop for two of the altarpieces – Leka and Røst – was reinforced by the results of the conservators' examination of the triptychs and the scaled measurement drawings. The supposed link between Ørsta and Leka was confirmed by the dendrochronological examination.

5. Conclusions

The results of our study prove that in situ photo-dendrochronological examination of polychrome objects may potentially give a very precise dating of elements, and thus, in this project, of complete triptychs. The method is cost effective, minimizes intervention, and may be used when core samples are not obtainable.

Wood originating from the same tree connected different elements within the same triptych, and connected the Leka and Ørsta triptychs to the same workshop [12].The provenance of the oak is confirmed to the Baltic area. The dendrochronological dating of the altarpieces proves the art historians right: the triptychs were made in the first quarter of the sixteenth century. Combined with other examinations, the dendrochronological investigation confirms that the triptychs in Røst, Leka and Ørsta churches most likely originate from the same workshop.

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