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Dendroorganology?
The dendrochronological method applied to musical instruments

Micha Beuting
Dendrochronologische Untersuchungen an Musikinstrumenten und Kunstobjekten, Hamburg (D)

The biological study of dendrochronology is used to determine the age of wooden objects using the wood’s tree ring structure. It was first applied in research on stringed, plucked and keyboarded instruments in the early 1980s and has been generally acknowledged in music-history since then.

After a short introduction about the work at the dendrochronological laboratories of Hamburg University and Dr. Micha Beuting, the lecture will show the potential of this method beyond mere dating by interpreting a large amount of data with reasonable care.

By using examples of instruments made by famous instrument makers, including members of the Guarneri family and Jacob Stainer, a series of statements will be made regarding storage duration as well as manufacturing processes in different workshops.

Another focus addresses the method of regionalisation and its potential benefit for organology, including ways of wood trading and information about the wood used in violin making centres such as Markneukirchen/Vogtland and Mittenwald.

In addition, criteria for determining the origin of wood from the same trunk will be presented and discussed. Different examples of instruments will be shown.

Finally, a classification of tree ring widths of spruce wood will be introduced, which could lead to a more precise description and in consequence a higher comparability of instruments’ front plates and resonance boards, e.g., in catalogues and documentations.
Approaching the large timber series of the Neolithic pile-dwellings at Lake Constance by the way of dendrotypology

André Billamboz
Landesamt für Denkmalpflege Baden-Württemberg, Hemmenhofen (D)

Within the field of pile-dwelling research in SW Germany, dendroarchaeological applications to large timber series allow on the background of the calendar framework a better depiction of the short term development of settlement, showing high variations of building activity coupled with varying strategies of timber supply and woodland use.

Examples are taken from systematic tree-ring investigations related to the Neolithic occupation at Lake Constance between 4200 and 2400 BC. On specific levels of dendro-dating involving various tree-species, precise data highlight the building activity along with the extension and organisation of the villages as well as the perpetuation of housing within short phases of settlement. A particular key of this approach is the dendrotypological analysis giving an insight into the structure and the dynamic of the exploited stands. Furthermore, the consideration of the ecological and climatological information of archaeological tree-ring data allows a better understanding of the interferences between settlement behaviour, climate evolution, environmental changes. With reference to younger periods, models can be developed reflecting the deep relationship between man and woodland through time.
Dendrochronology and human behaviour. Experiences and results in the province of Liège (Wallonia, Belgium)

Caroline Bolle and Jean-Marc Léotard, with the contribution of Catherine Bauwens, Geneviève Coura, Jean-Luc Charlier, Denis Hénrard and Guillaume Mora-Dieu

Ministère de la Région wallonne, Liège (B)

Despite the fact that our experience is limited, the purpose of our presentation is to show how we have structured the application of dendrochronology within the framework of archaeological analyses of historical monuments.

When it was first established, the “Service de l’archéologie de Liège” (“Service Public de Wallonie” – DGO4 – Belgium) had only minor involvement in the “archaeology of building frames”. The use of dendrochronology was limited to wooden pieces discovered in the sub-soil. Since 1998, the sector of archaeological analysis of historical monuments has grown progressively and today represents more than 30% of the activities of the Service.

Over the past decade, collaboration with dendrochronologists from the University of Liège (Dr. Patrick Hoffsummer, Dr. David Houbrechts, Jérôme Eeckhout), and from the Royal Institute for Cultural Heritage (Dr. Pascale Fraiture) developed substantially, becoming systematic, well organised and stronger. The accuracy of the results of dendrochronological analyses and the interdisciplinary approach have several key benefits: dating architectural remains, authentication, determination of the architectural construction phases and their development through time, creating links with other artefacts (plastering, decors, etc.) and finally, reinterpreting historical and iconographic sources.

Through several case studies, we will demonstrate how research perspectives have progressively broadened since the beginning of this collaboration. For example, we present the case of the old medieval infirmary of Saint-James Abbey in Liège: the interdisciplinary approach has now revealed new information with respect to the concept of the building, such as the regulating layout, the distribution and allocation of the different functions, the construction methods and indications concerning their use (see figure). Additionally, because the building seems to have been the seat of the same activity at least from the 14th century AD to the late 18th century AD, all of the adaptations documented may inform us about the history of fashions and architectural concepts, as well as developments in the treatment of the sick in this kind of context and thus more generally about the evolution of ways of thinking. We will also present the case of a house called “Seigneur d’Amay”: the complex story of a remarkable architectural project dating from the 16th century AD, a priori incomprehensible due to permanent changes, until its completion, elucidated by the confrontation of the historical, archaeological and dendrochronological analyses.

By placing material items in their context, the goal is not only to identify the development of building conceptualisation and construction processes but, more essentially, to better understand the evolution of human behaviour.
Figure

Hypothesis for the 3D reconstruction of the old infirmary of Saint-James Abbey in Liège, in the 14th century AD.

© Olivier Gilgean, for the “Service de l’archéologie de Liège”
One of the advantages of the dendrochronological dating method is that it is anchored in a biological context. This means that it is completely independent of other methods. If an event, for example the construction of a church or the building of a ship, involved the felling of one or more trees, then dendrochronology offers the possibility to say when this event took place, independently of archaeological or historical considerations. The method gives the historian and the archaeologist an independent answer to the most important question arising when carrying out research on an object: how old is it?

It is the most precise scientific dating method so far. No other method, i.e. radiocarbon, thermoluminescence, etc. can better it for precision and a precise date is essential if you want to interpret an archaeological find or a historical object in a historical context. Often the dating is of such precision that previously acknowledged theories have to be abandoned if they conflict with the evidence provided by the dating.

Dendrochronology can however provide more than dating. A great deal of additional information can be obtained from samples of timber: most obviously with regard to the quality of the timber, the methods used in its conversion, etc.

The question of the provenance of the wood – or timber, which is the word we ought to use – is of great importance in dendrochronological research on old shipwrecks, works of art, etc. It is unlikely that the place where a large sea-going ship was built or where its timber came from will be the same as the place where it sank and where it was found and excavated as a wreck hundreds of years later.

This paper will deal with examples like the oldest still standing stave-church in Europe, the famous Viking ring fortresses in Denmark, work of art from the 17th century AD, etc. For example, tree ring research on samples from Norwegian Viking ships excavated more than 100 years ago have produced new and sensational information giving space for new and intriguing interpretations (see figure).

It is thought-provoking that we can extract new and important information from objects which have stood for decades on exhibition or in storage in museums. These are objects which are well-preserved and well-stored but which, in many cases, perhaps suffer from lack of interest due to the public’s quite overwhelming obsession with new and spectacular finds. Everybody working in museums should bear this in mind when objects and finds – both new and old – are to be preserved for posterity.
Figure

The Oseberg ship excavated 1904. Dendrochronology demonstrates that it was made in the western part of Norway around 820 AD. © Kulturhistorisk Museum, Oslo.
How tree ring dating can provide historical contexts to buildings without history

**Thomas Coomans**
*Vrije Universiteit Brussel, Brussels (B)*

Because of the lack of historical sources for many medieval buildings, architecture historians have developed the stylistic method, which is based on the comparison of formal criteria and the postulate of a linear evolution. So history of medieval architecture has been written since the 19th century AD.

Tree ring dating often provides a precise chronology that allows the architecture historian, after a critical analysis of the coherence between the timber structures and the masonry, to place a building or a building phase accurately on the timeline. It is remarkable to note that this timeline differs in many points from the evolution as sketched by the traditional history of architecture. Thanks to a precise historical context – space and time – it becomes possible to identify the patron of a building, and sometimes also the builders and the users. From there questions of the meaning of a building, as a product of a precise context, can be asked and pages of the traditional history of architecture must be rewritten (see figure).

This paper is based on a ten years experience of working on “minor” medieval church buildings in the Low Countries, that is to say churches of mendicant orders and beguines. Because these religious were poor, the churches they have built do not have stylistic elements – carved capitals and bosses, ornamented portals, elaborated traceries, wall decoration, etc. – and often are simply covered with wooden vaults. For these reasons, these churches have been neglected by architecture historians. In a certain way, we could say that they have a past but no history. The renewed approach based on accurate chronology thanks to tree ring dating has given these churches a history.

Different cases of re-interpretation of medieval churches thanks to tree ring dating will be presented: identification of a church as a princely burial church (Dominicans at Leuven), *terminus post quem* for medieval wall paintings (Beguinage of Sint-Truiden, chapel at Ponthoz), interpretation of a conflict between a local lord and a duke (parish church of Bierbeek), identification of a master carpenter (Beguinage of Sint-Truiden), complex building phases (Dominicans at Leeuwarden), changing of political and religious influences (Franciscans at Maastricht), re-use of a 15th-century AD bell tower in a 19th-century AD church (Beguinage of Liège), etc. These examples will be placed in the perspective of the history of architecture and be used to define a method based on a better interactivity between building archaeologists and architecture historians.

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See figure on next page
Figure

Romanesque-type roof structure from the 12th century AD, drawn by canon Lemaire in 1951.
Making art in Tudor Britain and evidence from dendrochronology

Tarnya Cooper
National Portrait Gallery, London (UK)

Over the last three years the National Portrait Gallery in London has been undertaking research on its significant collection of 16th century AD panel paintings under the title Making Art in Tudor Britain. The Gallery has the largest public collection of Tudor paintings assembled from diverse sources over a 150-year period. The project asks a range of questions about the material choices of artists and what technical evidence about the fabrication (of panels, underdrawings and paint surfaces) can reveal in relation to the authenticity, meanings and functions of art objects. Although the National Portrait Gallery collection contains only the one genre of portraiture, it includes paintings produced for a wide spectrum of audiences (including institutions, citizens, courtiers, monarchy, etc). While much of artistic production was destroyed at this date, the NPG collections are likely to be more representative than collections of fine art of the same date, and thus the results will allow us to explore patronage in the widest context.

By early 2010 we will have surveyed more than 75 British and Anglo Netherlandish paintings dating from 1500-1550 AD using dendrochronology, infrared reflectography, x-radiography, microscopy and paint sampling. This paper will present the results of this work, focusing on the insights provided by the analysis of the oak panels and dendrochronology. In combination with other techniques, this critical evidence has allowed to re-date individual works and thereby establish several new patterns in the patronage of groups of paintings, including copies and versions after Hans Holbein and groups of kings and queens. The use of dendrochronology in a systematic survey combining other types of technical analysis has also allowed us to correlate and cross reference the use of pigments and other materials and provide a framework for the development of patterns in importation, usage and practice.

Significantly, we have also identified cargo or trade marks on the backs of Baltic oak panels dating from the 1540s AD which need further investigation and correlation with other examples.
Dendro-geography. Mapping the Northern European historic timber trade

Aoife Daly
Roskilde Universitet, Roskilde (DK)

With the developments in dendroprovenancing over the last few years, detailed analysis of the material evidence for trade across Europe in timber, and timber products, is now increasingly possible. The results of these analyses allow insight into the availability of timber, and the extent and nature of trade in timber, in Northern Europe, over ca the last two millennia.

When detailed mapping of connections between timber objects and structures in Europe is carried out, different interpretive questions must be asked, specific to the period that is being studied. Consideration must be taken of the logistics of transporting bulk timber using the technology available. We must in this regard make the distinction between bulk timber which is not easy to transport, and timber products like planks, panels and boards, which are prepared in the forest and are much more manageable. We must also take account of the geographic conditions when we identify timber sources and trade routes. Where we have large rivers, rafting of large cargos of timber is possible. In regions where we do not have major rivers, the transport of timber might be on a smaller scale. Additionally, we need to look at the shipping technology, to study the capacity for timber transport over sea through time. We also need to look at the ships themselves, as their building is also subject to the availability of suitable timber. When we determine the provenance of ships’ timbers in the archaeological record we must ask: when are we identifying the region where the ship was built and when do we see the transport of timber for shipbuilding elsewhere? We can also take into account the availability of timber. In regions where we see a considerable amount of imported timber in the dendrochronological record, can we see a pattern of timber shortage locally?

Despite these considerations, the identification of the provenance of wooden objects and constructions through dendrochronology is allowing connections to be mapped, between regions, at different periods. We can for example take the evidence from archaeological barrel finds. Barrels dating to the early 8th century AD found in Ribe in western Jutland, Denmark, were made from oak trees that grew in central Germany, near the Rhine. Barrels from France from the 12th century AD are found in London in England, Aberdeen in Scotland and Ribe in Denmark. From the mid-14th to the mid-15th centuries AD the source for oak barrels, at any rate in the Danish material, is predominantly southern Baltic. We see again in the 16th century AD French barrels appearing, this time in Ireland. While a boat found in 2007, in Drogheda Harbour, was built around 1524 AD of Irish oak timber, the barrels found in its cargo came from South-west France (see figure).

As we move in time towards the modern era, the interpretation of detailed provenance analysis has to take account of the increasingly complicated historic timber trade network. This talk will present detailed provenance analysis, and the insights these analyses allow, in a discipline that the author now calls “dendro-geography”.

See figure on next page
Figure

Barrel 5 from the Drogheda Boat, Ireland. The wood that this barrel was made from grew in South-west France.
The city of Groningen, situated circa 20 km from the North Sea in the northeast of the Netherlands, established its position as an important trading centre by joining the Hanseatic League in its early years (13th century AD). These trading relationships proved to be of great advantage during early Modern times for the import of wood from Germany and the more distant Scandinavian and Baltic countries.

In the 15th century AD, the Damsterdiep canal was built to link Groningen with the coastal port of Delfzijl, located on Dollart Bay, on the west side of the estuary of the river Ems (see figure). Boats travelling from Delfzijl to Groningen had to pass a portage on the eastern side of the city, at the junction of the Damsterdiep and the outer city moat (the ‘Schuitendiep’), which had a higher water level. This overland transport of boats and goods slowed the journey considerably. In the late 16th century AD, works to construct a wooden lock connecting the Damsterdiep and the Schuitendiep were initiated. This sluice would ease the passage between the two canals, reducing the effort and travelling time between the coastal port and Groningen. Timber for the construction of the sluice was bought in Emden, a German town on the east side of the estuary of the river Ems, opposite Delfzijl. By the 17th century AD, Groningen had become the most important stronghold in the north of the Netherlands. The expansion of the city required new, improved city walls and a new city gate on the east side of town. This gate, the ‘Nije Steentilpoort’ was built in 1620 AD, as indicated on a carved stone from the gate.

In the last two years, the archaeological excavation that preceded the construction of an underground parking lot in the eastern part of the city, revealed the following structures: the portage, the eastern part of the sluice, a bridge, the eastern city gate and part of the revetment of the Damsterdiep Canal. Subsequently, archaeologists, dendrochronologists and historians put their expertise together to unravel part of the city’s history. The dendrochronological investigation of a large number of wooden samples of different species collected from the excavated structures has provided information not only about the construction dates, but also the provenance of the wood, which originated mainly from Germany and Scandinavia. Furthermore, the dates of foundation piles from the city gate, accurate to the felling season, give an idea of the time span between the felling of the trees and their use, which improves our understanding of the use of non-seasoned, fresh wood. The dimensions and shape of most of the timbers indicate that they were transported as logs.

This study seeks to provide insight into the timber supply of the city of Groningen in the early Modern period and to point out the contribution of dendrochronological research to the information provided by archaeologists and historians.
Contributions of dendrochronological and technological examination of painting supports to the study of 17th-century AD Flemish painters’ workshops: the case of Rubens’ studio practice

**Hélène Dubois and Pascale Fraiture**
*Institut Royal du Patrimoine Artistique, Brussels (B)*

If the main contribution of dendrochronology applied to the study of a panel painting is to establish the earliest possible date for the fabrication of the support, and therefore for the execution of the painting itself, the examination of a large number of works produced in the same region and period allows the construction of an objective chronological framework in which it is possible to situate archaeological observations recorded on paintings, in relation with woodworking techniques such as appearance or disappearance of specific tool traces, or with social context such as the presence of guild marks on the reverse of some panels. The identification of the geographical origin of the timbers given by dendrochronology is also of great interest to shed light on the wood trade and commercial networks, in particular in regions in which regional forest covers were largely cleared at the period studied. Finally, in describing the growth of the wood used (rhythm, regularity, disturbances…), tree ring analysis brings to light information on the selection of the trees used and on the state of forests supplying these oaks.

The study of around 150 paintings on oak panels produced in the southern Netherlands from about 1450 AD to 1650 AD, placed in relation with the historical and social context, has thus enabled us to reconstruct a general evolution in the production of panel paintings for this region and period.

In addition to dendrochronology and archaeology, art historical studies of panel paintings also contribute to determining their provenance and their original function. The examination of the paint layer, using scientific analytical techniques, understanding of the way in which they were built, and detecting traces left by accidental damage, intentional modifications and former treatments, all help to the reconstruction of their original appearance and material history.

This multidisciplinary approach has been helpful to the study of P.P. Rubens’ studio practice. Rubens’ production of panel paintings in the period after 1610 AD, following his return to Antwerp from Italy, encompasses monumental altarpieces, mythological and religious compositions of diverse formats, portraits, landscapes and preparatory sketches (see figure). The painter’s habit of extending and modifying paintings and of using structurally awkward composite panels has been a puzzle. The recent study of many paintings in the Royal Museums of Fine Arts in Brussels reveals the use of second-rate panels, including damaged and repaired boards, sapwood, pith and tangential cuts, as well as the economical recycling of standard-size panels and off-cuts. This paper will demonstrate how the combination of archaeological, dendrochronological, art historical and technical studies leads to a well-documented analysis of Rubens’ studio practice and management.
Figure

Pieter Paul Rubens, *Portrait in a medallion of don Gaspar de Guzman, count of Olivarez and duke of San Lucar de Barrameda, 1587 – 1645*, Brussels, Royal Museums of Fine Arts of Belgium (inv. 4342). Oil on oak, 63.5 x 43.6 cm.

Front: © Royal Museums of Fine Arts in Brussels.
Back: © P. Fraiture, for the Institut Royal du Patrimoine Artistique
Tree ring based larch and stone pine long chronologies, reconstruction of altitude forest history and human occupation in the French Alps during the last millennium

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In the French Alps, the forests located in the subalpine zone contain isolated patches of multi-centennial living and/or dead larches (*Larix decidua* Mill.) and stone pines (*Pinus cembra* L.). Using dendrochronological methods, tree ring chronologies covering the last millennium and beyond were established using these old trees. These master chronologies are essential to assign a date or to reconstruct the natural or anthropogenic disturbances recorded by interannual growth variations. For this reason, old and dead trees are natural records very useful for the knowledge of past environmental conditions and in modelling climates reconstruction or attribution studies. They also represent precious archives for human history as they are used to date old constructions of wood.

Additionally, in mountain regions, traditional buildings, and notably old barns, built with stacked round unshaped larch or less frequently stone pine beams are also of particular interest to extend the master chronologies back in time. The studies undertaken a few years ago in the southern French Alps on buildings located around 2000 m a.s.l. have provided long tree ring composite chronologies covering the period 749-2007 AD by combining construction wood and series from living or dead trees. The dendrochronological analysis of about 800 samples from construction wood shows very old dates of logging (second half of the 12th century) in the high mountains of the Southern Alps. These chronologies are used for reference to date other witnesses of human occupation e.g., old mines, religious buildings, chalet, barns, etc. Tree ring chronologies also contribute to a better knowledge of the forest history and management and of climatic evolution in the southern part of the Alps during the last millennium.
Timber transport and dendroprovenancing in Thuringia and Bavaria

Thomased Eßing and Christoph Dittmar
Otto-Friedrich Universität Bamberg, Bamberg (D)

In dendrochronology, knowledge about the origin of timber and the provenance of wood samples is of great interest. The provenance attribution allows the reconstruction of forest use in the past and the establishment of regional or local chronologies which improve the dating success and dating reliability of wood samples from a certain region. The establishment of local chronologies is not difficult, if logging took place in the surrounding area with a circumscribed circle of not more than around 20km. If logging, however, took place far from the building site and timber from different provenances was used, wood grown under different conditions is present among the samples. In consequence, tree-ring series with different courses and signals are obtained reflecting the specific growth conditions of different provenances.

Historical sources about trade lanes in former times give only a raw and general impression about the amount of historical timber transport. Sometimes archaeological evidence of timber transport can be found while sampling, e.g. as signs and relicts on the beams. Another approach is to assign the samples to a specific provenance by using the characteristic properties of tree-ring series.

In the following contribution, a short overview is given about the knowledge of timber transport in Thuringia and Bavaria, some examples of relicts of timber rafting are described and a new methodological approach for the establishment of regional and local chronologies is introduced.
Dendroarchæological contributions to the history of forest exploitation: the case of the Gallo-Roman settlement of Oedenburg (Alsace, France) between 10 AD and 180 AD

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Dendrochronology has never been considered as simply a dating tool by dendrochronologists. Radial growth measurements from trees provide three kinds of information:

1. Chronology. Felling date estimations contribute to archæological chronologies.

2. Regional climate. Successful archæological series cross-dated over large areas require a strong common signal. At this scale, the signal represents climatic forcing on tree growth.

3. Local influences. These can be described using specific variables to provide information about stand origin, “provenancing” and woodland development.

Although archæological tree-ring dates are abundant, such data are used much more rarely in dendroclimatological or dendroecological fields than for chronological interpretation. Archæological material features are often cited as limitations. To build a structure, wood was transported to the site, local growing conditions are thus not obvious. The number of series that can be dated varies widely, abundant in some periods, extremely rare in others. Archæological material dated is always limited in the number of rings present, species, etc. In each case, for present or ancient series, site selection and sample representativity must be discussed. Although such limitations exist, recent studies, including archæological series, have provided dendroclimatological and dendroecological reconstructions for long periods. This has become possible because palæoenvironmental studies are now increasingly integrated within archæological research.

Our study of the Gallo-Roman settlement of Oedenburg (Alsace, France), established on the Rhine Limes, was conducted within this framework. The series dated provide description of some of the structural aspects of oak-stands that were exploited for construction. In this aim, the analytic tools employed are the “age trend form” and series classification, and dendrotypology. Archæological series were also compared to modern forest characteristics.

Throughout the chronology, woodland development appears to have been dominated by two stages. The first is oak tree harvest. We observe that (1) series patterns from a single archæological structure are more similar than between structures (see figure A) and (2) large tree-rings are present during the juvenile phase. These rings are larger than those observed consecutively up to modern logging (see figure B). The effect of oak tree harvesting is local high-forest clearing. During the second stage, the high forest is in the process of recovery. After a few years’ aging, Gallo-roman oak ring width becomes sharply inferior to that observed in the actual forest (fig. B). This can be explained by the high degree of competition between trees due to a poor thinning grade during recovery.

Within the chronology obtained, the exploitation of three oak-stand structures was recognized (fig. A):

- Between 10 and 55–65 AD, oaks were around 150 years old when they were felled; slow growth indicates that stands were denser than recent managed high forests; large juvenile rings indicate old logging and regeneration.

- Between 55 and 115 AD, oaks exploited were 200 or more years old, some of which show growth release due to the clearing effect. During this phase, logging, which may have concentrated on older preserved trees, is more intensive than before.

- Between 115 and 180 AD, oaks were cut down at around 100-120 years old. They came from stands that regenerated between 30 and 70 AD, in line with the first phase harvest. In accord with a greater degree of stand thinning, growing
was faster and more dynamic than in the other two phases, but the “age trend form” indicates that stands were still denser than the present high forest.

The dendroarchaeological study of the oak-tree supply for the Oedenburg settlement yields information about some of the structural aspects of the oak-stands. First, stands were previously exploited using a harvest and recovery system; second, supply may have focused more on preserved trees; and third, the regeneration rate was respected, but harvest age was lowered, resulting in greater thinning of a stand, although they were still denser than today’s managed high forest.
Growth patterns of oak and historical forest management in Flanders
(Belgium)

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A well-replicated reference oak-chronology for the region of Flanders (northern Belgium) has been under construction for nearly a decade. To date, local chronologies covering the Roman Era, Middle Ages and Modern Period are available. However, some important gaps still need to be filled. One of the major problems in constructing these local chronologies is the frequent occurrence of short and fast-grown tree ring series on archaeological oak samples, hampering statistical cross-dating and verification. Although such growth-ring series might be too short to allow dendrochronological dating, the growth patterns contain valuable information about the forest from which they originate and anomalies in the wood-anatomy often reveal specific interventions by men during their life-span.

A detailed analysis of the recorded growth patterns from local, historical wood samples allows us to get a glimpse of the woodland from which they originate. A methodology will be presented regarding how these growth patterns can be related to forest management practices. Growth patterns of wood from archaeological sites (see figure) and historical buildings will thus be compared with tree ring series of living trees from different Flemish forest sites. The short (archaeological) series in particular are often highly similar to the growth patterns of living shoots on coppices.

When examining the wood-anatomy of some archaeological or subfossil oak samples in more detail, some conspicuous features, such as sudden reductions in earlywood vessel diameter and ring-width, can be observed and quantified. Some of these can be related to special trimming techniques as pollarding or shredding. At particular locations in Flanders, relics of these trimmed trees can still be found. However, for comparison with archaeological wood more dendrochronological and wood-anatomical research on this type of ‘living cultural heritage’ is still needed.

Although archaeological wood samples often provide suboptimal wood for dating purposes, archaeology is the most important source of wood samples that are suitable to construct a local reference chronology. Mainly because wood from historical buildings often has a non-local origin. Indeed, Flanders has a long tradition regarding timber import and vast amounts of building and ‘high’ quality timbers have been imported from remote regions. Such imported wood samples cannot, of course, be implemented in a local chronology. Therefore dendroprovenancing studies are of utmost importance and all measured tree ring series should be scrutinized in order to verify their origin.

The goal of this presentation is to elucidate the progress in dendrochronological research in Flanders, a region where forests experienced a long history of intense human influence. It will be illustrated how this anthropogenic pressure on historical woodlands still influences dendrochronological studies today and how tree rings can provide valuable information about historical forest management and wood production. At the end, it should be clear that dendrochronology has evolved beyond dating.
Detailed image of two cross-sections from the archaeological excavations at Ypres (14th century AD) that display different growth patterns. The growth pattern of the upper image shows ca. 20 wide rings followed by a rather abrupt change to narrow rings, while the other cross-section displays a more uniform growth pattern with more narrow rings. Scale bar represents 1cm.
Around Brussels carpentry (15th-18th centuries AD). Contributions of dendrochronology in the study of buildings

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Since 2001, the architectural and archaeological heritage of Brussels has benefited from dendrochronological studies, due to new collaborations between the Monuments and Sites Directorate (MSD) of the Brussels-Capital Region and the Laboratory of Dendrochronology of the University of Liège. Most of the requests have come from different regional or municipal heritage researchers in projects related to protecting monuments, preliminary studies prior to restoration or archaeological research. In upcoming years targeted zones should be determined, coupled with the development of systematic dendrochronological research.

In this presentation, using examples of studies carried out by the Royal Museums of Art and History in association with the Monuments and Sites Directorate or by the Historical Heritage Brussels Unit, the contribution and limits of dendrochronology in the analysis of buildings will be emphasised. Research at the La Cambre Abbey, the Merode’s Residence, a residential house in the protected zone around the Grand Place, the Town Hall of Brussels and the Saint-Jean-et-Étienne-aux-Minimes Church will each be presented. The first three cases result from multidisciplinary research, combining archaealogical investigations, historical studies and dendrochronological analyses, and analyses prior to restoration or demolition projects. The final two cases present the combined results of archival research and dendrochronological examination of the frames in preparation for their future restoration.

The dating of roof frames and beams enables determination of very precise chronological phasing of the site being studied. However, it goes beyond the strict framework of the establishment of the overall changes in a single building, making it additionally possible to determine the chronology for the implementation of different techniques for various types of structures. This kind of study has only rarely been done in building studies in the Brussels region. Putting these different research projects into broader perspective contributes to socioeconomic considerations of the use of the wood during the Ancient Regime in Brussels and in bordering regions, particularly on the origin, supply and transport of timber. Nevertheless, the main challenge confronted in this discipline is the dating of samples. This results from the forest environment in which the timber was extracted. It is thus essential that this type of research be included in a framework of multidisciplinary research to determine the various phases of construction of a given site.

The dendrochronological analyses already concluded, or yet to be carried out, will allow comprehension of the typology of roof frames using systematic drawings of the structures studied. The Laboratory of Dendrochronology of the University of Liège will be able to gradually establish the chronology of regional architectural evolution using the dates obtained in the context of heritage studies.
From the Iron Age to the Roman Period: dendrochronology, archaeology and history

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In its first part, this talk will discuss the contribution of dendrochronology to the chronology of the Iron Age in temperate Europe, the heated debates it has provoked for over thirty years (and continues to feed), and recall briefly the fundamental changes it has made to our understanding of the development of the Iron Age, in conjunction with and sometimes in opposition to, the traditional methods of cross-dating and the use of dates supplied by historical data.

The second part will develop some of the main points by focusing on a series of recent examples taken mostly from Germany to Austria as far as the Early Iron Age is concerned (from Wehringen to Dürrnberg by way of Heuneburg), some of which are still open to discussion. For the Late Iron Age, through examples drawn from the Swiss Plateau, we shall illustrate the dialectical confrontation between the dates yielded by dendrochronology and those given by archaeology and history (e.g., palisades and rampart from Yverdon, rampart from Mont Vully, bridges in the Trois-Lacs region, notably from the La Tène site).

The contribution of dendrochronology to the chronology of sites and monuments from the Roman period, their conformity (or lack thereof) with historical dates will be dealt with through examples drawn from Gallo-Roman Helvetia (especially Aventicum-Avenches, mausoleums, wall, mills). We shall argue that if there is a problem with the correlation between dendro- and archaeological dates, the solution must be found in archaeo-historical interpretation despite the strong models elaborated over the past 150 years.
Dendrochronology, archaeology and science

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The word “science” is fairly ambiguous when used to express activities related to the social or human sciences. Ambiguity comes from the fact that the word embraces two domains, for which methodologies are not only very different, but the reliability of hypotheses and results is not based on the same background or paradigm. Social sciences generally use largely deductive networks in which density is one of the decisive elements of the validity of an assertion. By contrast, the “hard” sciences proceed by networks for which density is not in question; what is crucial is the capability for duplication of each node of the network, the reproduction of each step in reasoning, with respect to formal knowledge. In the humanities, the research approach activates the entire range of knowledge of the researcher, even when s/he is specialised in a given field. In science, the challenge is to gather the minimal number of elements clearly integrated into a system, the significance of which converges toward the result. The clarity of the process makes it appear as if the topic being studied is finite. But the “system” of an historian is, in many ways, infinite, the hidden reality taking place in the reasoning. As a result of this situation, there are two worlds which cannot be unerringly joined. Of course, these difficulties are clearly visible to most of us. The necessity for increasingly exchanging different viewpoints has resulted in the creation of a new discipline of specialists who work at the interface between humanities and science. This third kind of researchers and experts is the oil in the engine.

Dendrochronologists for archaeology and history fall within this third class of scientists. They come either from science or archaeological labs. They have a broad range of capabilities within their respective backgrounds. On one hand, they need to understand the research questions posed by archaeologists or architects, particularly the nuances of the questions and, on the other hand, they need to provide answers with scientific, quantitative arguments. This is not a cosy situation. Why? Because, in carrying out their scientific activities, they always encounter small difficulties and traps which destroy, brick by brick, some of the mathematical reasoning. Ultimately, dendrochronologists have to communicate or transmit a result which is not mathematically perfect. Fortunately, the validity of most dendrochronological results is verified by rigorous computations. More specifically, many different woods yield good results, while others are more difficult to analyse (e.g., dugouts, paintings, statues).

But obtaining the best results is not the main question. Well-correlated results belong to the domain of deep (acquired) knowledge. If need be, experts could develop a kind of software which lends itself directly to such solutions, but this would no longer be science because the scientific question is resolved. This would be only technique, fairly complicated, but technique nonetheless. It is another kettle of fish with results that seem obvious, but which cannot be proved by computations. This is often the case with small samples of woods. Dendrochronologists who work with climate – with scientists comparable to themselves – reduce this problem by rejecting poor samples. This, however, is not the habit in our field: we do not like to put away a potentially interesting sample, even if it is isolated, particularly if it is part of a work of art. A sample taken from archaeology, old buildings or painting panels, for example, has a potential which is not exchangeable. Of course, such materials are the source of difficulties, but it is just such difficulties encountered during the dating process that have led the scientist to explore further and advance in understanding and controlling variability in this process.

From such variability, the dendrochronologist can provide abundant information about past climates, past environments and human activities. S/he can: identify the region from which the trees originally came, explain something about the nature of this region, the landscape, suggest whether humans were or were not in an area at a specific time, follow the path of wood as it moves through several workshops, evaluate the health of a local economy at precise periods, participate in discussions of trade routes, etc.

Such explorations require close work between historians, art experts, dendrochronologists and logicians (not necessarily mathematicians). It is real interdisciplinary research that integrates a wide range of abilities. The role of non-mathematical reasoning may be dominant in such a strategy. This fact is not a flaw, but rather the necessary starting point to create, develop and perfect a new intellectual model. Each model, however, has a cost: it costs time! And, strangely, the circles concerned by dendrochronological research, fascinated by the DATES that flash into the brain, largely misunderstand this side of the research, which is a promise for tomorrow.
Building intensity and timber management in 994-995 AD at Pineuilh, La Mothe (Gironde, France)

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Pineuilh, La Mothe (Gironde, France) is one of the rare archaeological sites in France where a complete monitoring of its timbers was carried out from excavation to laboratory by the same specialist. This involvement in the different stages of the strategy, from sampling to tree ring analyses, allowed us to optimize the data contained in timbers, considered here as well as ecofact and artefact, in a global dendroarchaeological approach.

Considering the specific status of this site through

i. its establishment on an artificial islet the exact middle of the riverbed,

ii. the abundance and quality of archaeological relics (decorated military and horse riding equipments, ivory chess piece, wooden painted crockery, etc.),

iii. the presence of large wild mammals eaten,

Pineuilh clearly shows a symbolic, or even ostentatious character. These characteristics seem to indicate well-established elite headquarters, able to use the technical skills of the best building tradesmen and craftsmen. The dendro-dates show a continuous occupation of the site since 977 AD to the second half of the 12th century AD at the earliest. Due to the selection of many samples including cambium, it was possible to determine with an extreme precision the felling phases to follow the rhythm of building. The year 977 AD marks the start of the settlement with the development of a surrounding ditch; between 981 AD and 983 AD, a central main building is erected; finally, in 994-995 AD, a wooden footbridge and a landing stage are linked with it. This first period corresponds therefore to a circular area enclosed by a bank and ditch.

For the next period, which starts in 1043 AD - 1044 AD, the islet-platform is filled in after an important campaign of works, and creation on the top of a motte of a new central building which has left no trace, is served from now on by a new wooden bridge. The abundance of dendroarchaeological data for the entire occupation cannot all be presented in a concise presentation as part of this symposium. The period of 994 AD - 995 AD was thus chosen, since it represents a large part of the techniques developed for this case study:

1. Dating, for which dendrotypological archaeological arguments were developed to go beyond classical interpretations usually formulated on the basis of the last rings.

2. Types of applied sawing of very short-term allow us to refine this dating even more, to such an extent that they could be used as criteria for typo-chronological dating.

3. Types of wood conversion, characteristic of short periods, can be used to refine the dating process as a typo-chronological criterion.

4. The re-use of timbers within new structures also allows us to clarify in an original way the question of wooden stocks for the construction sites, and indirectly woodland management.
Working with dendrochronology: the interaction of the evidence

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This paper explores the relationships between stylistic dating, archaeological dating (from fabric analysis), dating from documentary evidence and the tree ring dating of buildings. A series of case studies will explore the issues raised by the process of combining the evidence from these diverse sources in an English context. The emphasis will be on the relationship between the dendrochronologist and the building historian. The combination of evidence from these diverse sources leads to a fruitful and enhanced understanding of both the tree ring evidence and the buildings.

In simple cases, the evidence from the different sources is consistent and reinforces the dating. However, the case studies will show how archaeological dating needs sometimes to be reconsidered following ‘incorrect’ tree ring dates. It will also explore how false dating can arise from documentary sources which have been taken too simplistically. In other cases a tree ring date which appears to show the building as of one date and a secondary phase can be demonstrated from the evidence of the fabric which is undetectable from the tree rings.

The case studies include: a 12th century AD church bell tower at Yarpole, Herefordshire; the 15th century AD great hall of the bishop’s palace of Hartlebury Castle, Worcestershire; the 16th century AD tower at Pendennis Castle, Cornwall; a 17th century AD merchants house in Maverdine Lane, Gloucester; a medieval barn in Herefordshire and the market hall at Ledbury in Herefordshire.
How to make the Forest of Carnutes speak. Dendrochronology as a source for the history of the Roman Empire: methodological considerations on a research project

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We re-examine here, from the point of view of historical methodology, a collaborative research project that yielded evidence of intermittent climatic fluctuations, and their agrarian and social effects in the history of the Roman Empire during the Republican Period at the end of the High Roman Empire. While dendrochronology has long been familiar to historians as a dating method, the possibilities that it offers as a source for environmental history has received less attention. With the growth in the amount of data available and published, this situation is, however, likely to change. We attempt here to describe dendrochronological climatic data as an historical source as such, clarify the uses to which an historian can put these data and conditions for their interpretation within an approach that leads from a dendrochronological signal to the interpretation of relationships between society and climate.

Duration, space, climate: contribution of dendrochronological data
Sources for ancient history are very often known for being lacunar, fragmentary, heterogeneous and sometimes uncertain. Dendrochronology, by contrast, offers a source of data that forms a coherent uniform series that is very precisely dated; its relevance is thus significant. The serial nature of the data offers several possibilities. The annual resolution of the data and their multi-secular extension can be applied to analyses at different temporal scales: description of climatic variation and long-term society-climate relationships, more in-depth analysis of an isolated crisis. Comparison can also be made between antiquity and more recent, better documented periods, sometimes comparisons within a given period to restructure understanding of ancient realities. The development of palaeoclimatic maps using dendrochronological data has been shown to be rich in information, especially when compared with literary sources. The regional component is crucial for a world characterised by a high degree of spatial diversity, as was the Roman Empire. The addition of the climatic component to the history of the Roman Empire cannot be done without taking into account the regional diversity of its components, as much at a climatic level as at the level of human societies. Among the different proxies available or possible, these characteristics explain the value of dendrochronological data for the reconstruction of past climatic conditions.

Historical interpretation: writing the climatic history of the Roman Empire
Like any other historical document, the information obtained from dendrochronological series must be critically examined both internally and externally. Internal critical reviews can be done only in strict collaboration with the dendrochronologists who can identify the limits of the series (features distinct to each species, geographic extension of the data, number of samples used, etc.) and the conclusions that can be drawn. External critical reviews consist in examining the dendrochronological data within their historical context. This includes comparing them with other available proxies to potentially refine the palaeoclimatic analysis and comparing them with historical and archaeological sources to clarify the link between climate and society. We will present some of the key elements of this comparison: modalities in the perceptions of climate found only in literary sources, identification of the vulnerabilities of agrarian societies and factors increasing such vulnerability, social modalities for resolution of agrarian and wheat-distributing problems from material economy to “moral economy”. The components of dendrochronological climatic data themselves also raise the question of the relationship of societies to their environments, particularly in forests and woods: we can in this way pose the question of the dwindling number of trees available with respect to the High Roman Empire.

Dendrochronological series are thus an invitation to deepen and renew studies of interactions between societies and environments and to address the complexity of the relationship of ancient societies to the climate by engaging in a real disciplinary dialogue.
Dendrochronology: new “documents” for the historian of medieval economy?

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As we all know, the results accumulating in science and technology are enlarging, often dizzyingly rapidly, the documentary field and questionnaire of the historian, which still give meaning to texts, when they are not compensating for the lack of documents or lacunae in them. We are forced, however, to note that the “new documents” they contribute, closed as they are in the “diabolical logic of allotment”, are still too often separated from the economic and social contexts and realities, just as much as the concepts supposed to assist in understanding of the mechanisms. The “archæological wood”, like dendrochronological analysis, is, alas, still quite far from taking the place it deserves among the sources used by the historian of economy and society. Yet, in the absence of documentary evidence, dendrochronology could provide precise evidence with the condition, however, that it is integrated into research questions broader than simple dating – indispensable as that is – of a given building or object. The economic and social history during the Middle Ages is thus a petitioner at several levels: new termini a quo for imports and/or exports of wood; refinement of the commercial cartography outrageously giving priority to grand international commerce; better perception of the “local” spread of the products of such international commerce; bringing to light of the importance of local production, trade and commerce; confirmation of the co-existence, competition or complementarity, at least in very important workplaces, of quite different commercial universes; revealing of the state of the forests and the intensity of deforestation, capable of clarifying possible changes in procurement zones.
Dendroarchæology of the first millennium AD: exploring the transition from Antiquity to the Middle Ages in Western and Central Europe (4th and 5th centuries AD)

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The transition from the Roman to the Early Medieval period in Europe was influenced by radical social and political changes. We would argue that those changes also had an impact on timber supply and woodland management, which provided the most important raw material before industrialization. Changes in woodland management can be detected through dendrochronological analysis of archaeological wood.

In the course of Roman occupation north of the Alps, the exploitation of woodland grew considerably in the 1st century AD. Both Roman military and civilian activities caused an increasing demand for wood. The process of the disintegration of the Roman Empire started in the 4th and culminated in the 5th century AD. This time of transition is considered to be a period of economic and political instability, and there are indeed almost no archaeological finds of timber to be dated to the 5th century AD. Over two hundred years, a decrease in population resulted in a dropping demand for timber, which led to a regeneration of woodland on the floodplains of the greater streams and rivers. It was not until the formation of Merovingian and Carolingian powers that the clearing of woodlands and the demand for wood as an important resource again increased.

In view of the technical relevance of wood in the pre-industrial period it can be argued that the exploitation of the woodlands was closely linked to economic development in general, in terms of quantity and quality. Our approach aims to highlight the complex interaction between the natural development and the anthropogenic management of woodland, within the context of socio-economic and environmental as well as climatic change. The relation between man and environment shall be explored from the following individual aspects: use of woodland and wood, change of woodland and timber crafts as well as traditions and innovations in wood technology.

In recent years, more than 3,000 wooden artefacts from archaeological contexts in Bavaria and Eastern France were analysed dendrochronologically. The timber was mostly oak, fir and beech, recovered from buildings, strongholds, water supplies and other infrastructures that were investigated archaeologically. Oak chronologies providing good replication could be built up for the river systems of the Danube, Lech, Isar and Inn in Bavaria, as well as for the Moselle, Meuse, Seine and Marne in France. In addition, the chronologies for fir and beech could be strengthened.

Dendrochronological parameters yielded insight into the structure of the stands exploited and furthermore into special forms of woodland management and woodland change. Certain periods of timber shortage have already emerged, in connection with the use of degenerate woodland and poor timber (e.g. beech), in terms of quality. Periods of woodland regeneration on the floodplains could be detected, as well as climatic extremes and periods of climatic changes.
A brief review of the development, limitations, and contribution of dendrochronology within art-historical and associated studies in the UK

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Chronology provides a fundamental structure for understanding the past. Scientific dating, of which dendrochronology is just one (albeit the most precise) of the available techniques, provides an increasingly refined chronological framework for the historic environment and hence our cultural heritage. Artefacts and decorative features within buildings often provide the dendrochronologist with a more challenging set of practical issues but, despite these difficulties, the increasingly routine provision of dating evidence is enhancing understanding and appreciation of significance, as well as opening up further questions and avenues of research.

Development of suitable methodological approaches and the application of the technique to an increasingly wider variety of artefacts and decorative features within structures has stimulated interest and encouraged research. Ongoing research looking at the potential of combining dendrochronological analysis with other scientific dating techniques and the possibilities offered by the use of Bayesian approaches to analysis can only enhance the potential and open up new areas of investigation such as the analysis of previously unsuitable material such as non-oak wood species.

The application of the technique to highly decorative objects does however clearly have inherent limitations including both analytical issues associated with the dating of single timbers and the associated interpretative issues.

The contribution of dendrochronological analysis to enhancing our understanding of this aspect of cultural heritage is explored both in general terms and using a series of examples which serve to illustrate aspects such as attribution, the use of native and imported timber, national variation using England and Scotland as examples, and the exponential increase in the value of the analyses as the number of objects dated increases.
Art, artefacts and dendrochronology: the story from England

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This paper explores the evidence from dendrochronological analysis for changes in the source of oak wood incorporated in medieval and post-medieval English artefacts. These changes are linked to differences in the qualitative nature of timber from native and foreign woodlands, different woodland management traditions, and technical changes in the methods of converting whole trees into useful timber. These complex changes influence the design and construction of artefacts at different periods, some of which are limited, particularly in scope and size, by the raw materials available. These limitations probably encouraged the development of different support techniques for artworks that are less limiting in form, such as canvas.

Evidence from archaeological, documentary and landscape historical sources will illustrate three key aspects of change. First, the different woodland management techniques in use across Europe at different periods. Second, the range of techniques utilised to convert trees into usable timber, particularly boards, from hand riven boards and hand sawing to the development of early mechanical techniques. This will also illustrate the different physical characteristics that these conversion methods leave on historic objects. Finally, the qualitative differences in the timbers that are produced by a combination of different growing conditions and conversion methods will also be illustrated. This is particularly relevant where these influence the viability of the oaks used in historic artefacts for successful dendrochronological analysis, thus potentially leading to biases in the nature of the dendrochronological evidence.

Case studies are used in this talk from a range of English oak sculptures, furniture, panelled walls and ceilings, altar pieces, staircases and trade objects such as barrels and boats from 12-19th century AD to illustrate several trends in the exploitation of native trees and the extensive intra-European trade in oak boards to produce all elements of historic material culture through-out the medieval and post-medieval periods in England. The same trends are shown to be present in English panel paintings of 15-18th century AD.
Dendrochronology applied to the Belgian pianoforte

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Although dendrochronology has long been applied to the dating of musical instruments, studies of coherent groups are rather recent. The keyboards are of particular interest, but among these the pianoforte only aroused interest by specialists in the past few years. The Belgian pianoforte being less well-known than the French, German and Austrian instruments, it is no wonder that no dendrochronological analysis of them had, until now, been carried out.

This study, conducted between 2002 and 2005, concentrated on 35 Belgian pianofortes. The organological (P. Vandervellen, Musée des Instruments de Musique) and dendrochronological (D. Houbrechts, Centre Européen d’Archéométrie de l’Université de Liège – ULg) analyses were conducted simultaneously. In addition to dating the soundboards, the dendrochronological study also collected dendrological data (species, stand types, growth directions, anomalies, origin of the wood) and information related to the technological history (direction, size and number of boards). Measurements were made from digital photographs (*Dendron* software, G.-N. Lambert, Université de Franche-Comté – CNRS, UMR6249). Because of the quality required, the photographs were taken with a camera attached to a motorized stand developed and built by the Institut de Physique Nucléaire Atomique et de Spectroscopic (ULg). Some species identifications were made using an electron microscope (P. Gerrienne, Service de paléo-botanique, ULg).

The results surpassed our expectations by far. First, the dates allowed authentication of most of the instruments analyzed and aided in understanding changes in manufacture. They also confirmed the homogeneity of the soundboards and allowed identification of a few soundboards which were posterior to the construction of the instrument.

Dendrochronological data also contributed decisive information about the species used (mainly spruce, but also some white pine), wood selection (slow and similar growth rhythm for all of the boards), the age of the trees (more than 150 years), the direction of the boards in accordance with the growth (progressive generalizing of the system in opposite directions), the quality of the boards (absence of flaws such as hitches and growth disturbances), and the wood origin (mainly from high altitudes, with best results from chronologies for the Bavarian Pre-Alps). Interesting data were also collected about the direction of the boards in relation to the keyboard (first parallel, then oblique) and their size (gradual lengthening). One particularly interesting fact is that the developments brought to light by the study accurately correspond to developments in manufacture.
The parallel development of systematic preventative archæology and dendrochronology

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In general, the potential of dendrochronology in a particular region depends on the wetlands in that region, and to the research excavations done in these wetlands. This situation was effective until the 1980s. However, with the development of systematic preventative archæology, it is becoming increasingly clear that the “wetland” factor has a rather secondary role in the contemporary development of dendrochronology.

We will show this by the situation in Lorraine and Champagne, two presumably “dry” regions where dendrology developed quickly the past two decades. Two special factors play a fundamental role in this development. Systematic trial trenching, in all types of landscape, prior to building and quarrying, has revealed hundreds of sites of very different types and contexts. In presumably “dry” landscapes, wet places are not an exception in these trial trenches.

The second factor is more technical and consists in the mechanisation of part of the excavation work. Experiences accumulated in preventative archæology show that mechanical control of all traces regularly reveals (deep) posts, pits, wells, springs, etc., all features which were not previously or incompletely detected and, in many cases, could not have been excavated manually. These structures have yielded most of the organic material on these sites.

These two factors resulted in another, extremely important, effect. These isolated wet places date to very different phases, in contrast with “traditional” wetland sites where occupation phases are often the same across all of Europe (typical examples are the phases around 3000 and 1000 BC).

The development of dendrochronological references has been particularly important for the later Iron Age and for the early medieval period which constitute some of the most surprising examples.

For the later Iron Age, several dozen new sites with good conservation were detected by trial trenching. These settlements contain buildings, wells, etc., which enabled the construction of a dendrochronological reference for this period. In addition, more advanced studies in architecture, forest exploitation, climate are in progress.

The same can be said for the Early Middle Ages. Moreover, the historical model of post-Roman history can be questioned by the numerous dendro-dates which seem to support the discontinuity model.
“Oil on panel”: the cradle of European easel painting

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In art museums we often find on the wall next to paintings a small label indicating the name of the artist, the title of the work and a discreet “oil on panel”. This short sentence, also recurrent in publications on paintings, is a disguise for a wealth of information of immense cultural importance. Looking beyond the image, to the reverse of a painting executed on panel may reveal subtle and complex narratives about the making of the work, apart from the inscriptions and labels of interest to the history or provenance of the art work. The wood often bears witness to the level of craftsmanship held by its maker and may also indicate a complex history of conservation over many centuries. Enquiries about the nature of paintings will continue to be posed in connection with new attempts of interpretation, and much too often essential clues have been made incomprehensible or even removed or destroyed during treatments because their meaning and relevance went unrecognised. Examples of this are the many 16th and 17th century AD panel paintings which in the 19th and 20th century AD were dramatically thinned from the reverse and cradled. Apart from rendering the panels even more vulnerable to environmental impact, our predecessors often in the process removed significant information about the production and the makers of these boards. Results of research into the panel makers and their practice as well as the impact of guild regulations on branding and marking, for instance with individual house marks, is just one example of how important this information may be for understanding the creation of a panel painting. Likewise, conservation documentation combined with dendrochronological research and archival studies of manuscripts and guild regulations has provided a greater understanding of the making of panel paintings. A case in point is a devotional triptych from the St. Ansgar Church in Copenhagen which was thought to be an 18th century AD copy until a dendrochronological study placed this hitherto unknown work to just after 1530 AD. Another example underlining the importance of dating panels by measurements of the annual rings are a small series of four seemingly identical Boschian replications now kept in several European collections. Ongoing interdisciplinary research is attempting to place the paintings in chronological order to determine which one is the earliest version of the composition later replicated on the other panels. And apart from dating the wood, the material itself tells us about forestry and trade in timber in the past, in addition to being evidence of summers and winters of our ancestors – who in their leisure time were enjoying the fruits of their own generation of artists having executed breathtaking images in “oil on panel”.

See figure on next page
Figure

Verso of Anonymous Antwerp master around 1530, Pietà, oil on panel, 130 x 80 cm.
The idea of dendroprovenancing – determining the geographical origin of timbers based on tree-ring study – was born in the 1970s AD, stimulated by problems with the dendrochronological dating of Dutch and Flemish panel paintings. The term “dendroprovenancing” was proposed by Bonde, Tyers and Wazny during a presentation at the “International Conference on Tree Rings, Environment and Humanity: Relationships and Processes” in Tucson in 1994, and was published in Archaeological Science in 1995. Since that time dendroprovenancing has gradually become an important branch of dendrochronology. Growing numbers of local reference chronologies provide increasing possibilities to localize imported timbers in buildings and works of art, to reconstruct the history of shipwrecks, to study the intensity, range, and main directions of timber trade in the past. It has also become obvious that chronologies built for climate reconstruction need to be reworked because of the implementation of tree-ring series of non-local origins.

Chronology building and the study of archives are important tasks, especially in the Baltic and Scandinavian countries – the main sources of high quality timber delivered to Western Europe in the past. This task has become difficult because, for the 16th and 17th centuries AD, for instance, it is much easier to find Polish or Lithuanian oak in Western Europe than in Poland or Lithuania. Maps showing the position of all local Polish oak chronologies presented in half-century time windows from the 12th to 17th centuries AD will illustrate this problem.

The territory to the south of Poland has been of interest to very few scientists dealing with timber trade; however, the huge river systems of the Danube, Dniestr, and Dniepr provide excellent opportunities to deliver products from the central- and east European forests to the Black Sea and to the Mediterranean Basin. The conventional track of following historical documents that have been cited hundreds of times, for example about cedar wood exported from Lebanon to ancient Egypt, will not bring us very far. Dendroprovenancing has proven to be an excellent tool for verifying documents concerning the historical timber trade in Northern Europe. The first steps of dendroprovenancing in areas south of Poland, illustrated by selected examples, allow us to envision a historical “circulation of timber” around Europe, and this vision should open the door to the many possibilities of this relatively new branch of dendrochronology.
New dendrochronological and historical evidence of long-distance floating of timbers to Riga

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With the continual increase in the number of absolute tree-ring chronologies constructed, in recent years in Latvia it has become possible to distinguish with increasing confidence historical timber of local origin from timber floated to Riga from a great distance down the River Daugava and the rivers close to the Daugava basin. In order to distinguish between timber floated from far inland and timber of local origin, we can look at differences in terms of tree-ring parameters and at the differences in similarity statistics between series of ring-width indices, and also consider the traces of special methods of working the timber and marks on the timber that are sometimes identifiable, as well as information from written historical sources.

Examination of the timber used in historical structures in Riga has shown that the trees selected in areas far inland and floated downriver (mainly Scots pine) in many cases had reached a considerable age and girth. Sometimes the large size of the timber serves as an indication that it could have been floated for some distance to its place of use or port of export. As is known, waterways were formerly the main routes for timber transport, and so floating was the easiest way of supplying large diameter timbers, in particular, to towns on the banks of major rivers. Close to the towns, better quality forest along the major rivers was gradually felled, and in consequence the timber source area shifted further and further from the location of use. Because of the more continental influence of climatic factors, these pines tend to exhibit greater similarity in the pattern of annual radial growth than do trees cut in the area of present-day Latvia and the immediate vicinity.

Indicative of the use of floated timbers in the historical wooden structures in the old centre of Riga are logs with specially cut recesses at one or both ends, provided for tying rafts, and such logs are found quite frequently in the course of archaeological excavation (see figure). Some variation in the forms of recesses has been observed, apparently relating to the use of either a rope or a pole, which was passed through the recess. There were regional and chronological traditions of tying raft logs, i.e. traditions that were more or less characteristic of region and period.

Direct or indirect indications of the source location of timber or the country to which it was exported can be obtained from written historical sources, but in Latvia this information has so far been utilised only partially. A major historical study on Riga’s trade in forest products does not give a direct answer to the question of the source of timber used in any particular structure. So far, there is useful written evidence that mast timbers supplied from the Dnieper basin (in the area of present-day Belarus) to Riga for export but rejected were used instead for building revetments along the Daugava waterfront. However, there has not been any international cooperation aimed at studying in detail the activities of particular timber traders or the role of ship-owners in historical timber export.

Structural timbers, barrel wood and other historical wood products sometimes have marks cut – and perhaps also painted – by the craftsmen. Usually, the timber was marked by craftsmen at the place where the timber was used. Even so, these marks are useful as a source of information for checking the time of use of the timber and the building history of the site. Presumably, in earlier centuries too, at least a proportion of the exported timbers were marked before being transported. These marks, too, or preserved information about them, could play a role in establishing the source location of the timber.

The pine tree-ring chronologies constructed so far in Latvia permit an approximate distinction to be made as to whether the timber for a particular historical structure was supplied from the Baltic area or from the basin of the Dnieper, or whether it most probably came from somewhere approximately between these two areas. In the absence of absolute tree-ring chronologies for the particular source areas, it is currently not possible to identify more precisely the source of the timber by means of dendrochronology. Thus, the additional information obtainable from the above-mentioned historical sources is important for establishing the timber source area with greater precision.
Ends of timbers with recesses cut for the purpose of tying rafts, uncovered in the cultural layer of the Old Town of Riga.