AmS-Varia 49

TVERRFAGLIGE PERSPEKTIVER

En presentasjon av fire utvalgte hus fra Forsandmoen 2007. Klimarom: Klimaets avhengighet av skala og landskap. Historieformidling og historiebevissthet: Den utfordrende fortellingen om den fjerne fortiden. Evig eies kun det tapte – med alle sine hemmeligheter. Refleksjoner rundt en gjenstand av kleberstein funnet ved Håelva på Jæren. The identity of Vlfberht and how the swords with his signature were spread in Europe. Norwegian dendrochronology; almost a victim of the Black Death. Skjevtrekantene fra Fiskåvatnet – en preliminær presentasjon av mikrolittmaterialet fra en heller ved Fiskåvatnet, Karmøy kommune, Rogaland. Hammel – en jernalderplads i Østjylland. Tverrfaglig innfallsvinkel til verneprognoser og vernestrategi for maritime kulturminner knyttet til anløpsplasser og leder fra jernalder og middelalder. Økser, amuletter og overtro: En steinalderøks i jernaldergrav på Avaldsnes, Karmøy. Bebyggelse, landskap og lokalklima.

Marianne Nitter og Einar S. Pedersen (red.)

Universitetet i Stavanger
Arkeologisk museum

Norwegian dendrochronology; almost a victim of the Black Death

TERJE THUN

Thun, T. 2009: **Norwegian dendrochronology; almost a victim of the Black Death.** *AmS-Varia 49*, 37–42, Stavanger. ISSN 0332-6306, ISBN 978-82-7760-140-3, UDK 902.674:948.1.03.

Scarcely any building took place in Norway for some 60 years after the Black Death. Hence, little material is available to construct tree-ring chronologies that overlap with the 14th century and many years of sampling were needed to bridge this gap. Archaeological excavations at the Archbishop's Palace in Trondheim and logs stored from the demolished Fløan Chapel provided the material required for a chronology in central Norway. In west Norway, samples from an unintentionally preserved church enabled the construction of the chronology for the period after the Black Death. Timber buildings from the 14th and 15th centuries still survive in southeast Norway, and these enabled the construction of an absolute chronology from this region. A number of radiocarbon dates have confirmed disputed dendrochronological dates.

Terje Thun, Museum of Natural History and Archaeology, Norwegian University of Science and Technology, NTNU, N-7491 TRONDHEIM, NORWAY. Telephone: (+47) 73 59 60 85. E-mail: terje.thun@vm.ntnu.no

Introduction

The Black Death in 1349-1350 reduced the population in many countries, and Norway with its shipping and international trade, was seriously hit (Sandnes 1971, 1977). One result of the plague was that scarcely any buildings were erected for many years (Thun 2002). This caused a serious problem more than 600 years later when Norwegian tree-ring chronologies for Scots pine (*Pinus sylvestris* L.) were being constructed.

A great deal of building took place before the Black Death, including stave churches (Christie 1981) and many other timber buildings (Berg 1998, Thun 1998). In addition to standing buildings, many timber constructions are also archived in the ground, especially in towns and cities. Several major medieval excavations from the late-1950s through to the 1990s unearthed large numbers of constructions built of Scots pine in the cities of Trondheim (Christophersen & Nordeide 1994), Bergen (Herteig 1990) and Oslo (Schia 1981, 1987), see fig. 1.

All this ancient timber enabled the construction of long, relative tree-ring chronologies based on comparisons of the tree-ring pattern revealed in the many unearthed logs. However, to achieve dendrochronological calendar dating of this material, regional tree-ring chronologies had to be constructed from the present day far enough back in time to overlap it. Thun (2002, 2005) described in detail the material used to construct Norwegian dendrochronologies. As no building timber has been found for a period of almost 60 years after the Black Death, the task of constructing long chronologies was more troublesome than expected, and it proved almost impossible for some parts of Norway.

Dendrochronology and the construction of tree-ring chronologies

The principle of dendrochronology should be well known. The method is used to acquire a precise date of the felling of building timber by matching the tree-ring pattern with tree-ring series of known age, referred to as an absolute chronology. All tree-ring sequences that can be matched with an absolute chronology are thereby calendar dated. The aim of dendrochronological work is to extend an absolute chronology as far back in time as possible and thereby enable the dating of timber from old houses and other constructions to the very year it was felled.

The tree-ring pattern in the various logs found in an archaeological excavation can be matched mutually, and a long chronology can be constructed. If the chronology based on such ancient timber is older than any absolute chronologies from the same region, it cannot be dated to specific years and is therefore called a floating or relative chronology.

The task of constructing long tree-ring chronologies on Scots pine started in Norway in the early 1980s to

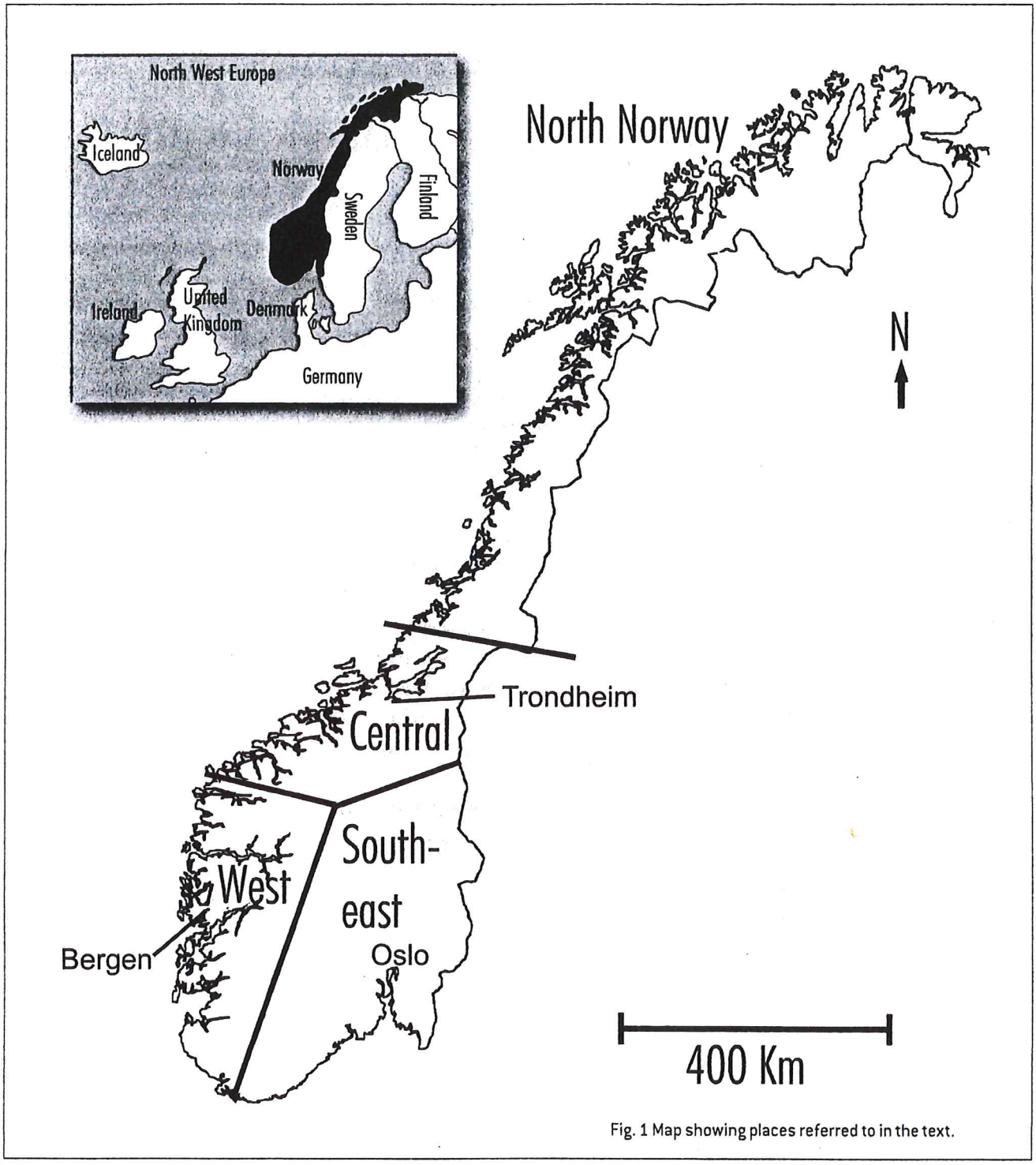

Fig. 1 Map showing places referred to in the text.

enable the absolute dendrochronological dating of archaeological material, but the effect of the Black Death caused a great deal of extra effort. Several fortuitous events solved this problem.

Central Norway

Samples were collected from approximately 1,000 logs unearthed in archaeological excavations in Trondheim, and a 442-year-long relative chronology was constructed. Because few medieval timber buildings remain in Trøndelag, it seemed likely to be almost impossible to extend this chronology using only timber from standing buildings.

However, samples were collected from the oldest known buildings in the interior of Trøndelag. At altitudes above 500 m, where trees used as building material had grown slowly, there would be hope of finding timber with many tree-rings. Samples were cored from

several old timber houses in Soknedal, approximately 50 km south of Trondheim (fig. 1). The houses were all dated to the 17th or late-16th centuries and an absolute chronology was constructed back to 1312, but there was no overlap with the 442-year-long floating chronology.

A tragic fire destroyed several buildings in the Archbishop's Palace (Erkebispegården) near Nidaros Cathedral in Trondheim in the summer of 1983. Excavations began on the site a few years later, and in the final phase, in 1994, many 15th-century timber constructions were unearthed. The tree-rings in this material, designated here as AI, matched the absolute chronology and were dated from 1498 back to 1284, thus also extending the absolute chronology back to that year.

As there was a general halt in building after the Black Death, I correctly assumed that the next layer containing logs would be from before 1350. A 236-year-long chronology, here called AII, was constructed from six large pine logs and it matched the floating chronology (fig. 2), but not the absolute chronology which AI had extended back to 1284.

After the curves from the Archbishop's Palace were constructed, I remembered a floating chronology obtained earlier from some logs presumed to originate from Fløan Chapel, which used to stand close to Steinvikholm Fortress in Trondheimsfjord, approximately 25km east of Trondheim, (fig. 1). It was demolished sometime in the 19th century, but some timber was kept (Christie 1981:177). In the 20th century, some of these logs were taken to Sverresborg Folk Museum in Trondheim with a view to eventually rebuilding the chapel there. They were brought to my attention early in the 1980s and several samples were collected from 10 of the logs. The medieval woodworkers had removed some of the outer wood, resulting in many missing tree-rings. However, a mean curve (floating chronology) of 192 years was constructed, but at the time, in the early 1980s, this did not match any absolute chronology.

It occurred to me that this floating chronology from Fløan could fill the gap between the chronologies, and this proved to be true. After AI had extended the absolute chronology back to 1284, it matched the Fløan chronology and dated that to the year 1377 for the out-

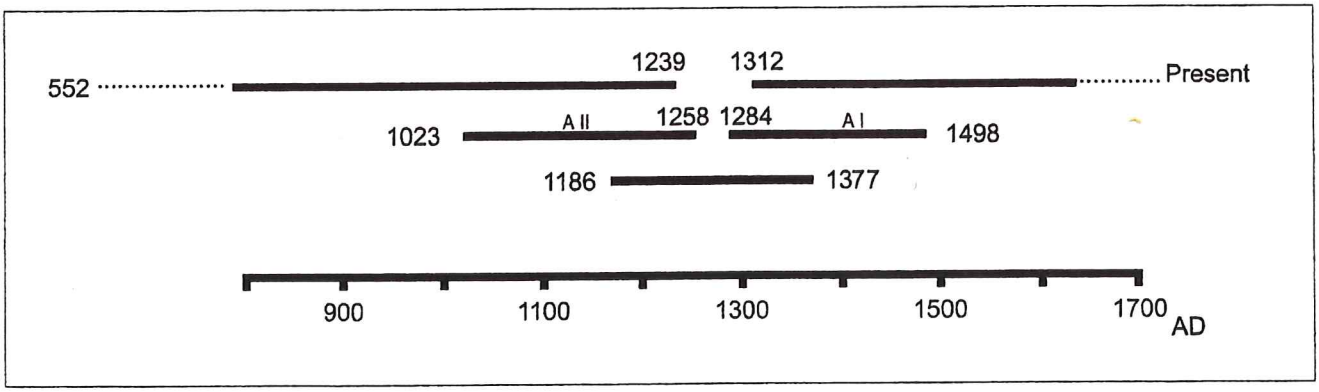

Fig. 2 The link between A I and A II is overlapped by the curve from Floan Chapel, showing that the gap in the chronology for central Norway is only 26 years.

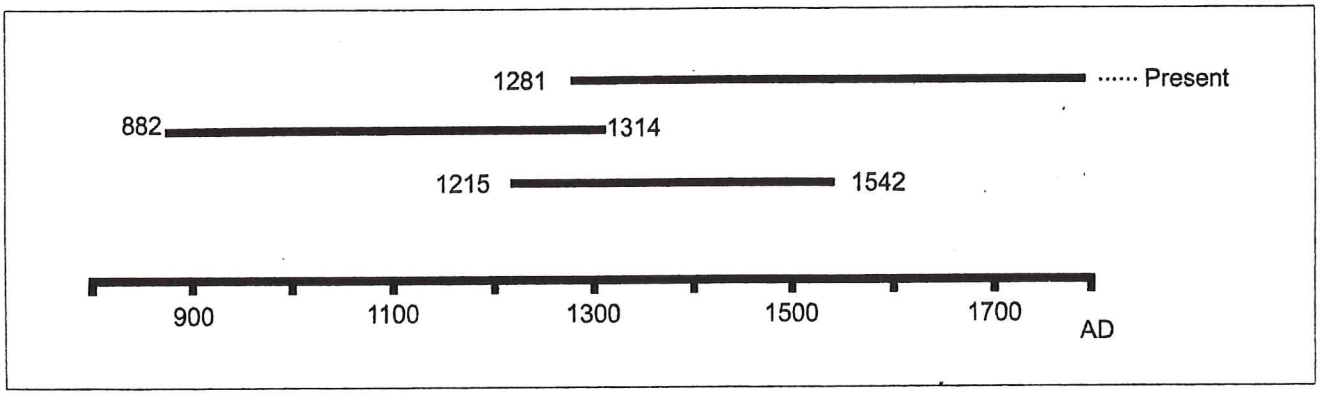

Fig. 3 Holdhus Church is the link between the absolute chronology and the floating chronology, also showing that a short overlap from 1281 to 1314 existed in the chronology for west Norway.

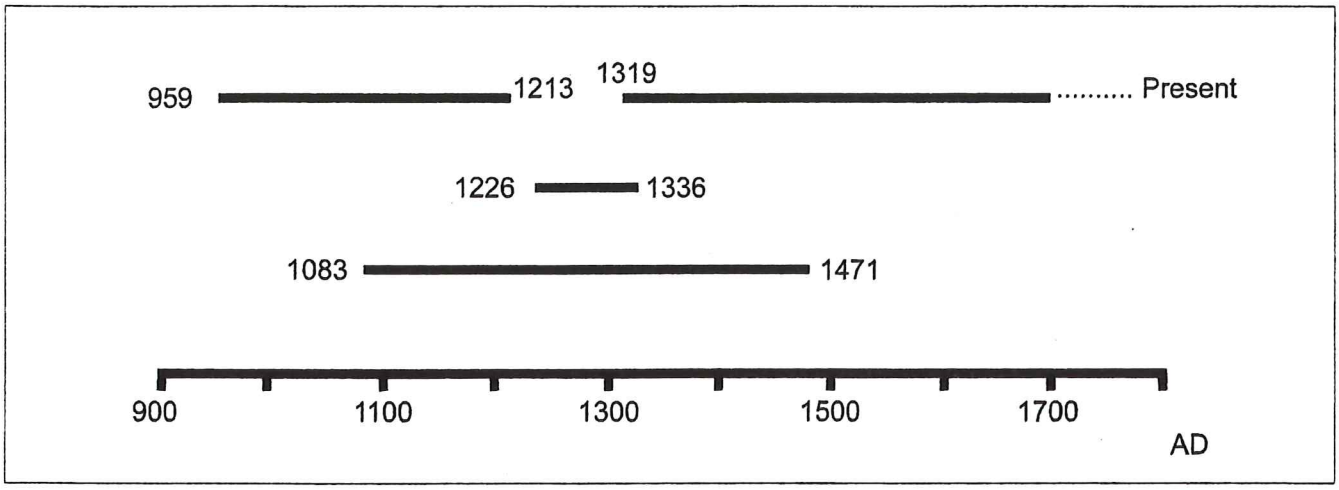

Fig. 4 The link (1083 – 1471) with 13th and 14th century houses in southeast Norway that overlaps the gap after the Black Death.

ermost tree-ring and back to 1186; the absolute chronology from central Norway thus reached back to 1186. This was sufficient to match with AII, also, and the assumption that it was from constructions made before the Black Death was thus confirmed as it was dated to 1258 and back to 1023. This extension enabled a dating of the floating chronology, based on ancient timbers, from 1239 back to 798, but later excavations have provided even older material and the chronology now reaches back to 552. See fig. 2.

Without the disastrous fire at the Archbishop's Palace in 1983, which provided material for chronologies AI and AII, and the storing of the logs from Fløan Chapel, the gap in the pine chronology from central Norway might have been impossible to bridge with building timber.

West Norway

In the early 1980s, material from the archaeological excavation at Bryggen in Bergen resulted in a 304-year-long floating chronology (Thun 1984), and after all the excavated material was processed the chronology was extended to 433 years (Thun & Hafsten 1990).

Samples from recent trees and building timber enabled the construction of an absolute chronology back to the year 1281. However, this was insufficient to find an overlapping position with the floating chronology from Bryggen. Either the Bryggen chronology was older than 1281 or the overlap between the chronologies was too short to match the tree-ring pattern. Several attempts were made to find material to fill the gap, but these were unsuccessful before the mid-1990s when samples were cored from Holdhus Church, approximately 25 km south east of Bergen (fig. 1). According to Hoff *et al.* (1997), this church has had a complex history. It was probably originally a stave church, and is first mentioned in a document from 1306. Various phases of rebuilding occurred up to the 17th century.

In 1880, the parish decided to build a larger church, and Holdhus Church was sold in 1889 to a local resident (Hans Holdhus) with the instruction to demolish it. However, instead he saved the church by selling it to the Society for the Preservation of Norwegian Ancient Monuments (Norwegian: Fortidsminneforeningen) to ensure its protection. Consequently, samples could be taken for dendrochronological dating with the hope of finding material to fill the gap in the chronology.

A 328-year-long mean curve was constructed from samples taken from various building phases inside Holdhus Church, and it matched the absolute chronology (fig. 3). The outermost tree-ring in the mean curve from Holdhus Church was thereby dated to 1542, and the curve reached back to 1215. This was also sufficient to date the 433-year floating chronology from Bryggen to the period from 1314 back to 882 (the original 304-year chronology was from 1302 to 999). This shows that an overlap of 33 years between the absolute and the floating chronologies actually existed before the material from Holdhus Church was added, but this overlap was too short to provide a dendrochronological match. See fig. 3.

The chronology for west Norway has since been extended back to 765 using material from medieval buildings, such as Urnes Stave Church (Thun 2002, 2005), but if Holdhus Church had not been saved by Hans Holdhus in 1889 it might not have been possible

to construct a chronology from this region with timber from man-made constructions.

Southeast Norway

Archaeological excavations undertaken in the medieval town of Oslo during the 1970s and early 1980s unearthed timber that enabled the construction of a 255-year-long floating tree-ring chronology (Thun & Schia 1987).

To enable dendrochronological dating of this floating chronology, samples were collected from old houses, mainly in the counties of Buskerud and Telemark, situated west of Oslo (fig. 1) where large numbers of medieval timber buildings remain standing (Berg 1990, 1991, 1993). Until recently, many rather isolated valleys in these counties kept up old traditions, and the continental climate also provides an environment with optimal conditions for preserving wooden houses. Old timber is therefore much more readily available in this part of Norway, and several houses were cored that permitted the construction of an absolute chronology back to 1319 already in the mid-1980s. For several years after that, new tree-ring sequences from building timber matched this chronology, or the 255-year floating one based on ancient timber from Oslo (Thun 2002, 2005). In the 1990s, however, samples from the ground floor of a storehouse from Søre Lande in Flesberg, Numedal, approximately 70 km west of Oslo, gave a 111-year-long tree-ring curve that failed to match either chronology. Perhaps this sequence fell into the gap between the two chronologies and a possible overlap was too short to provide matching?

In the mid-1990s, more systematic sampling started in southeast Norway to provide dendrochronological dating of houses expected to be old enough to be legally protected. (Pre-Reformation (1537) buildings were automatically protected in Norway at that time, but new legislation has since changed this to 1650.) This systematic sampling soon provided tree-ring curves from several 14th and 15th century houses (Thun 2002, 2005).

They gave a 389-year curve that filled the gap (fig. 4) and dated the tree-ring curve from Søre Lande to the period from 1336 back to 1226, showing that it had an overlap of 17 years with the original chronology reaching back to 1319. With all the new material, the floating chronology based on timber from the archaeological excavations in Oslo was dated to the period from 1213 back to 959. See fig. 4.

The systematic sampling from the mid-1990s therefore showed that southeast Norway had sufficient houses to construct a tree-ring chronology for this region.

Radiocarbon dating

Some samples used to construct the chronologies were also radiocarbon dated. For instance, several samples used in the floating chronology from west Norway were radiocarbon dated.

High-precision calibrated dates, together with correlation with increased building activity after late- and post-medieval fires, enabled the floating chronology in Bergen to be dated to the very year (Gulliksen & Thun 1990).

Another example is a cottage at Søre Gjellerud farm in Flesberg, approximately 80 km west of Oslo. The age of this house has been discussed for a long time. Some historians have supported the view that an inscription "Anno 1300" on the front of the house refers to the year it was built. Nicolaysen (1881-1891, Plate XV) was sceptical of this, but did not discount it. Hauglid (1956: 56-57) believed the cottage was medieval and could have been built in 1300, whereas Meyer (1932) suggested it was built around 1350. Stigum (1944, 1953), however, thought it was post-medieval and suggested a date around 1600 or a little earlier, which was supported by Berg (1998: 301-305).

The dendrochronological dating of the original timber in the house showed that the logs were felled in the winter of 1562-1563. As some historians were sceptical of this dating, a radiocarbon dating (T-12462) was performed on the samples from the original timber (Thun *et al.* 1998). This showed that the outermost tree-rings formed sometime between 1555 and 1575, a result in perfect accordance with the dendrochronological dating. Both methods thus clearly show that the inscription has nothing to do with the year the cottage was built, which shows that such an inscription need not refer to the year a house was built.

Conclusion

Painstaking efforts to find suitable dendrochronological dating material to bridge gaps in Norwegian tree-ring chronologies caused by an almost complete halt in building activity for some 60 years after the Black

Death were rewarded by a number of fortuitous events. These included excavations following a fire at the Archbishop's Palace in Trondheim, logs stored from a demolished chapel, the unintentional preservation of a medieval church and the fortunate survival of timber buildings from the 14th and 15th centuries in area that has both a favourable climate and sustained cultural traditions.

Acknowledgement

Per Harald Olsen, Senior Engineer at the Department of Biology, NTNU, helped to prepare the figures. Richard Binns, Trondheim, offered valuable comments and carefully corrected my English.

References

Berg, A. 1990: *Norske tømmerhus frå mellomalderen II.* Riksantikvaren & Norsk Folkemuseum, 303 pp.

Berg, A. 1991: *Norske tømmerhus frå mellomalderen III.* Riksantikvaren & Norsk Folkemuseum, 285 pp.

Berg, A. 1993: *Norske tømmerhus frå mellomalderen IV.* Riksantikvaren & Norsk Folkemuseum, 308 pp.

Berg, A. 1998: *Norske tømmerhus frå mellomalderen VI.* Riksantikvaren & Norsk Folkemuseum, 338 pp.

Christophersen, A. & Nordeide, S.W. 1994: Kaupangen ved Nidelva. *Riksantikvarens Skrifter 7,* 1-324.

Christie, H. 1981: Stavkirkene – Arkitektur. in Berg, K., Anker, P., Palme, P. & Tschudi-Madsen, S. (eds.): *Norges kunsthistorie I,* 139-252.

Christophersen, A. & Nordeide, S.W. 1994. Kaupangen ved Nidelva. *Riksantikvarens Skrifter 7,* 1-324.

Gulliksen, S. & Thun, T. 1990: Dating of a floating tree-ring chronology from Bryggen in Bergen. *The Bryggen Papers. Main Series 3,* 145-151.

Hauglid, R. 1965: Mer om hus, peis og billedvev. *Fortidsminneforeningens Årbok 1955,* 27-94.

Herteig, A. 1990: The buildings at Bryggen: their topographical and chronological development. *The Bryggen Papers. Main Series 3,* 1-134.

Hoff, A.M., Lidèn, H.E. & Storsletten, O. 1997: *Norges kirker. Hordaland 2.* Gyldendal, 1-187.

Meyer, J. 1932: Fortids kunst I Norges bygder. *Numedal B,* 1-64.

Nicolaysen, N. 1881-91: *Kunst og Haandverk fra Norges fortid.* Unpubl. plates.

Sandnes, J. 1971: *Ødetid og gjenreising.* Oslo, Universitetsforlaget, 385 pp.

Sandnes, J. 1977: Mannedauden og de overlevende. In Mykland, K. (ed.): *Norges Historie 4. Avfolkning og union 1319-1448,* 74-247.

Schia, E. 1981: Fra Christianias bygrunn. *Riksantikvarens Skrifter 4,* 1-292.

Schia, E. 1987: *De arkeologiske utgravninger i Gamlebyen, Oslo, 3,* 1-496.

Stigum, H. 1944: Laftet som grunnlag for datering av tømmerhus. *Norsk Folkemuseums Årbok 1945,* 71-100.

Stigum, H. 1953: Husene og tunet. Numedal. *Norske Bygder B.VI,* 149-205.

Thun, T. 1984: A floating tree-ring chronology from Bryggen in Bergen based upon dendrochronological studies of 42 pine logs. In Hagen, A, Helle, K & Herteig, A (eds.): *The Bryggen Papers. Supplementary series 1,* 96-100.

Thun, T. 1998: Dendrokronologi. In Berg. A. (ed.): *Norske tømmerhus frå mellomalderen VI.* Riksantikvaren og Norsk Folkemuseum, 253-260.

Thun, T. 2002: *Dendrochronological constructions of Norwegian conifer chronologies providing dating of historical material.* Dr. Philos. thesis. Norwegian University of Science and Technology.

Thun, T. 2005: Norwegian conifer chronologies constructed to date historical material, *Dendrochronologia 23,* 63-74.

Thun, T. & Hafsten, U. 1990: A medieval tree-ring chronology of 433 years, based on pinelog material excavated at Bryggen in Bergen. Appendix I in Herteig, A. (ed.): *The Bryggen Papers. Main Series 3, (1).*

Thun, T. & Schia, E. 1987: Dendrokronologisk analyse av jordfunnet materiale. In Schia, E. (ed.): *De arkeologiske utgravninger i Gamlebyen, Oslo 3.* Alvheim & Eide, 477-488.

Thun, T., Gulliksen, S. & Skjærvø, G. 1998: Er "Gammelstua" på Søre Gjellerud fra middelalderen? *Fortidsminneforeningens Årbok 1998,* 147-155.