

A Roman well in Alcester Dendrochronological study

by Torbjörn Axelson, 2011 version 3, September 2011 (new diagram added 14. Nov. 2011)

Background

I was searching among the QUB-samples¹ for Roman time samples, possibly contributing to the verification of the accepted anchoring of the Roman time dendrochronological complex in the medieval/present² when a samples labeled "ALCESTER" caught my attention. It dated convincing towards the South English references³. Starting from this sample I found that a collection could be built up. I become curious and asked for more information. Michael Baillie replied that they had been able to build two collections but not been able to date any of them certain enough at that time.⁴ Later David Brown at Queens University, Belfast and Caroline Rann at Warwickshire museum did supply me with a lot of valuable documents and meta data.

The QUB-collection contains 22 samples in the range Q1574 – Q1596 labeled "ALCESTER", originating from planks found in a Roman well in Alcester, "Lloyd's bank site" [52° 12' 48" N, 1° 52' 15" W](#).

The oak planks from the well were found when the well was excavated in 1975. They were sampled for dendrochronological analysis more than a year later and sent to QUB⁵ and measured same year.⁶ The samples were (re)investigated by David Brown 1990, but still not dated certainly enough to allow publishing.

Building a dated chronology

The starting point from which I prefer to build the chronology is Q1593. This sample is datable to AD 44 (youngest measured ring). There is a convincing T-value ($T > 7$) towards a mean of all available English Roman chronologies, and a great majority (13/16 with overlap > 50) gives best match at AD 44, six of them with $T > 5$. Also the curve graph is fully convincing.

Cybis CDendro, Algorithm: Proportion of last two years growth (2,0,T)
Correlations between available references in "English Roman" and Q1593 dated to 44 with $\text{corr} \geq 0.17$ and with overlap ≥ 96
Results sorted according to decreasing correlation coefficient values.

	Corr	T	Over	
		Test	lap	
all...	0.50	7.34	163	based on 16 members
MilesLane	0.42	5.87	163	61 MilesLane
Pudding	0.41	5.76	163	80 Pudding
Manoetter	0.39	5.11	152	33 Manoetter
ThamesTunnel	0.38	5.20	158	39 ThamesTunnel
SealHouse	0.38	4.41	116	171 SealHouse
Peninsular	0.37	5.11	163	44 Peninsular
Upwich	0.37	5.05	163	61 Upwich
NewFreshWharf	0.35	3.57	96	207 NewFreshWharf
Cannon	0.34	4.58	163	64 Cannon
WaltonLeDale	0.33	4.41	163	95
Ribchester	0.33	4.39	163	79
CarlisleQUB3	0.30	4.05	163	103
Carlisle4	0.29	3.91	163	94
Watling	0.26	3.28	153	57 Watling
Vindolanda	0.22	2.89	163	67
FriarStreet	0.17	2.12	161	44 FriarStreet

Analyzing the remaining Alcester-samples points for instance out a group consisting of Q1577, Q1592 and Q1595. (Q1577 and Q1592 are probably from same stem)

	Rest	Q1577	Q1592	Q1595
	Years	Corr T Test Olap	Corr T Test Olap	Corr T Test Olap
Rest		0.73 10.9 108	0.58 8.0 125	0.53 7.0 125
Q1577	109	0.73 10.9 108	0.68 9.5 108	0.60 7.7 108
Q1592	130	0.58 8.0 125	0.68 9.5 108	0.47 5.9 125
Q1595	172	0.53 7.0 125	0.60 7.7 108	0.47 5.9 125

The mean of those match towards Q1593 at AD 99 ($T=6.0$). There are some disagreement in the last about 15 years of overlap, but still they are visually convincing. So we can add this group to target collection containing Q1593.

Q1580 and Q1587 seems also being from one stem. A mean of them is next to be added at -30 (i.e. 31 BC; 73 BC for Q1587) with a beautiful correlation for most of the sample, although the last about 15 rings of Q1580 do not match at all – the sample was in bad condition. For chronology building, it should be truncated.

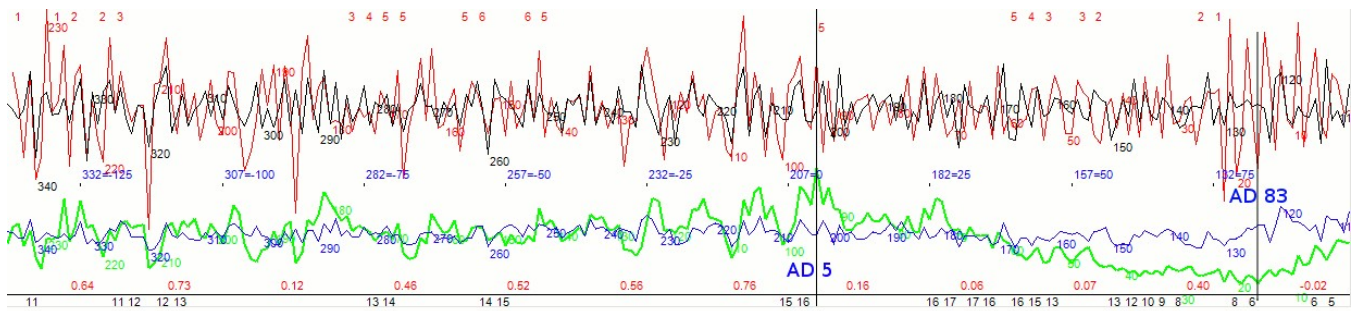
Q1578 dates (visually) at AD 74, but the later end does not match towards Q1595 after AD 55 where it is the only available sample. So at least one of the samples Q1578 or Q1595 may be problematic in their younger end. Also in the old end Q1578 is problematic: The 18 oldest rings before 57 BC seems not right. (According to the curve it looks like that the ring for 56 BC was measured as two, but it is just speculations as I can not remeasure the sample). When building chronology I prefer to truncate it at 55 BC, to avoid this problem. Except for those problems the sample fits very well in the collection.

Q1583 is very short (46 years only) and is not expected to be dated, although the match is extremely good both statistically and visually $\text{corr}=0.71$. The samples Q1589 and Q1584 seems to be from same stem, although it seems to be something wrong with those samples, and they were not included in the first version. (Later I understood that the ring for 114 BC was not measured in any of those two samples. This tree seems not have produced any visible late wood ring that year. 114 BC has a narrow ring in many English chronologies.)

Bad correlations during first century AD

We now have a chronology for the period 138 BC – AD 99. It gives $T=5.8$ towards a mean of the SouthEnglishRoman chronologies (mainly from London area about 150 km south east from Alcester). If the chronologies from NorthEnglishRoman (about 300 km north) are added, the value increase to $T=6.3$. (If also adding relevant chronologies from Northern Ireland⁷ we will see $T=7.0$). If also the corrected versions of Q1584 and Q1589 are added, we get $T=8$ towards all EnglishRoman (but that is not done in the version discussed in the rest of this paragraph, as it does not affect the AD period). If looking more closely we can see that there is a very good correlation towards both South and North English Roman chronologies until about AD 4 ($\text{corr}=0.49$ and $\text{corr}=0.45$ respectively). After that time, the correlation values decrease to about zero towards NorthEnglishRoman and to about 0.15 towards SouthEnglishRoman. At about AD 5 is also the maximum growth rate, and from that point it successively decrease until the minimum at AD 83. We may also note that the span AD 45 to AD 99 gives $\text{corr}=0.49$ towards "North Ireland bog". Except for shorter periods the correlation between Alcester_A and "North Ireland bog" is mainly negative. If we looks upon the individual samples the growth reduction do not come at exactly the same time for all of them. Only for Q1595 (AD99) it is dramatic. For the others more slightly.

One explanation, which seems maybe likely, are that the conditions for the site where those oaks grew became more humid during the first century AD. In the beginning the more humid conditions may have been positive for the growth rate, but when humidity continued to increase the environment become more unfavorable for the oaks, and the growth rate decreased and their climatological response changed. At the aerial photo of the area (Google maps), structures which looks like old meanders are visible. Maybe meandering could be *one possible* reason for the increased humidity at the site where (some of) those oaks grew. It is also possible that the "dendrochronological distance" to the other English areas are increasing according to more general climatological factors. We do not know. All this is just speculations. We can not know what really happened or why. We even do not know where those oaks actually grew, although probably not too far from Alcester as the wood pieces seems to be reused from different contexts but grown in the same area (see below).



Green=Alcester_A chronology, blue=mean of available English Roman chronologies. Black and red graphs shows the normalized (prop. last 2 years). Red numbers under the graphs, eg. 0.56, is the corr value for 20 years block. The upper red numbers are the total number of samples behind the average for the actual period.

Other chronologies

Two other chronologies are possible to build out of the QUB-Alcester samples. One, Alcester-B, covering 144 years consists of Q1574, Q1575, Q1576, Q1579, Q1581, Q1582, Q1585, Q1588 and Q1596. The other, Alcester-C, consists of Q1591 and Q1594 (same stem).

Archaeological interpretation

I received some texts, describing the excavation of the well. Together with photos taken during the excavation, we do get a very good understanding of the context where the wood samples were found. Edit Evans writes:⁴

Phase II This phase, which is not closely dated but probably belongs in the later 2nd to early 3rd century, saw the reconstruction of the northern boundary with the digging of a wall trench (wall 1) on the north side of Beam Slot 1. Immediately on the south side of this a well (Well 2) was sunk.

It was impossible to examine the whole of the pit as it extended dangerously close to the modern garden wall, but it appeared to be oval in shape with the long axis; east-west. At the bottom it was almost square in plan and cut to fit the timber lining almost exactly. The whole pit was 2.15 m deep from the lower Roman ground level, of which 1.05 m was above the surviving part of the shaft. This upper part of the pit was filled with mottled green clay. The timber lining of the shaft survived from just above the water table at the time of excavation (Fig AD). It framed a square of interior measuring 2 Roman feet, and the shaft was filled with dark grey, silty clay-loam. Outside the lining, the pit was filled with green clay and gravel. Three layers of the timber survived more or less intact with the remains of a fourth above. The lining was prefabricated, being made up of oak planks with a roughly wedge-shaped. Cross-section and slots cut through from the thicker side for about half the width of the plank. They were inserted in sets of four, so that the slots of the east and west timbers always faced upwards with the north and south timbers fitting down into them. Each set was assembled separately with no connection with those above and below, and appeared to have been wedged into place with large pebbles, especially at the corners. Outside the horizontal timbers, and also apparently for the purpose of keeping them firmly in place, was a set of vertical timbers, one at the north side, one in the north-east side, and three each at the east and south sides. There are none at the west side, but another had fallen in from the south-western corner under the box of horizontal timbers. This fallen timber, the one at the north side and the northernmost on the east side were planks with their bottom ends cut to a point; the other six were just rough pieces of wood hardly shaped at all. These vertical timbers were set at the bottom of the pit and firmed up by packing them around with gravel. They were apparently in place before the horizontal timbers, on the evidence of the fallen upright which could never have been able to fall flat in the bottom if even the lowest set of timbers had been in place, but they could not have been left to stand on their own, as the others would also have fallen in. In addition, if the vertical timbers had represented an earlier lining it would have been easier to pull them out before laying the horizontals, so tightly do the two fit together. As the bottom of the pit is only just large enough to contain the timbers, it seems probable that the lining was assembled by a man standing in the middle of the pit, building it around him. After the well went out of use, the timbers were presumably robbed down to the water level and the pit filled with clay.



Interior of the well seen when the timber lining is still in place. Photo taken towards east. The inner width is about 60 cm.



Lining 3 and 4 still left.

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This text together with the photos⁵ and drawings of all the pieces I received from Warwickshire museum, gives a very clear view of the well. From David Brown, I get the labels which makes it possible to connect the dendrochronological sample identities and the archaeological samples. Unfortunately some of the labels used when the samples were sent to Queens in spring 1977, are a bit confusing. Despite that, it seems possible to figure out where in the well they likely were found.

Scheme over the samples and their supposed locations in the well construction

Horizontal planks:

	N	E	S	W
1. lin.	N I [North 1] Q1574 (gr. b)			
2. lin.	N II [North 2] Q1575 (gr. b)	S II A ⁺ [East 2] Q1587 (gr. a1)	S II B ⁺ [South 2] Q1588 (gr. b)	W IV [West 2] Q1592 (gr. a4)
3. lin.	N III [North 3] Q1576 (gr. b)	E III [East 3] Q1595 (gr. a6)	S III [South 3] Q1589 (gr. a2)	W V [West 3] Q1593 (gr. a3)
4. lin.	N IV [North 4] Q1577 (gr. a4)	E IV [East 4] Q1596 (gr. b)	S 5 VI [South 4] Q1591 (gr. c)	W VI [West 4] Q1594 (gr. c)

Vertical planks:

V1	Q1578 (gr. a5)	north
V2	Q1579 (gr. b)	north-east
V3	Q1580 (gr. a1)	
V4	Q1581 (gr. b)	east
V5	Q1582 (gr. b)	
V6	Q1583 (gr. a2)	
V7	Q1584 (gr. a2)	south
V8	Q1585 (gr. b)	
V9	Q1586 (gr. a3)	south-west (laying down)

The distribution of the planks in the well as I do interpret the labels used when the samples was delivered for the dendrochronological analysis – some of them do not seems very logic to me. The color refers to dendrochronological group, where the brownish ones are dated, all before AD 100. They are probably reused. The yellow ones, which consists of probably "fresh" wood, fits each other very well (at least some of them are certainly from same stem), but the group is not possible to match towards any available reference and therefore undated. The blue samples are from same stem, but does not match towards anything else. The mixed distribution of timber from the two main groups clearly shows that the well must have been build at one occasion. The builders seems to have had all the planks available and could pick any of them despite source.



All but lining 4 now removed and the verticals becomes more and more visible.

© Warwickshire Museum 1975



Id.	Sum of ring widths ⁴	Place in construction	Width according to drawings	Relation
Q1574	92 mm	North 1	150 mm	61%
Q1575	109 mm	North 2	150 mm	73%
Q1576	183 mm	North 3	230 mm	80%
Q1577	122 mm	North 4	135 mm	90%
Q1578	187 mm	Vertical 1	250 mm	75%
Q1579	93 mm	Vertical 2	190 mm	49%
Q1580	126 mm	Vertical 3	210 mm	60%
Q1581	86 mm	Vertical 4	110 mm	78%

Q1582	116 mm	Vertical 5	130 mm	89%
Q1583	69 mm	Vertical 6	80 mm	86%
Q1584	140 mm	Vertical 7	170 mm	82%
Q1585	118 mm	Vertical 8	160 mm	74%
Q1586	184 mm	Vertical 9	230 mm	80%
Q1587	115 mm	East 2	150 mm	77%
Q1588	114 mm	South 2	125 mm	91%
Q1589	208 mm	South 3	240 mm	87%
Q1591	106 mm	South 4	130 mm	82%
Q1592	153 mm	West 2	190 mm	81%
Q1593	199 mm	West 3	240 mm	83%
Q1594	101 mm	West 4	130 mm	78%
Q1595	187 mm	East 3	240 mm	78%
Q1596	118 mm	East 4	150 mm	79%

Sum of all measured ring widths of each sample in comparison with the sample width as shown on the drawings. A big difference may depend on either that not all of the rings were measured or because the actual wedge was not split out optimal. The samples may also have been dried before measuring.

The verticals. All but the three on the southern side (no. 6-8) are clearly visible. No 1, 3 and 9 are real boards – they are all from the dated group. No.2, 4 and 5 seems to be just pieces of split wood and belongs to the undated group with sapwood.

From David Brown I also received information about sapwood and bark edge⁴³ which is necessary when interpreting the felling date. In English oaks the number of sapwood rings are between 15 and 50 (2σ)⁴⁴. Another kind of data, which can be extracted directly from the measurement series, is if two or more samples are from same tree. That is useful information too, as it will move the *terminus post quem* for all the samples to that of the latest. Dendrochronologically the samples can be classified into three main groups, "a", "b", "c" and "group a" in six subgroups (different trees):

Group (tree) a3-a6

In the group of dated samples, only the youngest, Q1595 [East 3] (AD 99) has sapwood preserved (27 rings), and its outermost ring was interpreted as bark edge. This tree was felled AD 99/100. Q1578 [vertical 1] (AD 74) and Q1592 [West 2] (AD 53, 5 unmeasured heartwood rings) are measured to, or close to, the heartwood/sapwood boundary. If they are felled AD 99/100 as well, they have 25 and 40 sapwood rings respectively, which is in the expected span for English oaks. Those three samples are also the ones with the youngest measured rings. For the rest of dated samples sapwood is missing, and they may therefore be of the same age, or felled earlier. It is however likely that also Q1577 [North 4] (group a4) and group a3, Q1593 [West 3] and Q1586 [vertical 9] (last two possibly same stem. Q1586 is partly disturbed, and therefore not included) may be felled at the same time (AD 99/100), but one or two other felling dates are as likely.

Group (tree) a1

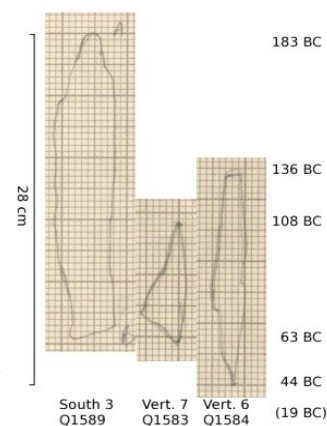
Q1580 [vertical 3] and Q1587 [East 2⁴⁵] (same stem) has heartwood rings measured 139 BC to 31 BC (although those after 46 BC are unreliable and therefore removed), but 22 more younger rings are marked as counted, so the heart/sap boundary is *after* 8 BC, and the tree is felled *after* AD 8 (2σ). It *may* possibly be felled even as late as the previous group (AD99/100), but also a lot earlier (even possibly in pre-Roman time!) There are clear signs of reuse, so it may be an old plank cut in at least two pieces.

Group (tree) a2

Q1589 [South 3], Q1584 [Vertical 7] and Q1583 [Vertical 6] are from same stem, with latest measured ring from 44 BC (oldest ring from 184 BC): As there is no sapwood preserved, the tree is cut *after* 29 BC (2σ). Vertical 6 and 7 are among those characterized as "just rough pieces of wood hardly shaped at all"⁴⁶. This is a bit puzzling. It is a bit difficult to imagine these pieces of rough wood from same stem taken from some where else (no signs of reuse), and held together as they do not seem to be from the same wedge (plank) but from same stem, which – if so – must have been cut in pieces to fit the well construction. A dry beam originally from an very old, maybe even pre-Roman construction, split up into wedges for this construction, seems not very likely. Is this maybe an indication for use of waterlogged oak timber from (natural) deposits in for instance the river?

Group B

The second, still undated, Alcester chronology – Alcester-B – consisting of Q1574 [North 1] (0 sap), Q1575 [North 2] (14 sap), Q1576 [North 3] (20 sap, bark), Q1579 [Vertical 2] (16 sap), Q1581 [Vertical 4] (20 sap, bark), Q1582 [Vertical 5] (0 sap), Q1585 [Vertical 8] (23 sap), Q1588 [South 2] (10 sap) and Q1596 [East 4] (25 sap, bark), covers 144 years. Many samples in this group seems to be from same stem as others and all are possibly from same stand. It seems that at least Q1579, Q1581 and Q1582 differs significantly from the rest. The presence of sapwood and barkedge and the lack of signs of reuse – notable especially on the verticals – makes it likely that this group consists of fresh wedges, which would – if they were dated – also closely date the well itself. The presence of sapwood and the appearance of samples in the group likely not from same tree as others, makes it less likely that it is from old underwater deposits. It is recommended to test this floating Alcester-B chronology when other samples from Roman contexts in the region are investigated and more local chronologies (and chronologies covering the late Roman gap) hopefully are built. It may be a good change to have it dated sooner or later if material from late Roman time is systematically investigated.

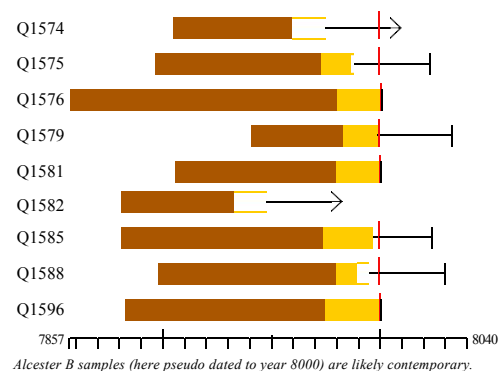
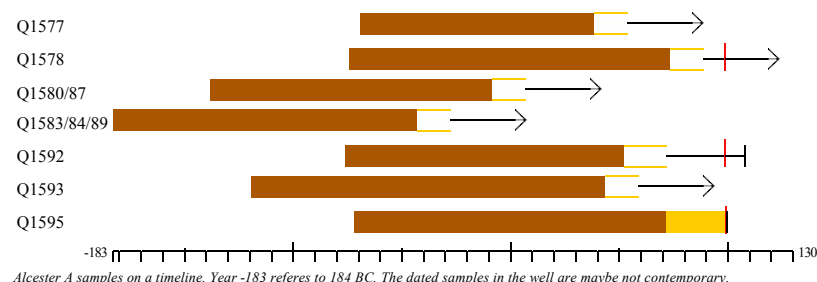


Crosscut shape for the three wedges from same maybe surprisingly old stem palced on a time scale according to date of the measured series. (The growth direction of V.6 and/or V.7 may be turned 180°). The stem diameter exceeded 60 cm. Earliest possible felling date is 19 BC, but may be much later. Is it a water loged stem from a (natural) deposit used? Drawings from Warwickshire Museum. Scale 1:5 on mm paper.

Group C (one tree)

Q1591 [South 4] and Q1594 [West 4] are from same stem and ends at the same year, but not yet datable. It seems to be from the same reused plank.

Timeline diagrams



Alcester B samples (here pseudo dated to year 8000) are likely contemporary.

Discussion and result

In the dated collection (A) sapwood are preserved only in three of the samples and bark edge only in one. In the undated collection (B) bark edge is preserved in three samples and sapwood in all but two. There is no obvious pattern in the distribution of samples belonging to chronology A (and its subgroups) and B (or C) in the well. Wood from all groups are mixed together, and those who constructed the well had a number of reused and possibly also new planks/wedges available for the work. Possibly some of the wedges were split out of a log taken from for instance a river deposit. We also can verify that the construction certainly was build at one and the same occasion and it looks like construction wood was a restricted resource at that time. From a strictly dendrochronological point of view the date so far is just "after" (and likly rather long time after) AD 99. It is however not unlikely that Chronology B is contemporary with the construction of the well. If the archaeological dating – late second or early third century – is correct we would not very much expect any strong match as there are very little reference material available from England from that time and it is weak and comes from distant locations (London area).

There are two possible interpretations. One is that all the planks are reused, originating from at least two different contexts, where one of them are dated to AD 99/100, and likely local, the others either local and than likely from late roman period or traded from elsewhere. As there seems not beeing any traces of reuse on those in group B it seems, however, likely that those planks were new (and possibly local).

Acknowledgments

Thanks to David Brown who kindly provided me with his very informative handwritten diagram from 1990 and other very useful information, and to Michael Baillie for useful information. Thanks also to Petra Ossowski Larsson who compiled and published the English Roman chronologies necessary for this study. Thanks also to Ben Wallace and Caroline Rann at Warwickshire Museum for all interesting background material clarifying the context.

And, yes, David Brown indeed also dated the chronology to AD 99, although not with correlations strong enough towards the chronologies available to him in 1990, and therefore of course unwise to publish as it could have turned out to be wrong. I may admit that I would probably not have been able to date this collection either, if not because that I found the date for Q1593 first! Building a floating chronology the ordinary way may not have revealed the problem with Q1589 (missed ring at 114 BC). Such an error would have caused too low correlation values to be of real interest. And without that interest, I may not have done any real efforts according to the Alcester material at all.

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1. ↑ More than 9,000 samples from Queens University Belfast (QUB) are available as undated files at www.chrono.qub.ac.uk/Resources/dendro_data/dendro.html
 2. ↑ See: T. Axelson: *Validating the dendrochronological dating of Roman oak wood in western Europe*
 3. ↑ NorthEnglishRoman and SouthEnglishRoman, chronologies compiled by Petra Ossowski Larsson available at www.cybis.se/belfast/NEngSEngRoman.zip (WebCite-link).
 4. ↑ E-mail from Michael Baillie January 24, 2011
 5. ↑ Sent Febr. 22, 1977 according to correspondence filed at Warwickshire museum
 6. ↑ note in sample Q1593
 7. ↑ The relevant Northern Ireland chronologies are available in: [Alcester-QUB.zip](#) (in the temporary chronology for N. Ireland bog, used here is an average of Ballinderry-A and Ballinderry-B, Balloo_312AD and LisbarnetCottage-A. See T. Axelson: *Validating the dendrochronological dating of Roman oak wood in western Europe* for details.)
 8. ↑ Evans, Edit: *Phase II*, extract from manuscript recieved from Warwickshire Museum.
 9. ↑ The photos are scanned versions of slides. I had to flip them, otherwise they did not correspond to Evans descriptions of the well. I have also cut them and improved the colors a little bit.
 10. ↑ Two samples labeled "S II" does not make sens. One of them is surely "E II", and I suggest the sample Q1587 to be the wrongly labeled one. There is a notice about possible sign of reuse on "E II" and Q1587 is among the dated ones sins Q1588 belongs to the undated group B. (Unfortunately a circle evidence if we want to prove that the samples in group B were fresh wood and not reused).
 11. ↑ See previous note.
 12. ↑ Measurement unit for the Alcester samples are 1/50 mm
 13. ↑ Handwritten diagram from 1990 by David Brown, which he kindly E-mailed 23. Febr. 2011.
 14. ↑ Baillie: *A slice through time*, 1995 p. 23
 15. ↑ Wrongly(?) labeled S II A
 16. ↑ Edit Evans in quotation above