THE DENDROCHRONOLOGY AND ART HISTORY OF A SAMPLE OF 16TH AND 17TH CENTURY PAINTED CEILINGS

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by
Anne Crone, Michael Bath and
Michael Pearce

Historic Environment Scotland

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FOREWORD

Historic Environment Scotland commissioned this technical paper in collaboration with AOC Archaeology to provide information on a collection of painted ceilings from 16th and 17th century properties. These ceilings form an invaluable resource not only for art history but also for the evolution of supply chains and the development of styles of decoration for timber in the 16th century.

The combination of art history, timber provenance and dendrochronology forms a useful addition to our knowledge of painted ceilings in the 16th and 17th centuries and has helped to explain the evolution of painting styles within the broader European context.

Dr Alick Leslie
Conservation Science Manager
Historic Environment Scotland
April 2016

1. INTRODUCTION

Historic Environment Scotland has acquired and inherited from the former Ministry of Works an extensive collection of painted ceilings, the beams and floorboards of 16th and 17th century houses. The timbers are a valuable research resource, not only for their obvious art-historical merit (Bath 2003 and see below) but because of the tree-ring data held within them. The latter has the potential to provide dates for the installation of the ceilings and thus enhance our understanding of their development over time, and to identify the source of the timber, thereby contributing to our knowledge of the historic timber trade. Some of these timbers have never been fully studied from an art-historical perspective and none had been dendro-dated, so a sub-sample of six ceilings from five buildings was selected from the collection for study and analysis. During the course of the project a further two ceilings which do not form part of the collection were also included in the analysis.

This paper presents the results of this project. In the first three sections the context and background to the project are explored. In Section 2 Michael Bath reviews the study of decorative paintings on ceilings in Scotland and identifies it as a very Scottish phenomenon. In Section 3 Michael Pearce outlines the history of salvage that resulted in the Historic Environment Scotland collection and in Section 4 Anne Crone presents the dendrochronological background and the methodologies employed in this study. In Sections 5 and 6 the evidence from each building is presented; what is known about the history of the building, the form of decoration present and the dendrochronological results. Finally, the contributions from this project to art-historical studies of painted decoration in Scotland and to dendrochronological studies are assessed in Sections 7 and 8.

2. THE CONTEXT – THE PAINTED CEILINGS OF SCOTLAND

Michael Bath

The principal art-historical issues surrounding the conservation and study of painted ceilings from Scotland could be summarised by keywords used in the respective titles of the only two books that have so far been devoted to their study. Apted's *Painted Ceilings of Scotland* (1966) signals a key property of this painting as the fact that it is found predominantly on ceilings and not walls. Bath's *Renaissance Decorative Painting in Scotland* (2003) suggests, however, that this painting has at least some connection, or affinity, with that movement or development in European, if not specifically Italian, art history generally referred to as the Renaissance.

Whilst this raises larger and more controversial issues than Apted's more straightforwardly descriptive title, the fact that nearly all examples of decorative painting of the 16th and 17th centuries to have survived in Scotland are painted on ceilings, not on walls (these are not 'murals'), sets them apart from contemporary traditions of decorative painting not only in England but also – with some possible exceptions – elsewhere in Europe. Apted's title, therefore, has the advantage of identifying perhaps the most salient feature of this tradition in Scotland which differentiates it from other national traditions, or from similar painting in England.

This richly developed and stylistically informed tradition of decorative painting is no mere northern extension of a 'British' – still less an 'English' – fashion but, rather, a fully indigenous national tradition whose most distinctive aspect is the fact that it was almost invariably executed on ceilings. Unlike mural paintings on plaster, Scottish ceilings normally consist of exposed wooden boards and beams, and this alone makes dendrochronology an appropriate tool for their dating.

The fact that the fashion for such painted ceilings spanned the 100 years or so in Scotland which saw the union of crowns in 1603 means that issues of national identity and difference cannot easily be overlooked in any continuing study, particularly at the present time. It also means that questions of chronology take on a particular importance. The removal of courtly patronage to London post-1603 has implications for taste, fashion and funding which are of some importance for British art history as a whole. These might well be illustrated by what we know about the closely analogous history of decorative plasterwork, where English influence on Scottish taste and fashions post-1603 is not in doubt, since matrices of the Nine Worthies, for instance, designed for the palace of Bromley-by-Bow in London were brought to Scotland and used in houses ranging from Balcarres in Fife to Merchiston Tower and at least nine other houses in Scotland (Bath 2003, p189; Napier 2013). In decorative painting, however, no such cross-border influences of English on Scottish examples in the 17th century have so far been detected. Chronology, however, is key.

The description of this as 'Renaissance' painting raises wider issues of its relationship with traditions and developments in European art at this period for which chronology is also key. The question of Scottish culture's wider European connections is, of course, an abiding historical and political issue, and was raised immediately in the review of Bath (2003) by Duncan Macmillan in his *Scotsman* review:

> Michael Bath has just published a new book called *Renaissance Decorative Painting in Scotland*. But what can he mean by that title? Surely the Renaissance never came here? We look back to the 16th century and that is not what we see at all. Where others enjoyed the Renaissance, in Scotland we see only the shadow of the Reformation: iconoclasm, ruins and the destruction of art. (*The Scotsman*, 17/04/2004, 'Critique' supplement, 4-5)

Since 2004 things have moved on somewhat, and with Thomas's (2013) volume we have a summative history of what subsequent research has revealed about the strictly 'Renaissance' character of Scottish culture at this period. Thomas now provides perhaps the best summary of developments in art history which have influenced this shift, based on more strictly academic and specialised work in this area by Thomas herself and by scholars including Ian Campbell, Peter Davidson, Robert Crawford, Jamie Reid-Baxter, Michael Lynch, Alasdair MacDonald, and the late John Durkan. The launch, in 2009, of the new online *Journal of the Northern Renaissance* signals in its title the shift in academic and historical thinking on this issue which has taken place in the last decade or so.

Questions of dating have always been central to arguments surrounding the European Renaissance, whether in Italy or elsewhere. The priority and formative nature of Italian models has, inevitably, led to assumptions about the relative belatedness of all its Northern successors, with the Reformation of the church often signalling the type of paradigm shift which might be thought to

have enabled those breaks with preceding 'mediaeval' models which is often held to characterise any rebirth of interest in the arts of classical antiquity in more northerly countries.

Despite the iconoclasm of reformers such as John Knox which, as Duncan Macmillan suggests above, made a Scottish artistic Renaissance seem unlikely, it is the Reformation which has nevertheless often been seen as the starting point for any manifestation of the Renaissance in Scotland. Thus there is the paradox of a Scottish Reformation which simultaneously rules out any possibility of a Renaissance, whilst also being seen as the break with the medieval past that signals its arrival. It should be clear that the changing status of Catholicism in Scotland is likely to be proposed as central to these contradictory readings of history, since Catholicism may be seen either as the tradition which retained the closest connections with Italian and wider European tastes and cultural models, or as the unreformed preserve of unenlightened 'medieval' ways of representing the world which preclude it. The place of Mary of Guise, Mary Queen of Scots, or of James VI's Catholic Chancellor, Alexander Seton, in these historiographic developments highlights these issues in recent discussion, e.g. the 'Marion Period' as a decisive development in Scottish architecture (McKean 2007), or the emphasis placed on Seton's neo-Stoic gallery at Pinkie House as a high point in the Scottish tradition of Renaissance painted ceilings (Bath 2007b).

The known dates of surviving examples of decorative painting seemed to support the claim for 'the Reformation as a clear enough starting point' for this painting (Bath 2003, 4), with the earliest surviving example being Kinneil in the 1550s and the majority being painted in the last quarter of the 16th century and later (Table 1). McKean (2007, p2), however, argues that 'In fact, 1560 has no relevance to the developing architecture of the country seat in Scotland', and takes what is called the 'Early Renaissance' period in Scotland, *circa* 1500-1542, back to the reigns of James IV and V. Taking a much wider and more inclusive range of artefacts into her discussion, including fine arts, music, literature and courtly pageantry, Thomas (2013, p85) finds the beginnings of a Scottish Renaissance as early as 1478-9 in the Trinity Altarpiece (*ibid*, p85) or 1485 in coinage (*ibid* p73).

The Trinity Altarpiece was the work of Flemish artist Hugo van der Goes, and the commissioning of such works by Scottish patrons from European masters is certainly evidence of Renaissance tastes, but the fact that Scotland had hardly any painters who could be identified as masters of the new styles in their own right before George Jameson in the 17th century is one of the things that has long discouraged any recognition that Scotland had its own Renaissance (cf. Bath 2007a).

If such dating is important for any rewriting of the history of Scottish painting, then dendrochronology clearly has a part to play, either to support and supplement, or to correct other evidence of dating. The few occasions where the painted ceilings that have survived are marked with their own dates are mostly noted in *Renaissance Decorative Painting in Scotland* and are listed in Table 1. However where – as in most cases – this is lacking it is necessary to rely on what is known about the history of the building and its owners. Documentary evidence for the actual painting, as opposed to the building which it decorates, is rare, although Apted and Hannabuss (1978) provide invaluable documentation of the archival records of payments to painters at particular sites; these are listed in Table 2.

Slightly more abundant is the knowledge of the date of publication or production of any books or prints which supplied their patterns, though this can never be more than a *terminus post quem*. Such identification does, however, relate to the actual paintings and not just to the building that contains them, and it also frequently helps in identifying the exact European models, sources or analogues for Scottish examples. A notable instance of this is the painting which was apparently executed at Kinloss Abbey in 1538 and described by the immigrant Italian, Giovanni Ferrerio, as painted in the Abbot's lodgings at that date (Bath 2010). This is not only the earliest known reference to such painting in Scotland, but is also ascribed to a painter called Andrew Bairhum, and thus one of the few examples for which we can identify the actual painter. The painting itself has disappeared, but Ferrerio's description of it as 'In the lighter style of painting' (*pictura leviore*) which, he says, is now most popular throughout Scotland (*per Scotiam receptissima*) not only describes its style but also, it might be argued, identifies its likely source, since one of the most influential sets of ornament prints which helped to circulate patterns for the newly fashionable style of *grottesco* painting went under the title *Leviores et … extemporaneae picturae quas grotteschas vulgo vocant* ('The lighter and extempore style of painting commonly called grotesques') (see Bath 2010).

The fact that the earliest known reference to decorative painting in Scotland thus not only identifies its artist and supplies a date, but also identifies its *antiqua* style and likely source in Italian prints, is good evidence for the arrival of truly 'Renaissance' styles into Scottish decorative arts at a surprisingly early date.

Date	Building
1465 – 1468	Guthrie Aisle, Angus
ca. 1497	St Marnock's Church, Foulis Easter, Angus
ca. 1520	St Machar's Cathedral, Aberdeen
ante 1538	Kinloss Abbey, Moray
ca. 1548-53	First Period Painting, Kinneil House, Bo'ness, West Lothian
1565	Abbey Strand, Holyrood, Edinburgh
post 1575	John Knox's House, Edinburgh
post 1579	South Block, Culross Palace, Fife
1581	Prestongrange House, East Lothian
1581-2	Balbegno Castle, Fettercairn, Aberdeenshire
post 1583	Nunraw House, Haddington, East Lothian
1584	Bay Horse Inn, Dysart, Fife
1589	Carnock House, Stirlingshire
1590	Advocates Close, Edinburgh
1591	Floor 2, 302-4, Lawnmarket, Edinburgh
ca. 1591	Traquair House, Borders
1592/1593	Inscribed Chamber, Delgaty Castle, Aberdeenshire
1594	James VI's Birthroom Edinburgh Castle, Edinburgh
1594	Chapel Royal, Stirling Castle, Stirling
1597	Painted Chamber, Delgaty Castle, Aberdeenshire
1598	Riddles Court, High St, Edinburgh
1599	Muses room, Crathes Castle, Aberdeenshire

Date	Building
1602	Nine Worthies Room, Crathes Castle, Aberdeenshire
1602	Gp 1-10 (Unknown)
1605>	Floor 3, 302-4, Lawnmarket, Edinburgh
1610 (?1618)	Monymusk House, Aberdeenshire
post 1611	North Block Culross Palace, Fife
post 1614	Pinkie House, Musselburgh, East Lothian
pre 1617	Huntly Castle, Aberdeenshire
1619	Laws Close, Kirkcaldy, Fife
1620	Gladstone's Land, Edinburgh
ca. 1620	Provost Skene's House, Aberdeen
ca. 1620/1634	Arbour Room, Kinneil House, Bo'ness, West Lothian
ca. 1624	Stobhall Castle, Perthshire
1627	Dean House, Edinburgh
post 1630	Mary Somerville's House, Burntisland, Fife
1633	Falkland Palace, Fife
1634	'Ballachastell', Castle Grant, Moray
1635	Gala House, Galashiels, Borders
post 1635	Gardyne's House, Dundee
1636	St Mary's Church, Grandtully, Perthshire
1636	1st Floor Sitting Room, Earlshall House, Leuchars, Fife
1638	Skelmorlie Aisle, Largs, Ayrshire
ante 1647	Aberdour Castle, Fife
post 1660	Royal Arms, Cullen House, Buckie, Moray
1675	Argyll's Lodgings, Stirling

Table 1 Known dates of painted ceilings

Key: *ante* = *terminus ante quem*; *post* = *terminus post quem*; date = exact date as recorded on actual ceiling or from contemporary records; *ca.* = approximate date inferred from historical circumstances or details of ownership; dendro-dated ceilings in red

Date	Place	Details	Artist	P.no
1494	Stirling	Chapel Royal	David Pratt	75
1502/3	Cambuskenneth	royal tomb	David Pratt	76
1512	Falkland	unspecified	Andrew Laing	58
1535/6	Linlithgow	fore-entry and chapel	John Ross	80
1537/8	Falkland	unspecified	D.Tod, T.Angus, R.Reid	96
1538	Kinloss Abbey	Abbey + Abbot's lodging	Andrew Bairhum	25
1538	Holyrood	heraldry	Andrew Barry	26
1542	Falkland	various work by 'Queen's painter'	?Pierre Quesnel	115
154/4	Edinburgh	Regent Arran's house	anon.	115
1548	Edinburgh	'roof of governor's house'	Walter Binning	28
1553	Hamilton	unspecified	Walter Binning	29
1580	Holyrood	royal arms	anon.	117
1581	Edinburgh	roof of 'inner Tolbooth'	David Workman	107
1586	Edinburgh	Council House walls	David Workman	107
1595	Edinburgh	Trinity College kirk lofts	John Workman	111
1595	Finlarg Castle	chapel interior painting	anon.	117
1599	Edinburgh	West Kirk loft	anon.	117
1617	Edinburgh Castle	heraldry	James Workman	108
1617	Edinburgh Castle	king's birth room	John Anderson	23
1617	Edinburgh Castle	royal arms etc.	John Sawers	81
1617	Edinburgh Castle	unspecified	John Stewart	91
1617	Holyrood	graining	James Workman	108
1617	Holyrood	chapel + royal chambers	Matthew Goodrick	42
1617	Holyrood	unspecified	John Smith	89
1617	Stirling	various	Valentine Jenkin	52
1618	Edinburgh Castle	unspecified	Sawyers, J.Stacie, W.Ker	55
1624-6	Edinburgh Castle	unspecified	James Workman	109
1625/6	Holyrood	Chapel	James Workman	109
1827	Burntisland	Council House	anon.	117
1627	Hamilton	'Duchess's painted chamber'	Valentine Jenkin	52
1627	Stirling	various	Valentine Jenkin	52
1628/9	Stirling	palace and chapel	Valentine Jenkin	52
1628	Falkland	royal arms boards	Valentine Jenkin	53
1628	Linlithgow	unspecified	Thomas Hall /John Sawers	44
1629	Linlithgow	various	J. Binning/J. Workman	27/109
1633	Stirling Castle	unspecified	John Binning	27
1633	Edinburgh	Castle	John Sawers	82
1633	Holyrood	various	Robert Telfer	96
1633	Holyrood	'Marquis's lodging'	James Workman	110
1633	Taymouth Castle	30 royal portraits	anon. 'German painter'	118
1634	Kinneil	various	Valentine Jenkins	53
1635	Ballachastell	gallery	John Anderson	24
1637	Edinburgh	Parliament House	John Sawyer	83
1638	Largs	Skelmorlie Aisle	James Stalker	91
1640-3	Glasgow	University Laigh Hall	Robert Littlejohn	59
1656-9	Glasgow	University, Principal's Lodgings	Gavin Littlejohn	59

Table 2 Dated paintings identified in Apted and Hannabus 1978 (NB archival and other records cited by Apted and Hannabuss seldom specify the type of painting involved and although irrelevant types of painting such as 'ironwork', ships, clocks, or moveables and ephemera have been excluded from the following list, the painting cannot always be assumed to have been decorative painting on wood or specifically on ceilings. Late 17th century examples, post-1660, are not included)

A source identification which has equally important implications for art history is the recent discovery of a source for one of the emblem panels in the Long Gallery at Pinkie House, Musselburgh. The panel (Figure 1) showing classical nymphs and satyrs dancing around a newborn baby lying in its crib in a doorway, with the motto *Nympharumque leves cum satyris me secernunt populo* ('The light-footed nymphs with satyrs distinguish me from other people'), has now been shown to copy one of the engraved illustrations to Blaise de Vigenère's French translation of the *Imagines* of Philostratus the Elder (Bath 2013) (Figure 2). This discovery not only clarifies what is going on in this picture, which Philostratus describes as a painting of the 'Birth of Pindar', showing how bees flew down to put honey on the lips of the infant poet, but also establishes it as a notable example of classical ekphrastic painting, confirming all the other indications that Chancellor Seton designed Pinkie House above all as a *villa suburbana* to revive the arts of classical antiquity in Scotland (Bath 2013). It is, however, the date of publication of Vigenère's *Images ou Tableaux de Platte Peinture des Deux Philostrates* that is relevant in this context. First printed in Paris in 1578, unillustrated (Adams *et al* 1999-2002, F.478), it was not until 1614 that Vigenère's French edition of Philostratus appeared with illustrations by a Parisian engraver called Jaspar Isaac. This is a year later than the date of the actual building, which a carved inscription tells us was built by Seton 'not as he wished it to be, but as circumstances and finances permitted, 1613' (*Dominus Alexander Setonius hanc domum aedificavit, non ad animi, sed fortunatum et agelli modum, 1613*). It should not surprise us that designs for the interior decoration were only decided on once the building itself had been completed, but the fact that Seton used an image which he could only have found in a book published in Paris the year after the date the house was built suggests just how closely in touch he must have been with the publication of learned books published overseas. It also gives us a *terminus post quem* for the actual painting of his long gallery, a year or so later than the date he records for the actual building of the house itself, and just 10 years after the Union of the Crowns which had secured the prospect of an enduring peace between England and Scotland, a peaceful union which Seton's building on the site of the last battle to be fought between the two nations was almost certainly designed to celebrate (Bath 2013).

Figure 1 Pinkie House, Nympharumque leves. Birth of Pindar emblem.

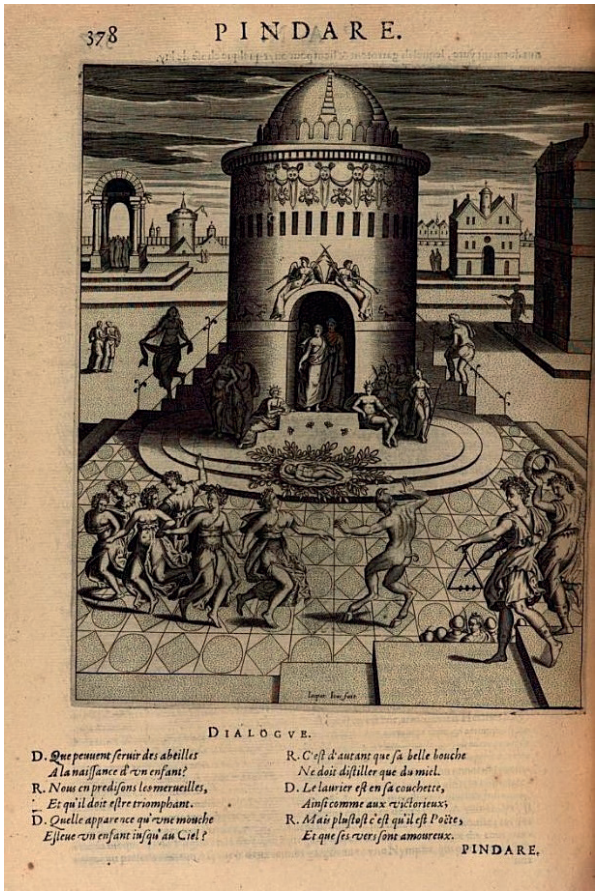

Figure 2 Philostratus, Imagines, trans. Vigenère, 1614, Birth of Pindar illustration.

3. THE HISTORIC ENVIRONMENT SCOTLAND COLLECTION OF PAINTED CEILING TIMBERS

Michael Pearce

The collection of painted ceiling timbers now in the care of Historic Environment Scotland came together in a very piecemeal manner, mainly during the 1950s and 1960s. Timbers had already been salvaged from several houses by the Ministry of Works and Ancient Monuments Board, and the specialised conservation needs of these ceilings were soon recognised. Consequently, in 1964 the National Trust for Scotland and the Ministry of Works set up a joint conservation centre at Stenhouse Mansion in Edinburgh with a particular remit to conserve these ceilings. The history of salvaging some of the ceilings which form part of this study are recorded below, together with a brief summary of the conservation techniques used then and now.

The first ceiling to be rescued came from Carnock House in Stirlingshire (NRS-DD27/602: HS - HSCC_0_1956_SP). Carnock had been offered to the Ministry of Works as a potential Property in Care in 1914 but instead the estate was sold to the Alloa Coal Company in 1915. By 1941 the house was decayed and during its demolition a salvage operation was organised by James S. Richardson, an Inspector of Ancient Monuments with the Ministry of Works. Richardson requested the removal of decorative plasterwork and a painted ceiling for the 'National collection'. The conservator John Houston salvaged from the second floor a ceiling that had been concealed by plaster. The painted beams were sawn in half to speed removal.

The painted boards are now at the Stirling Smith Art Gallery and Museum, which also has the original front door. During this current project the half-beams were identified in Historic Environment Scotland's storage using a list of their measurements made in 1954. Most of the half-beams carry aphorisms or biblical quotations such as; '*Gif that in werteu thow takis ony paine*' and '*naikit I cam into ye warld and naikit*' (see Figure 16 in Section 6.2).

In 1959 Edinburgh City Council converted ancient tenement buildings at 302-4, Lawnmarket into a new headquarters for the Midlothian Police force (HS - HSCC_0_1595_SP). Two painted ceilings were discovered and recorded *in situ* by the Ministry of Works. The city architect decided that they should be moved and reduced in size. The work was supervised by Ministry conservators and the offcut painted timbers were retained in storage. The ceilings were again available for study and conservation during the recent conversion of the building as the Missoni Hotel (Crone and Sproat 2011).

At Abbey Strand at Holyrood the old timber ceiling was removed in 1967 so that the floors could be strengthened. A series of nine painted beams were salvaged with painted boards bearing two patterns. The ceiling spanned a broad gap between beams and was supported by an unusual arrangement of 10 small oak cross-beams, which were also painted (Figure 3).

The 'Bay Horse Inn' at the Pan Ha, the shore at Dysart belonged to the Crown Estates and was restored in 1968 under the National Trust Little Houses Scheme (NRS - DD23/406: HS - HSCC_0_1063_SP). The timber ceilings of the first floor rooms were salvaged and stored and subsequently passed to the Ministry of Works and NTS paintings conservators Rab Snowden, Bill Adams, and Ian Hodkinson at Stenhouse Mansion.

Figure 3 Abbey Strand: the small painted beams jointed between the larger painted beams. Some of the boards examined in this study can be seen in the right-hand corner.

3.1 Conservation

When these painted ceilings were salvaged in the 1950s and 1960s contractors fumigated the timbers with methyl bromide to control wood-worm (HSCC_0_1063_SP). Conservation of the painted surfaces rather than restoration by 'in-painting' remains the usual guiding principle (Murray 2009). Most of the original painting was carried out in size or gelatine media. As the media weakens, the paint requires periodic reinforcement by consolidation, usually by the addition of size glue applied through Japanese tissue paper (Figure 4). The process renews the original paint media without adding extra gloss to the surface.

Some areas of painting employed selective use of pine-resin media and varnish. This can darken and is resistant to cleaning. The painted ceiling discovered at Advocate's Close in 2010 has areas of this second type of paintwork (Murray and Magris 2010; and see Figure 18 in Section 6.3). The ceiling covers two sections over a long hall space and a smaller private or dais room. The hall was painted with flowers and fruit and the smaller room with a geometric pattern. This included an interesting marbling effect which was at first invisible under a discoloured varnish. Extensive use of mixed-media had not been previously seen in Scottish Renaissance painting.

3.2 Dendrochronological assessment

One of the authors (AC) was commissioned to assess the collection for its dendrochronological potential. All of the beams in the collection were examined but in the case of the boards the assessment focused on a single large assemblage from one building. Beams from 12 buildings are present in the collection (Table 3). The parent buildings of two groups of timbers are unidentified. These are 'Gp 1-10' (so-called because of the numbers painted on them by an early recorder) and 'Northfield' type (so-called because of the style of decoration). Analysis focused on the larger of the beam assemblages, those from Abbey Strand, Bay Horse Inn, Dysart, Carnock and Lawnmarket. The large assemblage of pine boards from Abbey Strand were also chosen for analysis.

Figure 4 Size glue being applied through Japanese tissue paper to one of the Carnock House beams.

Building	Timbers	Sampled	Species
Bay Horse Inn, Dysart	12	10	Pine
Carnock	12	11	Oak
Abbey Strand	11	11	Oak
'Gp 1-10'	9	9	Pine
Lawnmarket	9	8	Pine
Prestongrange	8	5	Oak
'Northfield type'	5	5	Pine
Midhope	5	-	Pine
225-9 High St Kirkcaldy	3	-	Oak
Pinkie House	2	-	Pine
Rossend	2	-	Oak

Table 3 Summary of beams in the HES collections

4. DENDROCHRONOLOGY; CONTEXT AND METHODOLOGICAL APPROACHES

Anne Crone

The purpose of this section is to outline the context within which the analyses of the painted ceiling timbers should be viewed and understood, and to present the methodologies applied in sampling, measuring and analysing the timbers.

4.1 Context

Dendrochronological analysis is routinely undertaken in Scotland and there is now a substantial dataset of buildings and archaeological sites that have been analysed (most recently summarised in Crone and Mills 2012). As well as exact calendrical dates dendrochronology can also identify the source of the timber, a technique known as dendroprovenancing (see below). As a result the dendrochronological evidence has helped to highlight and define historical patterns of timber usage in Scotland which differ significantly from elsewhere in the UK. Scotland's native timber resources were substantially diminished by the late 15th century and the country had to look abroad for the timber needed for its building works. During the 16th and 17th centuries boards and beams of both oak and pine were imported primarily from Scandinavia, and oak boards for more specialised purposes such as painting and carving were also imported from the regions bordering the southeastern corner of the Baltic. Scotland was so reliant on imported timber that native-grown timber is rarely found in buildings of this period; native oak has been identified dendrochronologically in only six post-1450 buildings while native pine has only been identified in a few vernacular buildings of early 19th century date. We might therefore anticipate that the timber used in the painted ceilings was imported, with all the attendant issues of identifying the source.

The successful dendro-dating of imported oak is now fairly routine, made so by the large numbers of well-replicated site and regional chronologies that are available across Europe, and reflected in the relatively large number of dated Scottish 'import' chronologies in the oak reference group used in this study (see Tables A3, A10 and A14 – and below). The strength of the regional climatic signal in many of these chronologies is such that it is now possible to date single oak sequences with confidence. The dating of imported pine has proved to be less straightforward, and this may be due to the extent and quality of chronological coverage in the source areas, in that the available regional chronologies are not always fully representative of the variety of environmental niches that exist there (Crone and Mills 2012, p348). Dendroprovenancing relies on the existence of this network of regional and site chronologies and the source region of the timber can be identified through the strength and consistency of the statistical and visual correlations between undated and dated chronologies (*ibid* p330-1).

With ideal samples (i.e. with bark edge - see below) dendrochronology can provide exact calendrical dates for the felling of timbers which are subsequently used in building construction. However, the relationship between felling date and construction date is not always straightforward. There can be a lag between the felling of the timber and its incorporation into a building because of issues like seasoning, stockpiling, transportation times and delays in building schedule (Miles 2006; Crone and Mills 2012, p358-61). The main issues which must be considered in interpreting the dendrochronological dates of imported timber are transportation times and stockpiling. In Scandinavia, timber processing was carried out in spring and autumn, when floodwater and meltwater made sawmilling easy (Lillehammer 1999, p13). However, ships carrying Scandinavian timber tended to arrive in Scotland in the sailing season between May and September (Ditchburn 1990, p81), so timber felled in the autumn of one year will not have been transported overseas until the spring of the following year, thus introducing a lag of at least one year between felling and use in a building.

Timber was occasionally imported for specific building projects (see Chapter 4.2) but most of it ended up in merchant's timber yards where it was stockpiled until it was needed. Scandinavian oak used in the roof of the Great Hall at Edinburgh Castle had been stockpiled over a period of five years (Crone and Gallagher 2008) but later in the 16th century, in the building boom that Edinburgh experienced as its population tripled in size (Glendinning, 2003) it is unlikely that good building timber would have lain around for so long. The shortage of timber that stimulated the import trade would also have encouraged the recycling of timber and the

presence of recycled timber can introduce early dendrodates which bear no relation to the building under study. This has been observed in many Scottish buildings of this period (Crone and Mills 2012, p362) but none of the painted ceiling timbers in this study bore evidence of re-use, presumably because the ceilings were on and for public display and redundant joints and holes would mar the decorative appearance.

4.2 The assemblages

The results of the dendrochronological analyses are summarized in Table 4. As described above the ceiling assemblages in the Historic Environment Scotland collection were the focus of this project. However, during the course of the project the painted ceiling in Advocate's Close, Edinburgh was exposed (Borden and Holden 2010) and the beams became available for analysis, so this ceiling has been included in this corpus. Timbers from Law's Close, Kirkcaldy, including components of the painted ceiling found on the first floor, had been analysed in 1998 but at that time the assemblage could not be dated (Mills 1998). The work on the HES collection has now enabled this assemblage to be dated and consequently, it is also included in the corpus. The Abbey Strand pine boards could not be dated at the time of publication (Crone 2013) so this paper presents the most up-to-date results. The results from the Lawnmarket tenement have already been published (Crone and Sproat 2011) but are also reported on here because the timbers also form part of the Historic Environment Scotland collection.

All the ceilings discussed in this paper are of board-and-beam construction, the beams supporting the boards which formed the floor of the room above (Bath 2003, p7). The beams used in the painted ceilings were either exclusively oak or pine; a mixture of species has not been found in any ceiling (Table 4). Only two assemblages of painted boards were examined, from Abbey Strand and Law's Close, Kirkcaldy, and these were both pine. Observation of other *in situ* painted ceilings suggests that pine was used solely for the boards.

4.3 Sampling methodology

The presence of bark edge on a worked timber is essential if a precise calendar date for the felling of the tree is to be obtained. In the absence of bark edge a felling estimate (the range of years within which the tree is likely to have been felled) can be calculated if some sapwood (the outermost band of living wood between heartwood and bark edge) survives. The nature of the outermost surface on the timbers is therefore critical in evaluating which of the ceiling timbers are the most ideal candidates for analysis.

The beams in all ceilings were invariably boxed heart baulks, the faces axe-dressed square leaving strips of bark edge along the edges. The Abbey Strand boards were plain-sawn, i.e. sawn tangentially across the log (sawmarks lying at right angles to the edge of the board indicates that they were mill-sawn rather than pit- or trestle-sawn). This means that some boards spanned the entire width of the original timber, incorporating the pith and

Location	Species	Type	Felling dates	Analysed samples	Dated samples	% dated	Known history
Abbey Strand, Edinburgh	Oak	beam	1563, 1564, 1565	10	8	80	built by 1570
	Pine	boards	*tpq*1546	26	5	19	
Carnock, Stirling	Oak	beam	1589	11	8	73	unknown
Advocate's Close, Edinburgh	Oak	beam	1588, 1589, 1590	9	8	89	datestone '1590'
Bay Horse Inn, Dysart	Pine	beam	1582, 1583, 1583/4	9	5	56	carving '1583'/ built by 1585
Gp 1-10 (unknown)	Pine	beam	1599, 1602	8	5	63	unknown
302-5 Lawnmarket, Edinburgh	Pine	beam	1589, 1591, 1601, 1603, >1605	20	11	55	unknown
Law's Close, Kirkcaldy	Pine	beams and boards	1617, >1618, >1619	19	6	32	unknown

Table 4 Summary of dendrochronological results

Figure 5 Sections through some of the Abbey Strand pine boards, arranged in order of their position within the original tree. From top: Boards B2, B5, A13 and A6.

Figure 6 Sampling the Advocate's Close ceiling by coring

representing a relatively complete ring sequence (Figure 5, A13 and A6), while others came from the outer chord of the original timber, the rings running almost parallel to the faces of the board (Figure 5, B2). The change in colour which indicates the presence of sapwood in pine was visible on a number of boards (Figure 5, B2 and B5) so it is likely that these particular boards lie near the bark edge. However, the boards were tongue-and-grooved so it was difficult to determine whether the bark edge was present as so little of the original surface had survived the dressing and shaping of the boards.

Other factors that need to be taken into account when selecting candidates for analysis are the quality, i.e. length and sensitivity, of the tree-ring sequence. In general, only those timbers which combined bark edge with a sequence of over 50-60 rings were sampled. Occasionally, samples with a longer ring-pattern but without bark edge were sampled, if they were part of a larger group and might contribute to the construction of a robust site chronology.

Sampling of beams from *in situ* ceilings was undertaken by coring, using a specially designed corer, powered by an electric drill (Figure 6); this removes a core 10 mm in diameter. The method of sampling of the beams in the HES collections was dictated by the location of bark edge. If the bark edge extended to the end of the beam where there was no painted decoration, then a slice, no more than 50 mm wide, was removed by handsaw. Where the bark edge survived only in restricted sections along the beam, as was usually the case, a core was removed. The boards were sampled by sawing a slice across the entire width. As described above the bark edge had usually been removed on the boards and their ends were often split or damaged so that the tree-ring sequence was interrupted. The sampling location was thus determined by the position where the most complete, uninterrupted tree-ring sequence could be obtained without damaging the painted decoration. Occasionally, this was in the middle of the board, where it had lain over a beam and was thus unpainted. More often, though, an undamaged sequence could be obtained by removing a larger slice from one end.

4.4 Measuring and analytical methodology

The cores were mounted in routed wooden holders and the surfaces of the cores were prepared for tree-ring measurement by gentle sanding and paring. The surfaces of the sawn slices were also finely sanded to enhance the tree-ring pattern.

The tree-ring sequences were then measured on a Heidenhain measuring table, under a low-power microscope, linked to a P.C. Data capture, analysis and plotting were undertaken using *Dendro* software (Tyers 1999). The program produces t-values, a statistic which measures the degree of correlation between sequences, and as a general rule of thumb values above 3.5 are considered to be significant, although the length of overlap also has to be taken into account. The numbers presented in the tables throughout Section 6 are t-values; the larger the t-value, the greater the degree of correlation between the sequences and/or chronologies being compared. Visual cross-matching of the graphed tree-ring width sequences is undertaken to verify any statistical positions of match. Cross-matching proceeds in a stepwise fashion; the strongest internally replicated group forms the core of a site master chronology which is then compared with the remaining unmatched sequences to find further acceptable statistical and visual matches.

The data were compared against the same group of dated chronologies for the relevant species, comprising all the available Scottish 'import' chronologies, as well as selected regional and site chronologies from Scandinavia; for ease of reference these will subsequently be called the oak reference group and the pine reference group.

5. THE PAINTED DECORATION

Michael Pearce

5.1 Painting on the boards

Amongst the ceilings dated in this study there were six types of decorative painting on the boards. These differing styles were used in the same properties at the same time in different rooms. There are three main types of floral arabesque which could be called *flower-strewn*, *space-filling floral,* and *flat arabesque*. Two 'geometric' patterns reference moulded ceiling ribs with an attempt at *trompe l'oeil* coffers. One has *star and arabesque fields*, the other *thin-ribbed compartments*. The painting at the Bay Horse Inn is unlike the others studied here. There were several other styles in use during the period. Patterns on the beams are discussed below.

The first type of floral arabesque, seen at Abbey Strand, Carnock House, Floor 2 in 302-4 Lawnmarket, and Law's Close, Kirkcaldy, can be described as a loose floral style, with fruit, leaves and flowers, set on a trailing *rinceau* stem, strewn over and showing the background colour. The boards from Abbey Strand with three bays of this pattern show beautifully rendered apples on a pale background (Figure 7). The style resembles painting on plaster in the 'arbour room' at Kinneil House.

Tentatively, we could suggest that this *flower-strewn pattern* or *arabesque*, though enduringly popular and seen at Northfield House, a merchant's country villa in East Lothian dated 1622, developed slightly earlier than the *space-filling floral pattern*. This second floral style, of flowers and fruit, absolutely fills the space between the beams, hardly showing any background (which can be dark or black.) There is often a red and yellow railway-track margin at the edge. The pattern may be derived from the borders of so-called 'Oudenaarde' tapestry. The pattern was found on the Floor 3 ceiling at 302-4 Lawnmarket, (Crone and Sproat 2011, p23-5), which also includes a squirrel and a grotesque head, in the hall at Advocate's Close, and at Law's Close. This is perhaps the most commonly found design seen in several merchant's houses and at Gladstone's Land in Edinburgh.

Much simpler than these florid styles was the *flat arabesque* where the shapes of leaves and stems are treated as pattern rather than rendered in naturalistic colour. This kind of ornament could be found in pattern engravings intended for painters, metalworkers, bookbinders or embroiderers. Part of the Floor 3 ceiling at the Lawnmarket was painted

Figure 7 Abbey Strand: an apple in the flower strewn section

Figure 8 Abbey Strand: the star and arabesque pattern

in this manner, and similar arabesques were used on the beams, neatly framed, and can seem as repetitive as stencil decoration though they were painted freehand. At Law's Close the ceiling pattern of one room is in this manner with a simple shading pattern that hardly raises the one dimensional character.

A geometric pattern used at Abbey Strand was based on an octagonal interlocking tessellating grid, alternating stars on a blue background with a finer arabesque pattern (Figure 8). A chequer of red and yellow around the two fields was intended to emulate deep coffering. At Abbey Strand the fictive ribs dividing the compartments were not well executed and the pattern was cramped by the ceiling beams. This scheme of *star and arabesque fields* worked better uninterrupted by beams on flat lining boards on a partition at the Bay Horse Inn, at the Magdalen Chapel in Edinburgh, and at Grange House, Bo'ness (destroyed, known from a sketch at RCAHMS.) A variation of the same grid pattern outline forms the basis for the decoration of a room at Culross Palace.

A second geometric style may be slightly later. In these rooms the ceiling was marked out into compartments with thin fictive ribs in red and yellow, as if it were an elaborately crafted coffered roof. Shouldered junctions show an affinity to international strapwork designs. In the smaller room at Advocate's Close, perhaps Clement Cor's private room or *chamber of dais* beyond his hall, the fictive compartments were decorated with a wood-grain pattern (Figure 9), as is the genuine oak ribbed ceiling at Kinneil House. A room at Law's Close and the Merchant's House in St Andrews were painted like this.

The main ceiling pattern at the Bay Horse Inn was unique, consisting of a very delicate geometric pattern with fictive shadowing, with some fine arabesque work. Amongst surviving examples of painted ceilings there are other types of pattern: at Huntingtower, perhaps the earliest, the beam decoration borrows from the *première renaissance*, and others described by Michael Bath (2003) employ mottos and motifs from printed works, or depict astrological motifs.

5.2 Painting on the beams

The decoration of the beams was not related to the painting on the boards in any stylistic correspondence. Most beams had decorative patterns – some had moralistic inscriptions like those at Carnock House or Sailor's Walk in Kirkcaldy.

One beam from Carnock has a pattern resembling a repeating classical frieze and the same idea had been used at the Bay Horse Inn, Dysart (Figure 10). On other Bay Horse beams patterns of flowers and fruit were divided with a thin belt, sometimes on the diagonal (Figure 11).

Many ceiling beams were decorated in red and yellow with a simple arabesque in a rectangular compartment sometimes alternated with a square 'diamond point' in black and white. This *framed arabesque* scheme was widespread, and beams at 302-4 Lawnmarket, the hall

at Advocate's Close, and Law's Close (Figure 12) are similar. Other examples include Gladstone's Land and Moubray House in Edinburgh, and Northfield House in East Lothian.

At Midhope Castle, East Lothian, some of the boxes and frames were skewed to formed parallelograms, with a decorative effect like the 'belts' at the Bay Horse Inn. (These beams were subsequently installed at Abbey Strand.)

Another common beam motif which Michael Bath has described as the 'trailing tassel' is hard to characterise (Bath 2003, p20, p26.) The pattern consists of splashes of colour which fade into the next motif. It perhaps has something in common with the repeating motif used at Huntingtower; both look a little like a stream of comets, but are probably descendants of a pattern of husks. The trailing tassel was often used with the space filling patterns of flowers and fruit, and can be seen at the 302-4 Lawnmarket (see Figure 23 in Section 6.6), Gladstone's Land and Northfield House.

Figure 9 Advocate's Close: thin-ribbed pattern before conservation revealed graining pattern

Figure 10 Bay Horse Inn: beam with repeating frieze pattern

Figure 11 Bay Horse Inn beams: pattern divided by thin 'belts'

Figure 12 Law's Close, Kirkcaldy: beam with framed arabesque

6. THE BUILDINGS
Anne Crone and Michael Pearce

6.1 ABBEY STRAND

6.1.1 Construction history

After the Reformation in 1560, Andrew Chalmers, Commendator of Holyrood, acquired the Abbey Strand property and rebuilt it (Gallagher 2013, p72). The building was described in 1570 as the 'greit mansioun' which was 'new biggit' (i.e. newly built), but it may already have been occupied by then because in 1569 a house belonging to Andrew Chalmers in Holyrood was searched by soldiers, in violation of the sanctuary (*ibid*).

6.1.2 Painted decoration

The eastern section of the ceiling was painted with naturalistic flowers and leaves of which two bays survive. Because of a large gap between beams one bay was supported by oak cross beams which were also painted. The western section of painted boards of only two bays has brightly painted geometric ribs with a blue background enclosing stars alternating with cross shapes with small scale silhouetted arabesque detail. This pattern was also found at the Bay Horse Inn, Dysart, Grange House, Bo'ness (destroyed), and the Magdalen Chapel in Edinburgh.

The beams have a simple arabesque in a rectangular compartment in red and yellow alternating with a square 'diamond point' in black and white. This scheme was widespread, and the beams of the Floor 2 ceiling at 302-3, Lawnmarket, the hall at Advocate's Close, and Law's Close are similar. Other examples include Gladstone's Land and Moubray House in Edinburgh.

6.1.3 Dendrochronology

Oak beams

There are 11 beams from Abbey Strand in the HES collection, of which 10 were analysed (Table A1, *see appendix*). A core group of eight timbers correlated well together (Table A2) and a site master chronology, ASOMNx8, 194 years in length was constructed. ASOMNx8 was compared against the oak reference group (Table A3 and A4, *see appendix*). The comparison produced significant correlations with many of the Scottish 'import' chronologies and with the regional and site master chronologies from southern Norway. One of the other timbers, CR2 did not correlate with any of the components of ASOMNx8 but it did produce low but consistent correlations with a number of the southern Norwegian chronologies (Table A4, *see appendix*). It was therefore incorporated into the site master chronology to form ASOMNx9 and this improved the correlations with the Scottish 'import' chronologies and the Norwegian chronologies (Tables A3 and A4, *see appendix*) and dated the chronology to 1370–1564 AD.

Oak; date of construction

The chronological relationships of the dated timbers are illustrated in Figure 13 and their dates are presented in Table A1. With the exception of CLCC7, whose outermost rings were too compressed to measure, the outermost measured ring on all the other dated timbers falls in 1562, 1563 or 1564. However, on most of timbers the earlywood pores of the next year's growth were just beginning to form (indicated by +1 in Table A1, *see appendix*). This means that the trees were felled in the following year, probably in the early spring. This new growth was not present on CR3 and CLCC4 but in all likelihood they were probably been felled in the early spring of the following year just before the tree started its new growth. Thus, two of the dated timbers were felled in the early spring of 1563 and five were felled in the early spring of 1564. CR2 was felled in the early spring of 1565 and this may be why it does not correlate with any of the other dated timbers, having arrived in Scotland on a cargo from a different region. The varied felling dates indicate that the timber was being drawn from a stockpile of timbers and this means that we cannot say exactly when the ceiling was constructed, other than that it must have been constructed at some time between 1565, the last felling date, and 1570 when it was described as newly built.

Pine boards

There were 41 boards from Abbey Strand in the HES collection, all of which were pine. They came from three separate ceilings, A, B and C, although Ceiling B was painted on the ends of the boards used in Ceiling A. In all 33 boards were sampled based on factors such as sequence length and presence of bark edge and of these 26 boards were eventually fully analysed (Table A5, *see appendix*).

Internal correlations produced seven discrete groups of sequences (Table A6, *see appendix*). The statistical correlations within some of these groups are so high as to suggest that the boards were all converted from the

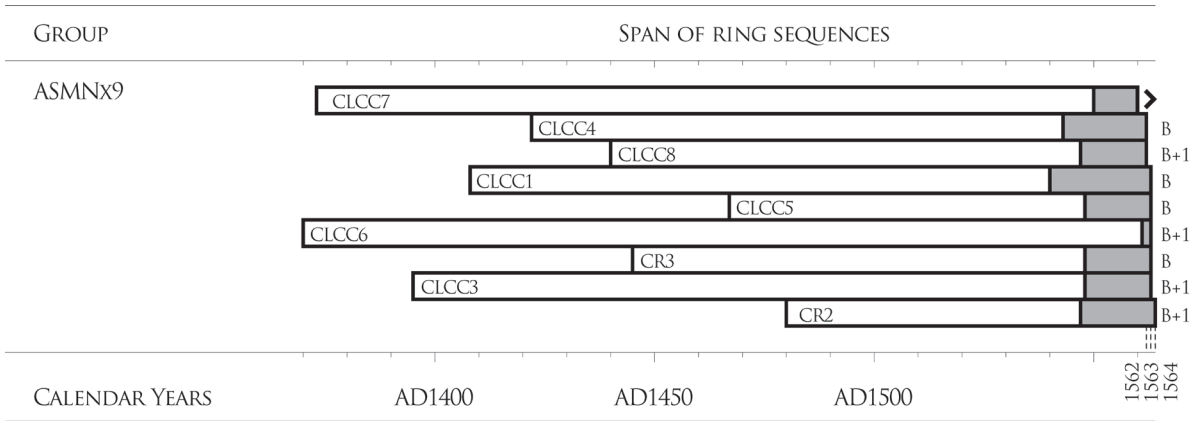

Figure 13 Abbey Strand oak: bar diagram showing chronological relationships between the dated timbers

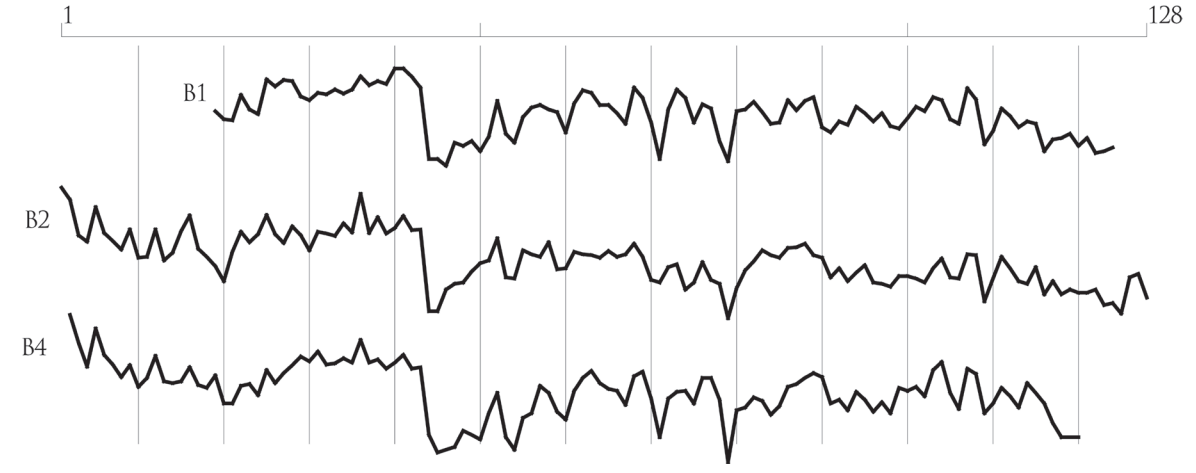

Figure 14 Abbey Strand pine: tree-ring graph showing degree of visual correlation between the sequences B1, B2 and B4

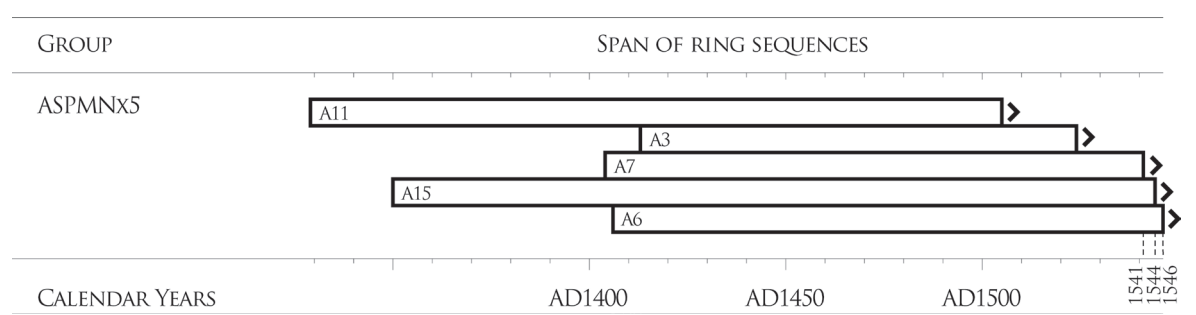

Figure 15 Abbey Strand pine: bar diagram showing chronological relationships between the dated timbers

same tree, i.e. A11/15, B1/B2/B4 and B11/B12/B13. However, caution is necessary in interpreting the statistic in this way; despite the highly significant correlation between A11 and A15 the two boards are unlikely to have originated in the same tree because the pith was present on both samples and A15 started growth 22 years after A11 (Figure 13). B1/B2/B4 are more likely to have come from the same tree; they all had sapwood so they are clearly from the outer part of the original tree; furthermore, their end-years fall within eight years of each other suggesting that they are not far from the bark edge (Figure 14). Similarly B5 has sapwood (Figure 5) while the other two boards within that group, B6 and B7 display growth-rings lying almost parallel with the face of the board, indicating that they too are from the outer part of the original tree.

The pair- and trio-masters were compared against each other but there was only one acceptable visual and statistical correlation, between B8/9/10 and B11/12/13 (t = 4.98). The pair- and trio-masters and the other individual sequences were then compared against the pine reference group (Table A7). A1115m, A36m and A7 produced consistent correlations with some of the dated chronologies and although there were no internal correlations between the sequences, a sub-master ASPMNx5, 218 years in length was constructed which yielded strengthened correlations with some of the regional and 'import' chronologies, dating it to 1329 – 1546 AD.

Pine; date of construction

The chronological relationships between the dated boards are illustrated in Figure 15. There is no unequivocal evidence for the bark edge on any of the dated boards. The colour change denoting sapwood, the outermost rings of the tree, is often not present and as pine dries the wood can spall off along the growth-rings leaving a curved edge which can be mistaken for the waney edge. The fact that the end-dates of A7, A15 and A6 cluster within five years of each other suggests that they may lie near the bark edge but they can provide no more than a *terminus post quem* of 1546 AD for their felling. As the oak beams to which the boards were fixed were felled between 1563 and 1565 AD it would seem that there may be several decades of tree-rings trimmed off the boards.

6.2 CARNOCK HOUSE, STIRLING

6.2.1 Construction history

Carnock House was built by Sir Robert Drummond of Carnock who was master of work to James VI from 1579 to 1583. He died in 1592 and was succeeded by a grandson, a minor. The poet Alexander Montgomery wrote a eulogistic epitaph.

6.2.2 Painted decoration

The ceiling came from a second floor room at Carnock. The boards are painted with flowers fruit and leaves with bold outlines in black, which could be described as *flower strewn*. The beams carried inscriptions in Scots in black-letter on the background of a white scroll (Figure 16). The margins of the beams were bright yellow with a simple red decorative pattern. The underside of the beams was adzed away in 1630s to take a plaster ceiling.

Some of the inscriptions originate in an English collection of moral advice by William Baldwin, *A Treatise of Morall Phylosophie* (1547). One is from a verse attributed to the stoic Musonius:

> *Yf that in vertue thou take any payne,*
> *The payne departeth, but vertues remayne.*
> *But yf thou haue pleasure to do that is yll,*
> *The pleasure abateth, but yll taryeth styll.*

The lines recur in Scots dress in the Bannatyne manuscript complied in the 1560s.

Instead of an inscription a beam from the end of the room has a repeating frieze similar in conception to some of the beams from the Bay Horse Inn but markedly inferior in execution.

6.2.3 Dendrochronology

There are 12 oak timbers from Carnock House in the HES collection, of which 11 were sampled for dendrochronological analysis (Table A8, *see appendix*). Internal comparisons highlighted two pairs with such high t-values as to indicate that they had originated in the same tree. AR4 and BR9 cross-matched with a t-value of 11.46, while TR2 and AR8 cross-matched with a t-value of 15.52. Consequently, tree-masters for each pair were made and these were then treated as single sequences. (AR4 and BR9 were thought to be the same beam so the dendrochronological results simply confirm that this is the case.)

Figure 16 Carnock House: opening of the stoic line 'gif that in werteu thow takis ony pain'

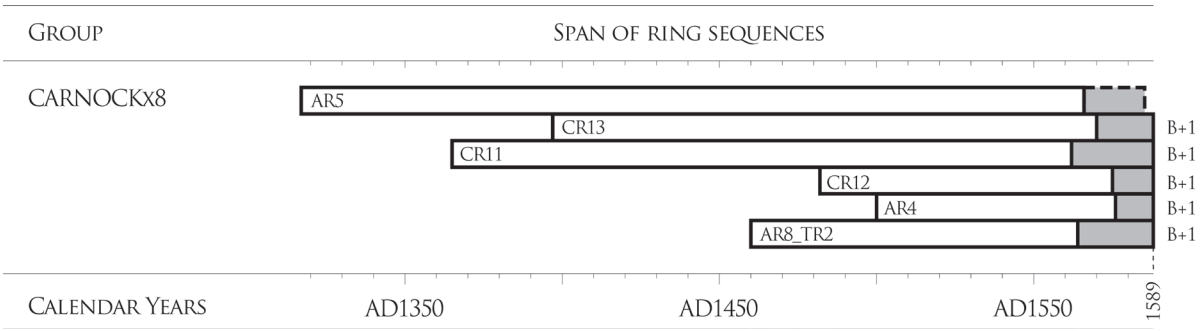

Figure 17 Carnock House: bar diagram showing chronological relationships between the dated timbers

There was good internal correlation between only four sequences from the assemblage (Table A9, *see appendix*) and consequently a sub-master, CARNOCKx4, was constructed, 272 years in length. CARNOCKx4, the two tree-masters and the remaining individual sequences were then compared against the oak reference group (Tables A10 and A11). This produced highly significant correlations dating CARNOCKx4 to 1317 – 1588 AD. Both AR8_TR2 and AR4_BR9 were also dated to 1588 AD against the same regional chronologies. Consequently, they were incorporated into an enlarged site-master, CARNOCKx8.

Date of construction

The chronological relationships within the site master are illustrated in Figure 17. The calendrical date of the outermost ring on five of the six dated timbers (counting TR2 /AR8 and AR4/BR9 as single timbers) is 1588 AD (Table A8). However, in every case the springwood pores of the next year's growth are just beginning to form under the bark (indicated by +1 in Table A8, *see appendix*) indicating that the trees were felled in the early spring of 1589 AD. AR5 was felled in either the early spring of 1588 or 1589; woodworm damage to the sapwood meant that it was impossible to determine whether 21 or 22 sapwood rings were present. That the majority of timbers present were felled in the same year strongly suggests that the ceiling was installed in 1589 AD or soon after; there is no evidence of stockpiling.

6.3 ADVOCATE'S CLOSE, EDINBURGH

6.3.1 Construction history

The building was bought in 1579 by Clement Cor, a burgess in the town council from 1588-98, and three times town bailie (Borden and Holden 2010, p3). He made major changes to the building, extending it upwards and creating three apartments in the levels above the hall in which the painted ceiling was found. The door lintel bears the date '1590' and the initials of Cor and his wife.

6.3.2 Painted decoration

The larger room has a pattern of *space filling flowers and fruit*, and was probably the urban equivalent of a hall. At the north end of the space the ceiling pattern is different, and this was perhaps the private room or *chamber of dais*. This smaller space has a pattern of fictive *thin-ribbed* compartments. The shapes marked out by the ribs are filled with wavy wood-graining effects (Figure 18). In both spaces the joints between the boards were covered with paper strips before painting. The beams have framed arabesques.

6.3.3 Dendrochronology

The painted ceiling consisted of 19 beams but some were shrouded in plastic sheeting and were therefore not accessible. In all nine beams were sampled by coring and all sampled beams proved to be oak. The ends of the painted boards were not accessible at any point in the ceiling so it was not possible to determine their species or growth-pattern.

Of the nine sampled beams, B6 had insufficient growth-rings and was dismissed from further study (Table A12, *see appendix*). Internal correlations amongst the sequences were quite low (Table A13, *see appendix*) so no attempt was initially made to construct a site-master; instead the individual sequences were compared directly against the oak reference group (Tables A14 and A15). Most of the sequences produced significant and consistent correlations against many of the chronologies, although some, i.e. B11 and B17, displayed weaker signals. A site-master chronology, ACMNx8 was constructed which was dated to 1428–1590 AD.

Figure 18 Advocate's Close: private room, graining in compartments of thin-ribbed fictive ceiling

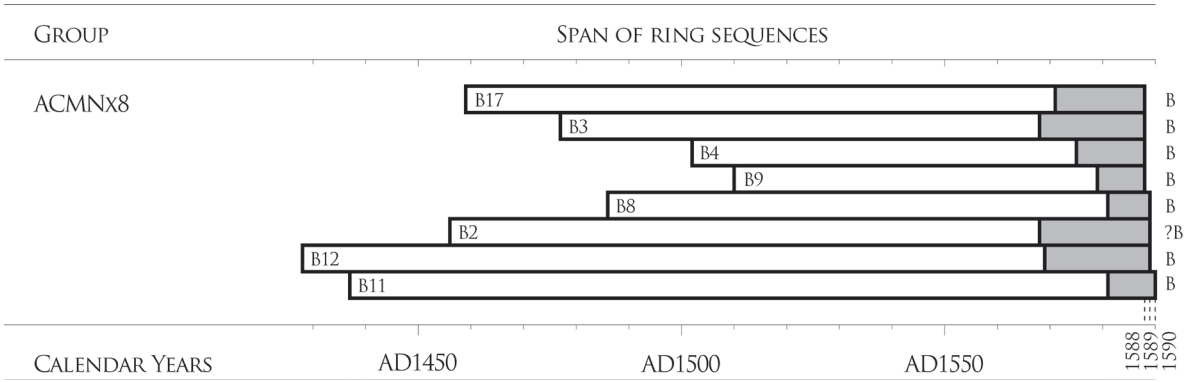

Figure 19 Advocate's Close: bar diagram showing chronological relationships between the dated timbers

Date of construction

The chronological relationships of the dated timbers are illustrated in Figure 19 and their calendar dates are presented in Table A12 (*see appendix*). There is a range of dates for the outermost rings – four are dated to 1588, three to 1589 and one to 1590. With the exception of B2, which had compressed outer rings, there was a complete growth-ring present under the bark on all the timbers indicating that the timber had been felled after growth had ceased, i.e. in the winter or early spring, before the new year's growth commenced. Thus, for instance, B3 could have been felled in either the winter of 1588 or the early spring of 1589, while B11 could have been felled in either the winter of 1590 or the early spring of 1591. However, even if B11 was felled in the autumn of 1590 it is unlikely to have been shipped to Scotland until the spring of 1591, when the next sailing season began (see above).

The range of felling dates present and the lack of internal correlation within the assemblage is consistent with the use of a stockpile of timber which had accumulated over time from a range of sources. The builder or owner is likely to have bought the timber from a merchant, who in turn obtained his stock from the many Scandinavian ships arriving in the East coast Scottish ports laden with timber (Ditchburn 1990). The latest felling date present in the dated assemblage is 1590/91 so the ceiling cannot have been installed before 1591 at the earliest but it is possible that it was installed up to a year or so later. The door lintel with the date '1590', suggests optimism on the part of the builder because the timber cannot have been obtained by then, but also intimates that perhaps little more than a year or so elapsed before the ceiling was installed.

6.4 BAY HORSE INN, DYSART

6.4.1 Construction history

The house was built for Patrick Sinclair; his initials and those of his wife Catherine Nisbet appeared on the painted ceiling. He was the son of Henry, Lord Sinclair and was a prominent citizen of Dysart. The date '1583' is carved over the entrance to the pend and Sinclair is recorded as having a 'new-biggit' house in 1585.

6.4.2 Painted decoration

The painted ceiling covered two rooms spanning the first floor of the house. There were also fragmentary boards from partitions. Each beam had a different pattern, several with florid naturalistic forms outlined strongly in black. The pattern of the beams was partly unified by narrow painted straps, some placed diagonally (Figure 11). Other beams had a repeating pattern deriving ultimately from a classical palmette frieze (Figure 10).

The painting on the boards showed great finesse with interlacing arabesques. There were also fragments of painted partitions which included heraldry, the motto *utrumque paratus*, and a section of the *star and arabesque* pattern.

6.4.3 Dendrochronology

There were 12 joists from the Bay Horse Inn in the HES collection but of these three were not suitable for dendrochronological analysis because they were either too young and/or too damaged by woodworm (Table A16). The outermost rings of BHI8 were also damaged by woodworm so it was only possible to count them, although the inner rings were measured. The outer decades of some of the longer sequences such as BHI3 and BHI7 were also very narrow and faint, and in the case of BH13, too compressed to measure.

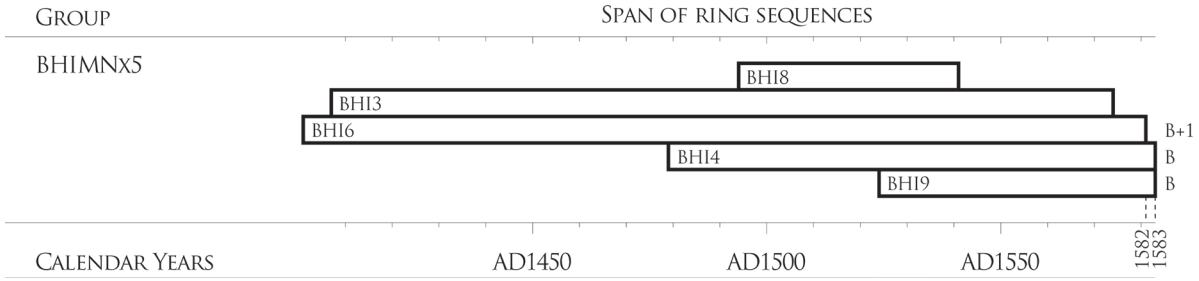

Figure 20 Bay Horse Inn: bar diagram showing chronological relationships between the dated timbers

Internal comparisons produced a group of four sequences with consistent correlations (Table A17, *see appendix*) and a site master chronology, BHIMNx4, 183 years in length, was constructed. The remaining sequences were compared against this master but this yielded no further correlations. The site chronology and individual sequences were compared against the pine reference group (Table A18, *see appendix*). BHIMNx4 produced consistent correlations dating it to AD 1401–1583. One other sequence, BHI9, also produced consistent correlations with the same suite of chronologies (Table A18). Although it did not correlate with any of the master components (Table A17, *see appendix*) its inclusion in a new site chronology, BHIMNx5, strengthened correlations with many of the regional chronologies (Table A18, *see appendix*).

Date of construction

The chronological relationships of the dated timbers are illustrated in Figure 20 and their calendar dates are presented in Table A16 (*see appendix*). The bark edge was present on BH16, BHI9 and BHI4 indicating, respectively, felling in the spring of AD 1582, the spring/summer of AD 1583 and either the winter of 1583 or the spring of 1584). Even if BH14 had been felled in the winter of 1583 it would not have been shipped to Scotland until 1584 (see above) so the ceiling may have been constructed in 1584 or soon after. This tallies with the description of the house as 'new biggit' in 1585.

6.5 GP1-10 (UNKNOWN)

6.5.1 Construction history

Nothing is known about the building from which this group of beams came. The group have been given this name on the basis of a series of sequential numbers painted on them, possibly by an early recorder.

6.5.2 Painted decoration

The beams show two phases of painted decoration. It is unusual to find the painting scheme modified. It seems that the painted room was subdivided by a partition and redecorated. One pattern includes a kind of stylised husk (Figure 21), another a run of a cursive 'S' and dot, both very similar to painting at Northfield House (see Bath 2003, 12).

6.5.3 Dendrochronology

Of the nine timbers in the HES collection only one was not sampled for dendrochronological analysis because it was too young (Table A19, *see appendix*).

The timbers of this group were of small scantling, no more than 100 mm x 130 mm across, but the ring-sequences were exceptionally long. Consequently, the rings were very narrow and occasionally faint, as in the last four decades of UNK6.

Figure 21 Gp 1-10: beam showing 'husk' pattern

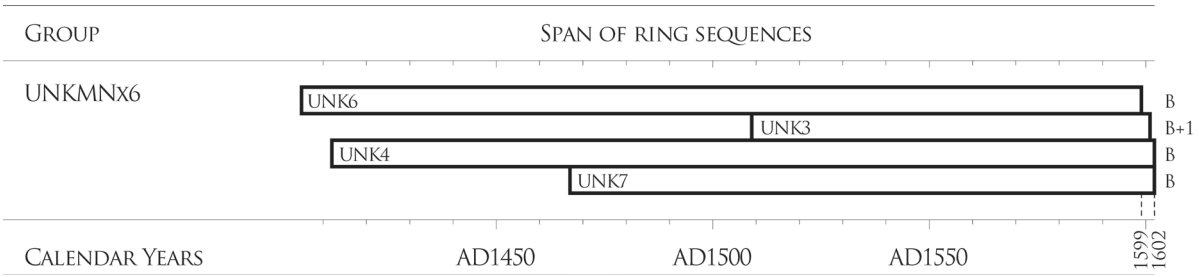

Figure 22 Gp 1-10: bar diagram showing chronological relationships between the dated timbers

Internal comparisons produced a group of three sequences with consistent internal correlations (Table A20, *see appendix*) and a site master chronology, UNKMNx3, 198 years in length was constructed. The remaining sequences were compared against this master but this yielded no further correlations. UNK3 and UNK5 compared well visually and statistically (t = 4.39) and a pair master, UNK3_5, 110 years in length was constructed. The site chronology, pair master and individual sequences were then compared against the pine reference group (Table A21, *see appendix*). UNKNMNx3 and UNK3_5MN both produced relatively low but consistent correlations with this suite and so were combined to form a new site chronology, UNKMNx5, which strengthened the correlations (Table A21, *see appendix*). Thus, five of the eight timbers are now dated and the site chronology, UNKMNx5 spans the years AD 1412–1602.

Date of construction

The chronological relationships of the dated timbers are illustrated in Figure 22 and their calendar dates are presented in Table A19 (*see appendix*). The bark edge is present on all but one of the dated timbers, indicating felling in 1599 and 1602. The ring was just beginning to form under the bark on UNK3 indicating that it was felled in the spring of 1602 and as two of the other dated timbers were also felled in 1602 it seems likely that the ceiling was installed late in 1602 or shortly after.

6.6 302-4 LAWNMARKET, EDINBURGH

6.6.1 Construction history

Tenants and landlords of these tenement buildings are recorded in the housemails book of 1636 (Crone and Sproat 2011, p19) but nothing is known of its construction date.

6.6.2 Painted decoration

Within the tenement were two ceilings with quite different painting styles. The most recent, on Floor 3 (Crone and Sproat 2011, p23-4), has red painted beams with *framed arabesques* on their sides (Figure 23), similar to those at Abbey Strand. The densely painted pattern of fruit and leaves is not unlike the ceiling in the hall at Advocates Close. However, the Lawnmarket ceiling includes a squirrel and a man's head. These patterns of fruit are similar to those used in so-called 'Oudenaarde' tapestry borders of the period.

The beams of the other ceiling on Floor 2, were painted on all three sides with the repeating motif of obscure character which Michael Bath has dubbed a 'trailing tassel' (Figure 24). This was a popular choice and other versions appear at Huntingtower and Pitheavlis at Perth, at the Merchants House in St Andrews, and other ceilings. The boards were painted with a pattern of flowers and leaves on a white background.

Figure 23 Floor 3, Lawnmarket: boards space-filling floral, beams with framed arabesques and trailing tassels, restored (SWPG)

Figure 24 Floor 2, Lawnmarket: boards flower-strewn, beams trailing tassel after restoration in 2009 (SWPG)

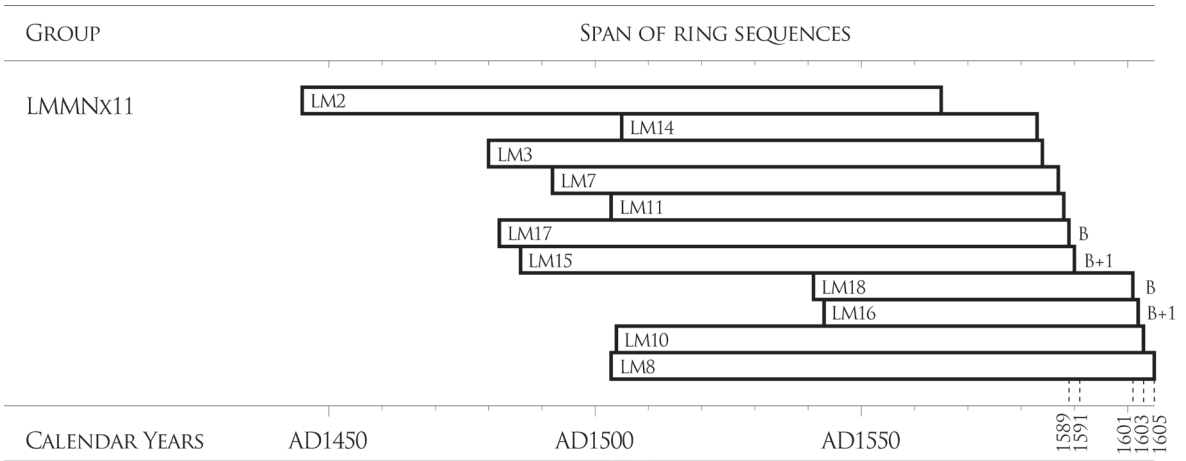

Figure 25 Lawnmarket: bar diagram showing chronological relationships between the dated timbers

There is also an area of one-dimensional arabesque, where stems and leafy shapes are silhouetted in one colour like a stencil rather than rendered and shaded (see Bath 2003, 26). This was probably a small room partitioned off from the main space, perhaps for sleeping or other uses.

6.6.3 Dendrochronology

The results of the analysis of this building have already been published in abbreviated form (Crone and Sproat 2011) but for completeness sake, and because the focus of this report differs from that of the published account, they are also presented here.

During renovations in 1959 the two painted ceilings in this building had been moved to other floors and reduced in size. Nine of those beams which were not used in the new arrangements had been taken into storage and now form part of the HES collection. The beams of the painted ceilings had survived as sawn-off stumps protruding from the wallhead on Floors 2 and 3 of the building and during renovations in 2006 13 of these stumps were also sampled. In all, samples from 22 beams from the two painted ceilings were available for analysis, but two was subsequently dismissed from further study because of their short sequence length (Table A22, *see appendix*).

Despite representing two ceilings the samples were treated as a unitary assemblage and all 20 sequences were compared internally against each other. There were low but consistent correlations between seven sequences, with some stronger correlations between pairs of sequences (Table A23, *see appendix*), and consequently a site chronology, LMMNx7, 161 years in length and incorporating those seven sequences, was constructed. One other pair, LM16 and LM18 were combined to form a pair-master, LM16-18, 63 years in length.

The site chronology, pair–master and individual sequences were then compared against the pine reference group (Table A24, *see appendix*). The pair master LM16_18 and two of the individual sequences, LM7 and LM17 compared well with these regional chronologies, and when the four sequences were included in a new site chronology, LMMNx11 at the corresponding position of match, the correlations with the regional chronologies strengthened (Table A24, *see appendix*), dating LMMNx11 to AD 1445 -1605. Thus, 11 of the 20 timbers have been dated.

Date of construction

The chronological relationships of the dated timbers are illustrated in Figure 25 and their calendar dates are presented in Table A22 (*see appendix*). The bark edge was present on four, possibly five of the dated timbers, indicating felling in 1589, 1591, 1601 and 1603, while the outermost ring on LM8 was dated to 1605 indicating a felling episode after that date. There is thus at least 17 years between felling episodes. There is abundant evidence for stockpiling at this period, amongst the buildings described in this report and elsewhere, but it seems unlikely that timber of good construction quality would have lain around as much as 17+ years, particularly at a time when Edinburgh was experiencing a building boom. We have argued that two phases of construction are indicated, one in 1591 or shortly after and another shortly after 1605. Of the *in situ* timbers on Floor 3 LM10 was felled in 1603 and LM8 was felled after 1605 so we surmise that Floor 3 is the later construction. There are no *in situ* timbers with surviving bark edge on Floor 2. However, LM15, one of the *ex situ* timbers felled in 1591 correlates well with LM2 on Floor 2 and its decoration also suggests that it formed part of Floor 2, so as none of the dated *in situ* timbers end later than that date we surmise that Floor 2 was the first to be installed, in or shortly after 1591.

Figure 26 Law's Close, Kirkcaldy: red and green but flat arabesque

6.7 LAWS CLOSE, KIRKCALDY

6.7.1 Construction history

The building is described as being 'built about 1590 by the Law family of ship-owner/merchants' (Kay 2006) but the evidence for this date is not given.

6.7.2 Painted decoration

Three painted ceilings were discovered in this merchant's house. One had the *space filling floral*; another had the *thin-ribbed compartments*. A third room was decorated with a pattern similar to the *flat arabesque* (Figure 26) but with a restricted use of shading and colour, short of the full rendering seen in the *flower strewn arabesque*. The type is uncommon.

These three different patterns of painting may have been adopted for different room functions, for communal use, private spaces or bedchambers.

6.7.3 Dendrochronology

The pine timbers from this building were sampled in 1990 during renovation work and analysis was undertaken in 1998 but at that time the assemblage could not be dated (Mills 1998). The timbers sampled included six of the painted ceiling boards on the first floor, three joists from the second floor and 10 elements of the roof structure (Table A25). Internal correlations produced only three pairs that compared well together and pair-masters were constructed (Table A26); the correlation between R16Y and R16Z was so high as to indicate that they had come from the same tree.

The pair-masters and the individual sequences were then compared against the pine reference group (Table A27). Two of the pair-masters, LCK14MAS and LCKE7E10, as well as two individual sequences, LCKR15 and LCK2E3 produced consistent correlations, particularly against the other Scottish 'import' chronologies and some of the regional chronologies. A site-master, LCKMNx6, 131 years in length was constructed which dated to 1489–1619 AD.

Date of construction

The chronological relationships of the dated timbers are illustrated in Figure 27 and their calendar dates are presented in Table A25. LCK2E10C is the only sequence with unequivocal bark edge and it was felled in 1617 AD. The outermost rings on LCKR15 and LCK2E3 are dated to 1618 AD and 1619 AD respectively but there is some uncertainty about presence of the bark edge (Mills 1998). However, on the basis that the dates cluster so closely with the absolutely dated timber it seems very probable that they do indeed lie on the bark edge. The painted ceiling was therefore probably installed some time shortly after 1619 AD.

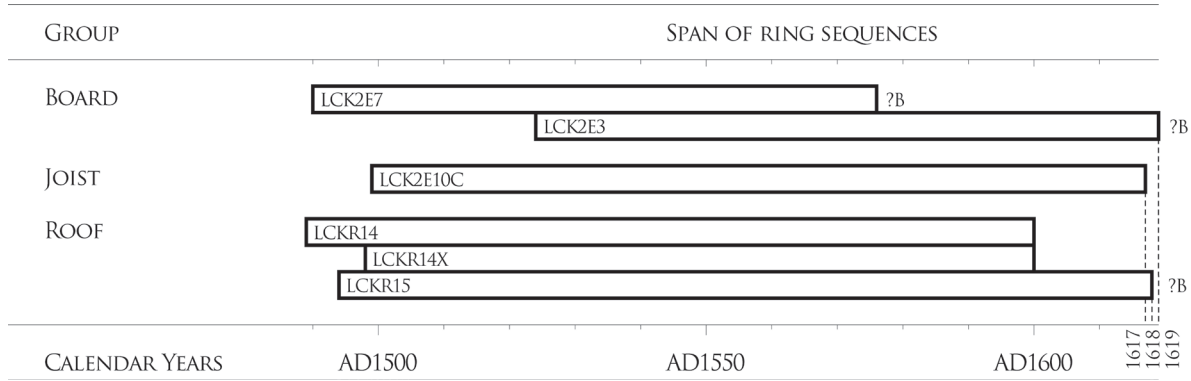

Figure 27 Law's Close, Kirkcaldy: bar diagram showing chronological relationships between the dated timbers

7. THE CONTRIBUTION TO ART HISTORICAL STUDIES

Michael Bath

The various types of subject matter and decorative styles on the buildings included in the present survey are summarised below.

Abbey Strand, Advocate's Close and Lawnmarket all belong with the large number of other painted ceilings in houses all down the Royal Mile in Edinburgh, which comprise the most numerous group of such ceilings to have survived anywhere in Scotland, with further examples at John Knox's House, Moubray House, Gladstone's Land, 'Mary of Guise's House', Canongate Tolbooth, Riddles Court, Somervilles Land, etc. It is not surprising that painted ceilings should have been so numerous in what were, in fact, mostly burgess houses down the main street of Scotland's capital city, and although their choice of decorative styles is not, generally, particularly adventurous or original, it is characteristic of what might be thought of as the 'vernacular' style of decoration to be found throughout Scotland at this period. It thus represents the normative patterns and styles on which the whole tradition rests, which makes its dating of some importance.

At Abbey Strand we find on the second-floor beams some outstanding examples of Renaissance arabesque work (Figure 28). Essentially two-dimensional leafy scrollwork, which could be elaborated into infinitely variable patterns, arabesque ornament became fashionable throughout Europe from the late 15th century onwards, with pattern prints designed by such Renaissance masters as Pellegrino (Figure 29), Ducerceau, Balthasar Sylvius, and Pierre Flötner circulating widely and used in metalwork, wood carving, weaving and embroidery as well as in painting. None of the Scottish examples – at Abbey Strand, 302-4 Lawnmarket (Figure 30), Gladstone's Land, Moubray House (Figure 31), Old Gala House (Galashiels) – have yet been shown to copy these pattern prints directly, however, and this would not have been a difficult style of decoration for apprentice craftsmen, who belonged to the masonic guilds responsible for all this painting in Scotland, to have designed for themselves. Arabesque work is found on several other Scottish painted ceilings, and the Abbey Strand examples closely resemble those recently uncovered on beam sides and soffits further up the Royal Mile at Moubray House, which are similarly enclosed in rectangular frames, suggesting that both may have been executed at a similar date if not by the same hand, though it should be noted that neighbouring householders were always likely to follow local fashions or the tastes of their neighbours. What one might call 'boxed' (or 'framed') arabesques are characteristic of this style in Scotland.

Figure 28 Abbey Strand arabesques

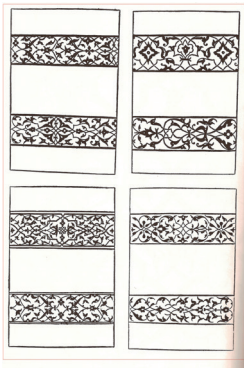

Figure 29 Francisque Pellegrin, arabesque patterns from La Fleur de la science de poutraicture et patrons de broderie (1st edition Paris 1530).

Figure 30 Arabesques at 302-4 Lawnmarket

Figure 31 Arabesques at Moubray House, Edinburgh

Figure 32 Fruit and flowers at 302 Lawnmarket

Figure 33 Fruit and flowers at Gladstone's Land

Figure 34 Rossend: 'In utrumque paratus' detail showing hands holding sword and trowel

The collection of rich, but random, fruit and flowers painted on the boards at 302-4 Lawnmarket (Figure 32) represents a style found almost everywhere across Scotland in the late 16th century – with examples notably at Northfield House (East Lothian), The Merchant's House (St Andrews), Stobhall (Perthshire), Old Gala House (Galashiels), Aberdour Castle (Fife), etc. Its most accomplished example in Edinburgh is to be found almost directly opposite, across Lawnmarket, at Gladstone's Land (Figure 33) and it might well be described as the most characteristic type of decoration on Scottish painted ceilings. It is also a type of subject that requires no models or pattern prints, and could be executed by the yard once an apprentice had acquired the necessary skills. The second-floor ceiling at 302-4 Lawnmarket is somewhat unusual, however, in introducing a number of animals and birds amongst its leaves and different fruits.

The bunches of grapes enclosed in acanthus leaves on the boards from Carnock may be seen as a variety of this type, treated on a larger scale since they fill the boarded space between beams and not the actual beams. The fragmentary aphorisms and biblical texts on the beams at Carnock (Figure 16) resemble those 'Grave Sentences' (Bath 2003, p169) found at such places as Crathes, Delgaty, Traquair, and Earlshall. These are an important witness to the deeply embedded status of proverbial wisdom in Scottish culture of the 16th and 17th centuries, which has long been recognised in literature, and in the Bannatyne manuscript in particular (Whiting 1949; 1951; Bath 2003, p176-7). The 21 similarly biblical texts inscribed on the beams at Sailor's Walk, Kirkcaldy are among the more notable examples of such sententious wisdom, whose architectural functions have been well studied in a British context by Tessa Watt (1991) and whose connections with commonplace rhetoric and, quite possibly, the art of memory are discussed in Bath (2003, p16-17). The fragmentary 'IN VTRVMQVE PARA…' text preserved in the gable-end panel from the Bay Horse Inn has been identified as part of an emblem motto ('In utrumque paratus') which the emblem books by Claude Paradin and, following him, Geffrey Whitney associate with two hands holding a trowel and a sword to show that the country should be prepared for either war or peace, or as the version of it used in the Skelmorlie Aisle (Ayrshire) puts it 'for warre or worke' (Bath 2003, p133-4). The emblem was also used at Rossend (Figure 34), and in 'Mary of Guise's House'. This might lead to it being more associated with the copious use of emblems at such sites as Culross (where Whitney is also the source) or at Pinkie House, but the Bay Horse Inn's

version locates this emblem in a quite elaborate piece of *trompe l'oeil* false architecture consisting of a classical archway. This is mural painting and not part of a ceiling, therefore, but its art-historical significance should be clarified in association with other more extensive and better preserved examples of false-architecture such as the ceilings at Skelmorlie Aisle or Pinkie. This tendency to play with illusion in the interpretation of architectural space is typical of Renaissance Mannerism, bringing art into close association with architecture and confirming that neoclassical impulse which has been identified in much more ambitious buildings such as Pinkie House.

The readiness of Scottish decorative painting to interpret two-dimensional surfaces as three-dimensional can also witnessed in its widespread use of *trompe l'oeil* effects, whether the simple illusion of chamfered or rebated frames in the ubiquitous boxed arabesques, or the more complex strapwork cartouches which we find at Pinkie, or the type of false-architecture at Pinkie, Skelmorlie Aisle or Bay Horse Inn. Whilst *trompe l'oeil* can be found in most traditions of decorative painting at this period, the fact that Scottish boards and beams were seldom, if ever, carved might well account for the popularity of such treatments in Scotland, unlike England where exposed woodwork is much more commonly treated to decorative carving.

The English taste for decorative plasterwork is commonly alleged to have taken its starting point from Henry VIII's extraordinary stucco decoration of Nonsuch Palace between 1538 and 1545, even though this was high-relief external work for which the Italian Nicholas Bellin is thought to have been responsible. However, as Claire Gapper points out, there was already much experimentation with plaster as a decorative medium before this date in England, and it is certainly the case that 'Only on the ceiling did plaster come to dominate the decorative scene in England in a manner which was unknown in the rest of Europe' (Gapper 1998, Chap IV).

Although similar decorative plasterwork is found in Wales, 'there were no parallel developments in Scotland until later in the 16th century' (*ibid*). Plaster ceilings in England are typically covered in rectilinear patterns known as 'fretwork', frequently with bosses or pendants at the intersections of beams or ribs. Their conformity in many cases with the patterns illustrated in Sebastiano Serlio's *Five Books of Architecture* has encouraged the description of these as 'antique work'. One of the most popular rib layouts is the 'cross and star' pattern used in Wolsey's lodging at Hampton Court and illustrated in Serlio, Book IV, f. 68v (Gapper, fig. 23). This pattern is also found in Scotland at Kinneil House, although executed in wooden coffering not in plaster (Figure 35). By the end of the 16th century ribs in England are frequently enriched with decorative detail, but long before this moulded wooden ribs were laid on plaster, whilst

Figure 35 Kinneil House: 'Parable Room' ceiling with rib mouldings in cross-and-star pattern based on Serlio, and painted *trompe l'oeil* chamfering of panels

exposed structural timbers were sometimes treated to decorative carving. Applied detail in carved wood or lead mouldings is found in the ceiling of Wolsey's closet and elsewhere (Penoyre 1994, p14). In Scotland, where the exposed wood is seldom given to such three-dimensional decorative treatment, the painting nevertheless frequently gives the two-dimensional surfaces a three-dimensional appearance through the use of *trompe l'oeil*. Such detail is characterised historically, in both countries, as 'antique work', with Hans Vredeman de Vries's designs for strapwork frequently identifiable as patterns for plasterers in England just as we find them used in the *trompe l'oeil* painted strapwork that, in Scotland, we find at places such as Pinkie House.

Painted wooden ceilings are not unknown in England, though they are certainly far less common. The surviving examples confirm the impression of a shared Renaissance design vocabulary that we have noted in the English plasterwork. The 16th century painted ceiling from Winchester College, for instance, has such a stylistic correspondence with Scottish practice that it was felt to be entirely appropriate to copy some of its detail for Historic Environment Scotland's newly redesigned and reconstructed Palace of Stirling. Painted in 1554 for the headmaster of Winchester College, the most obvious sign of the College ceiling's appropriateness as a pattern for use in Stirling was its use of medallion heads ('portrait heads') in roundels (Lewis 1995, figs. 3, 4, 7-10). Lewis writes 'Dendrochronology indicates that the joinery is of two phases, the ceiling and part of the frieze dating to 1498-1505. The remaining frieze boards were not made until after 1547, supporting [the] view that the decoration of the frieze was commissioned by the warden John White in celebration of the marriage of Mary I and Philip of Spain in Winchester in 1554' (*ibid* p162). The decorative style shows 'the early diffusion of the Antique style and its sophisticated and scholarly application in domestic as well as ecclesiastical settings' in England. It is a claim we should now have no hesitation in advancing for Scottish painted ceilings.

8. THE CONTRIBUTION TO DENDROCHRONOLOGICAL STUDIES IN SCOTLAND

Anne Crone

8.1 Pine

The greatest advances in this study have been made in the chronological coverage of pine. A handful of 18th century buildings have been dated, all constructed with pine imported from either Scandinavia or the eastern Baltic (Crone and Mills 2013, p347-51 – and see Table 5) but the only 16th and 17th century constructions using Scandinavian pine were floorboards and joists in the Palace at Stirling Castle (Crone 2008, p17-18). The painted ceilings project has added five assemblages covering this period and enabled us to date another building, Lambs House in Leith (Crone 2010 – and see below). This expanded dataset allows us to explore the provenance of the timber and examine some methodological issues in a little more depth.

Provenance

The pine reference group includes regional and site chronologies from central, south-west and south-east Norway and Sweden. Table 6 summarises the correlations between the Scottish building chronologies and these regional chronologies and it is clear that the Scottish data correlates most strongly with the southern Norwegian chronologies; there are no correlations with the central Norwegian chronology and very few with the Swedish chronologies. If we look at the source of the timber in these regional chronologies it is possible to more closely identify the source of the Scottish timber. The regional chronologies with which all the Scottish data correlates most strongly and consistently are from the districts of West and East Agder, the southernmost tip of Norway. There are also consistent correlations with the Oslo chronology, the timber for which probably came from Oslo fjord or even up-river of the city (Aoife Daly pers comm). There are fewer correlations with the SE Norway chronology, which is based on timbers mainly from the upland and inland areas of Numedal and Hallingdal (Thun 2005, p72), and even fewer correlations with the W Norway chronology which is based on timbers from the lowland areas around Bergen (*ibid*). The dendrochronological evidence therefore suggests that the timber being exported to Scotland was coming mainly from southern Norway with some coming from the more easterly districts. This would also explain the occasional correlations with some of the Swedish chronologies.

SCOTTISH PINE CHRONOLOGIES (in chronological order)				
Building	**Timber**	**Chronology**	**Felling dates**	**Source**
Stirling Castle QBCPINEx6	boards	1370 - 1535	1535	Norway
Abbey Strand	boards	1329 - 1546	tpq 1546	Norway
Bay Horse Inn	beam	1401 - 1583	1582, 1583,1583/4	Norway
GP 1-10	beam	1405 - 1602	1599, 1602	Norway
Lawnmarket, Edinburgh	beam	1445 - 1605	1589, 1591, 1601, 1603, >1605	Norway
Lamb's House, Leith	beams	1408- 1608	1604/5, 1608/9	Norway
Law's Close, Kirkcaldy	beams and boards	1489 - 1619	1617, >1618, >1619	Norway
Stirling Castle SPPINEx15	beams	1476 - 1671	1664, 1665, 1667, 1670, 1671	Norway
Duff House	beams	1565 - 1737	1736, 1737	Scandinavian
Fort George	beams	1350 - 1764	1762, 1763, 1764	Finland/Russia and E Baltic
Market St Haddington	beams	1590 - 1776	1708, 1765, 1776	E Baltic
Elderslie House	beams	1580 - 1774	1768, 1774	E Baltic
Stirling Castle GHPINEx5	beams	1593-1786	1783, 1786	E Baltic

Table 5 Summary of all imported pine chronologies in Scotland

	ASPMNx5	BHIMNx5	UNKMNx5	LCKMNx6	LMMNx11	LHLMNx6	FORTHx6	SSPINEx15	QBCPINEx6	IMPORTx8
At end-year	*1546*	*1583*	*1602*	*1619*	*1605*	*1608*	*1329 - 1619*	*1671*	*1535*	*1329 - 1671*
Master chronology										
Norwegian chronologies										
99700010 (AD 552 - 1979)	/	/	/	/	/	/	/	/	/	/
Mid-Norway - Trondelag										
99500010 (AD 765 - 1996)	4.4	/	/	/	/	/	5.10	/	/	5.05
SW Norway										
99200010 (AD 871 - 1986)	4.34	4.15	/	/	/	/	4.35	/	6.66	6.51
SE Norway										
NOMK0908 (AD 1121 - 1863)	/	6.85	5.46	4.04	6.02	6.67	4.33	8.88	5.18	8.24
W and E Agder, S Norway										
N007m005 (AD 1471 - 1622)	4.53	3.59	/	4.12	6.24	/	5.94	7.18	3.91	9.15
Bolvaerk, Oslo										
VAuAaseralPISY2	4.73	7.88	4.09	4.52	7.15	6.66	6.84	7.89	6.85	10.64
East Agder										
K010301s (AD 1395 - 1706)	6.09	4.16	/	3.75	4.51	4.14	7.04	7.34	6.18	9.00
Lower Saxony (Norwegian source)										
Swedish chronologies										
DALARNAB (AD 1391 - 1888)	5.28	/	/	/	/	/	/	/	5.03	/
Thomas Bartholin pers comm										
E GOTLAND (AD 1469 - 1840)	/	/	/	/	3.5	5.61	4.35	4.87	/	6.41
Thomas Bartholin pers comm										
GOTLANDB (AD 1490 - 1987)	/	/	/	/	/	/	/	4.87	/	4.04
Thomas Bartholin pers comm										

Table 6 Summary of correlations between regional chronologies and Scottish import chronologies

The Norwegian historian Arnvid Lillehammer has examined the timber trade between Scotland and Norway from a different perspective, using contemporary documentation (Lillehammer 1986; 1990; 2013) to chart where the skippers were sailing from in Scotland and to where along the Norwegian coast, as well as the quantity and type of timber product being exported. The districts of Sunnhordland, Rfylke, Agder, Telemark and the area around Oslofjord were heavily involved in the timber trade of this period (Lillehammer 1986, p97; 2013, p7-8) but most is known about the trade in Ryfylke because Lillehammer has studied the records of this district in detail. The 17th century in this district is known as the Scottish Period and the timber trade was called the *Skottehandelen* or the 'Scottish Trade', appellations reflecting the importance of the Scots in the trade (Lillehammer 1990, p100). The Scots were also dominant in Sunnhordland; for instance, in 1597-98 68% of the foreign vessels visiting this district were Scottish (Lillehammer 2013, p8). The dendrochronological evidence does not appear to reflect this trading activity along the west coast but this may be more of an issue of chronological coverage and levels of replication, i.e. how many timbers are represented in each chronology. We have speculated that the tree-ring signal from the small, varied environmental niches up the fjords of Norway's west coast may be too distinctively local to be picked up in the regional chronologies and thus generate little or no correlation (Crone and Mills 2012, p348), and the apparent difference between the historical and dendrochronological evidence seen in this study suggests that this may well be the case.

Methodological issues

The heterogeneity of many assemblages of imported timber has already been noted (Crone and Mills 2012, p343) and this is also a characteristic of the assemblages under study here. Internal correlation was generally low, with only pairs and/or trios of sequences comparing well together. This is most noticeable in the Abbey Strand pine boards where correlations between some of the groups were so strong as to suggest an origin in the same tree or woodland (Table A6) but there were no correlations between the majority of the boards. Some of the groups of matching boards lie alongside each other, for instance B5/B6/B7 and B11/B12/B13 (Figure 3). This suggests the use of a mixed stockpile of boards from various sources, but not so mixed that occasionally groups of boards from the same tree have ended up in the same building and in the same stack, so that the carpenter, working his way systematically through a stack, will have placed the boards alongside each other.

There are assemblages of imported timber whose dendrochronological characteristics are more homogenous, i.e. that display greater internal agreement, like the Abbey Strand oak beams for instance, and the Stirling Palace pine beams and boards (Crone 2008, p40, p42), and these may represent cargoes of timber that were imported for a specific building job, selected from a restricted number of sources in Norway and then batched together for shipping. The Crown certainly sent merchants abroad to buy timber for Royal building projects; in 1512 the skipper, Thomas Bannatyne was sent to Norway '*to bring hame gret tymmer*' (TA 4, p289) and in 1539 a Charles Murray was sent to Denmark to buy timber for building works at Stirling (TA 7, p159).

The degree of heterogeneity in an assemblage hinders the construction of a robust site chronology which can more easily be dated and for this reason experience has shown that for pine dendrochronology the larger the assemblage of samples the better the chances of successful dating (Groves 1997; 2000). The proportion of each assemblage that has been successfully dated is presented in Table 4; for pine it varies from 19% to 63% but is still much lower than the proportion of oak timber that is now routinely dated. The factors affecting a successful outcome for pine are varied (see below) but size of assemblage and length of ring-sequence are important determinants. Most of the dated timbers in this study are over 90 years in length but there are a few dated sequences with only 60 rings and one with only 48 measured rings (see Bay Horse Inn and 302-4, Lawnmarket). However, there are also many long sequences with between 100 and 200 rings which could not be dated. It is therefore difficult to determine guidelines for sampling which will ensure successful dating. What is clear is that, for 16th century and later assemblages of imported timber, they are likely to be very heterogeneous, reflecting the mixed nature of the cargoes arriving in Scotland, and for that reason, as large an assemblage of timbers as possible will always be desirable. With the exception of Carnock all the assemblages studied here, both oak and pine, have displayed a range of felling dates (Table 4), and comprehensive sampling would ensure that the fullest range of felling dates are identified, thus making it easier to clarify the relationship between felling date and construction date (see Chapter 2.3).

The expanded dataset of pine 'import' chronologies covering the 16th and 17th centuries has improved our ability to date new assemblages of this period. They helped to date some of the pine rafters and floor joists in Lamb's House, Leith by confirming the low correlations obtained against some of the regional chronologies, thus dating the building to 1609 and indicating that the pine was also coming from southern Norway (Table 6; Crone 2010). They have also helped to refine the source of the pine chronologies from Stirling Palace; identified as Scandinavian at the time (Crone 2008, p19-20) it is clear that the source of their timber is also southern Norway (Table 6). As the eight pine 'import' chronologies which represent pine from southern Norway correlate well together (Table 7) they have been combined to form a master chronology, IMPORTx8 which spans the years 1329 –1671 and contains 59 sequences. This will provide a powerful tool for the dating of imported pine from this area in the future and may also prove useful in dating buildings in the source areas in Norway itself.

			QBCPINEx6	SPPINEx15	UNKMNx5	ASPMNx5	BHIMNx5	LCKMNx6	LHLMNx6	LMMNx11
	Begins	*Ends*								
QBCPINEx6	AD1370	AD1535	/							
SPPINEx15	AD1476	AD1671	-	/						
UNKMNx5	AD1405	AD1602	-	-	/					
ASPMNx5	AD1329	AD1546	5.53	3.15	3.98	/				
BHIMNx5	AD1401	AD1583	-	-	-	4.64	/			
LCKMNx6	AD1489	AD1619	-	4.10	5.97	4.56	5.17	/		
LHLMNx6	AD1408	AD1608	-	3.35	5.74	5.20	4.74	4.87	/	
LMMNx11	AD1445	AD1605	-	4.32	5.23	3.18	4.13	7.96	4.22	/

Table 7 Summary: t-value matrix for all Scottish pine import chronologies

8.2 Oak

The oak beams in Abbey Strand, Carnock and Advocate's Close also came from the same districts of Norway as the pine beams and boards. This is unsurprising; oak grows naturally only in the coastal districts of southern Norway and, during the later medieval period, the bulk of the oak was exported to countries such as Denmark, Germany and the British Isles (Thun 2002, p25–6). It also replicates the pattern observed in earlier work, in that most of the imported oak found in buildings in Edinburgh and the Lothians has been identified as Norwegian (Crone and Mills 2012, p339).

As they came from the same areas it seems most probable that the oak and the pine were imported together in mixed cargoes and so we might expect the same issues of heterogeneity. However, the oak assemblages display greater homogeneity than the pine (Tables A2, A9 and A13), possibly because the timber was being felled in a more limited number of woodlands. The export of oak from Norway was banned from 1602 (Lillehammer 1986, 104) presumably because it was already in short supply by then, so by the late 16th century there may have been fewer and fewer sources of oak to exploit.

8.3 Discussion

Scottish documentary sources indicate that Norwegian timber was arriving in Scotland from the early decades of the 16th century but these references give no indication of the scale of the trade at this time (i.e. in 1501 - *'payit to Noroway men for tymir'* - TA 2, p272; in 1506 - *'to the Northland for tymir'* - TA 3, p196; in 1512 - *'to pass in Norway to bring hame gret tymmer'* - TA 4, p289). Records begin to improve by the middle of the century when the numbers of skippers and vessels arriving in ports begin to be counted (Lillehammer 1986, p101; Ditchburn 1990, p80) but it is not until the 17th century that records are detailed enough to be able to quantify the trade. The dendrochronological data thus provides an important source of material evidence for the timber trade in the 16th century to complement the scant documentary sources. It shows that oak beams were being imported from Scandinavia from the late 15th century and throughout the 16th century. Towards the end of the 16th century pine beams from Norway begin to replace oak and by the early 17th century imported oak is rarely found in Scottish buildings, the single oak beams in Lamb's House, Leith (1609) and Gardyne's Land, Dundee (>1660) being those rare examples. The earliest evidence for imported pine boards are those over the Queen's Bedchamber, Stirling Palace (1535). The sawmills that produced these boards first appeared in Norway in the early 16th century and within decades were widespread throughout southern Norway (Lillehammer 1986, p100) so the Stirling Palace boards may represent an early example of this new export commodity. We have only had the opportunity to analyse the boards of two other ceilings so far, at Abbey Strand and Law's Close, Kirkcaldy and both of these are also Norwegian pine. Scotland imported large quantities of these boards; in 1602-3 Scottish vessels transported 16,000 boards from the district of Ryfylke alone (Lillehammer 1990, p103) so many of these must have ended up in the painted ceilings of the era.

Many of the Scottish vessels visiting the fjords of Ryfylke came from the ports around the shores of the Forth; in 1567, vessels from St Andrews, St Monans, Kirkcaldy and Leith are recorded and this pattern continues into the 17th century with vessels from St Andrews, Crail, Anstruther, Pittenweem, St Monans, Elie, Largo, Leven, Wemyss, Dysart, Kirkcaldy, Burntisland and Culross all recorded in the Norwegian Customs Books (Lillehammer 1986, p105-6). All these vessels were carrying boards and beams for the building industry in the ports and their hinterlands. The results of the dendrochronological analysis of eight buildings in which these timbers finally came to rest suggests that, from a dendrochronological point of view the Forth could be treated as a single region, with timbers from neighbouring forests in Norway ending up on either side of the Forth.

This pattern of timber importation has not been identified in England. Apart from Baltic oak boards used for specialised purposes such as panel painting (Cooper 2011, p302) and making chests (Bridge and Miles 2011) imported oak used in building construction has rarely been identified in England (Ian Tyers pers comm). Imported softwoods for building timber only begin to appear in the late 17th century; dendrochronological analysis has identified pine beams of this date in a few buildings in London and spruce timbers used as piling at Tilbury Docks (Groves 1997; 2000). A well-developed tradition of woodland management (Rackham 1983, p84-91) probably meant that the English needed less recourse to foreign timber than in Scotland.

In Section 2 MB makes the point that the painted board-and-beam ceilings were a very Scottish phenomenon which, with a few rare exceptions, was not developed elsewhere in England or Europe. The emergence of this decorative fashion towards the mid-16th century coincides with the appearance of sawn pine boards amongst the cargoes being shipped into Scotland and it is tempting to speculate that the arrival of this new commodity stimulated the development of this fashion, the wide, regularly-sawn boards offering a good medium for the application of painted decoration. That said, Baltic oak boards had been used as a basis for painted decoration for some time, as for example in the barrel-vaulted ceiling in the Guthrie Aisle, Angus, painted between 1465 and 1468 (Crone and Fawcett forthcoming), but the Norwegian pine boards may have provided a cheaper and more easily available alternative, as they had only to be shipped the relatively short distance across the North Sea. Of course, this is no simple causal relationship and there were other factors at play in the development of the fashion for painted ceilings, not least the attraction and influence of the decorative imagery appearing in Europe, and the increasing wealth of the merchant classes and the attendant building boom in Edinburgh and its environs.

9. SUMMARY

In this study eight painted ceilings from seven buildings have been successfully dated by dendrochronology (Table 4). None of these new dates expand the accepted chronological range of the corpus – they fit comfortably within the century from *circa* 1550 to *circa* 1650 – but they do substantially add to the body of recorded dates (Table 1). There is associated dating evidence, in the form of either datestones or documentary references for the construction of three of the buildings. In all instances the dendro-dates lie close to the associated dates, showing that at Advocate's Close and Bay Horse Inn the ceilings were installed a year after the datestone, while for Bay Horse Inn and Abbey Strand, there is a lag of one to five years respectively before the documentary references to their construction. We can thus be confident that the dendro-dates for the four ceilings without associated dating evidence relate similarly closely to the actual date of installation. These findings tally with Michael Bath's discovery, mentioned earlier, of a new source for one of the emblems at Pinkie House, which copies an engraving that was only published a year later than its 1613 datestone.

All of the timber used in these ceilings, both oak and pine, came from Norway, probably from the southern and eastern districts of the country. The successful dendro-dating of the pine constructions has enabled us to build a robust local chronology for the Forth which will facilitate the dating of imported pine timbers in the future and may also prove useful in dating buildings within Norway itself.

Analysis of the decorative schemes shows that the ceilings reported on in this study display fairly representative examples of some of the styles and patterns employed throughout the corpus, with the exception of the Bay Horse Inn which, though a small building, was remarkably sophisticated in its decoration, and reflects an aristocratic and literate culture. The other ceilings in this study show no real major developments in the range and style employed over the period, apart from the increasing dominance of the busy space-filling pattern of fruit and flowers. It seems that these patterns satisfied the needs of urban elites who felt less inclined than aristocrats to demand novelty.

This collaborative study, between art-history and dendrochronology, has yielded new evidence about the character and history of the painted ceilings of Scotland, and suggests economic stimuli for the appearance of this fashion in the mid-16th century, some decades after the influence of the European Renaissance begins to be seen in other areas of the decorative arts.

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APPENDIX

Table A1 Abbey Strand oak: Sample details

Beam	No. rings	Outer rings	Calendar date	Felling date	Season of felling
CR1	*c50-60*	*be*	*not measured*		
CR2 (B7)	85 +1	be	1480 - 1564	1565	spring-cut
CR3	119	be	1445 - 1563	1563/1564	winter-cut
CL/CC1	156 +1	be	1408 - 1563	1564	spring-cut
CL/CC2	224	be	*undated*		spring/summer-cut
CL/CC3	169 +1	be	1395 - 1563	1564	spring-cut
CL/CC4	141	bark	1422 - 1562	1562/1563	winter-cut
CL/CC5	97 +1	be	1467 - 1563	1564	spring-cut
CL/CC6	194 +1	be	1370 - 1563	1564	spring-cut
CL/CC7	188 +2?	be	1373 - 1560	*tpq* 1560	
CL/CC8	123 +1	be	1440 - 1562	1563	spring-cut

Table A2 Abbey Strand oak: ASOMNx8 t-val matrix

	CR3	CLCC1	CLCC3	CLCC4	CLCC6	CLCC7	CLCC8	CLCC5	
CR3	/								)
CLCC1	3.88	/							)
CLCC3	3.36	3.36	/						)
CLCC4	4.19	4.12	6.2	/					) ASOMNx8
CLCC6	5.82	4.42	5.62	5.33	/				)
CLCC7	x	5.68	3.75	3.68	4.74	/			)
CLCC8	4.76	4.42	x	3.44	4.45	x	/		)
CLCC5	3.94	4.43	3.59	x	3.39	x	4.45	/	)

Table A3 **Abbey Strand oak: Statistical correlations with Scottish 'import' chronologies (those chronologies shaded in light grey are Norwegian in origin, those in dark grey are southern Scandinavian, i.e. Swedish or Danish, and those which are unshaded have a generic Scandinavian provenance)**

	CR3	CLCC1	CLCC3	CLCC4	CLCC6	CLCC7	CLCC8	CLCC5	ASOMNx8	CR2	ASOMNx9
At end year	*1563*	*1563*	*1563*	*1562*	*1563*	*1560*	*1562*	*1563*	*1563*	*1564*	*1564*
Scottish import chronologies											
DUNTARVIE (1385 - 1529 AD)	4.41	4.37	4.94	6.11	6.17	6.26	3.99		9.48		9.51
Duntarvie Castle, West Lothian											
DTHMNX2 (1360 - 1509 AD)		4.04	5.58	4.20	5.98	4.93			6.28		6.58
Townhouse, Dunbar, East Lothian											
EDINCAS2 (1358 - 1509 AD)	4.15	5.46	3.68	4.89	6.50	6.27	4.41		7.63		7.68
Edinburgh Castle, Great Hall											
375HSMN (1338 - 1570 AD)	4.00		4.66	3.79	3.62				5.71		6.15
375 High St, Edinburgh											
FTMAS2 (1318 - 1572 AD)	5.87	6.90	4.97	4.97	8.64	6.60	6.19	6.50	10.54	3.97	10.57
Fenton Tower, East Lothian											
BRECHIN1 (1359 - 1470 AD)		5.15		3.80	4.15	5.30			6.49		6.49
68-74 High St, Brechin											
QMBH01 (1423 - 1550 AD)			5.87	6.19	4.75		3.68		8.07		8.13
Queen Mary's Bathhouse, Holyrood											
JKNOXH1 (1466 - 1560 AD)		4.72					4.63	4.19	4.84		4.73
John Knox House, Edinburgh											
OCHMN (1373 - 1563 AD)	4.90	5.46			6.22	4.18	5.54		7.09		7.25
Old Craighouse, Edinburgh											
STSERFx7 (1377 - 1511 AD)	4.19	6.08	5.79	6.54	6.15	4.33	4.74	3.56	6.28		6.35
St Serfs Church, Dysart, Fife											
PANLKL39 (1366 - 1569 AD)	3.54		3.82	4.79	6.70	7.27	3.65		9.23		9.15
Panel, NMS Edinburgh											
CARNOCKx8 (1317 - 1588 AD)	6.27	5.18	4.50	4.28	5.86	4.07	3.71	3.68	6.19	4.46	6.57
Carnock House, Stirling (*ex-situ*)											
ACMNx8 (1428 - 1590 AD)	3.81						3.63		5.56		6.17
Advocates Close, Edinburgh											

Table A3 (Cont'd)

	CR3	CLCC1	CLCC3	CLCC4	CLCC6	CLCC7	CLCC8	CLCC5	ASOMNx8	CR2	ASOMNx9
At end year	*1563*	*1563*	*1563*	*1562*	*1563*	*1560*	*1562*	*1563*	*1563*	*1564*	*1564*
SEP1505 (1355 - 1505 AD)				3.74				4.34	5.95		5.75
Stirling Palace											
SEP31538_9 (1366 - 1538 AD)					4.12		3.73	4.23	5.11		4.81
Stirling Palace											
SEP31539 (1361 - 1539 AD)							4.05	4.22	3.69		
Stirling Palace											
SEP41592 (1390 - 1592 AD)					3.95		4.81	4.13	5.88		5.79
Stirling Palace											
FTMAS1 (1366 - 1547 AD)		3.77				4.13	4.08				5.73
Fenton Tower, East Lothian											
MIDHOPE (1265 - 1505 AD)									5.64		
Midhope Castle, West Lothian											
GAROOF1 (1348 - 1464 AD)						4.07			4.85		4.85
Guthrie Aisle, Angus											
GAROOF2 (1350 - 1458 AD)											
Guthrie Aisle, Angus											
BRECHIN2 (1451 - 1575 AD)											
68-74 High St, Brechin											
GLB1_56A (1475 - 1544 AD)											
Gardyne's Land, Dundee											
GLA3_2 (1376 - 1595 AD)											
Gardyne's Land, Dundee											
GLB3_4ST (1500 - 1660 AD)											
Gardyne's Land, Dundee											
LHLA_08 (1424 - 1608 AD)											
Lambs House, Leith											
OSU1NEW (1391 - 1520 AD)											
Old Student Union, St Andrews											

Table A4 **Abbey Strand oak: Statistical correlations with foreign chronologies**

			CR3	CLCC1	CLCC3	CLCC4	CLCC5	CLCC6	CLCC7	CLCC8	ASOMNx8	CR2	ASOMNx9
		At end year	*1563*	*1563*	*1563*	*1562*	*1563*	*1563*	*1560*	*1562*	*1563*	*1564*	*1564*
Chronology	**Location**	**Calendar range**											
Danish chronologies													
2X900001	Sjælland	AD830-AD1997		4.26			3.62	3.85	3.58	3.51	5.35		5.26
9M456784	West Denmark	109BC-AD1986									/		/
JUTLAND6	Jutland	AD846-AD1793	3.75	4.53			3.63	3.86		4.79	4.44		4.49
Swedish chronologies													
SM000012	W Sweden	AD1125-AD1720		3.71			4.91		3.74	5.21	4.9		4.73
SM100001	Ystad, S Sweden	AD1310-AD1539						4.14		4.96	4.07		4.15
Norwegian chronologies													
Grimstad	Eide kirke, Grimstad town, S Norway	AD1403-AD1731	5.85	6.57	4.66	6.36	4.74	5.94	4.91	3.8	11.72		11.93
N053N027	Vennesla and Bjorvatn, S Norway	AD1480-AD1678	4.75							4.21	4.78	3.86	5.69
N-all01	Agder - Denmark - Germany-Scotland	AD1264-AD2005	6.79	8.42	5.39	6.5	4.63	7.88	6.26	6.59	11.49	4.21	11.94
N-hist03+rec	Agder 208 timber mean	AD1208-AD2005	4.13	4.61		4.3		4.39			5.39	3.98	5.96
Norwegian ship chronologies													
00651m02	A7739 B&W mean 2	AD1352-AD1568	3.58	4.92		6.19	4.44		3.97	5.29	5.94		6.2
Z010m001	Larvik 5 and 6	AD1480-AD1727	3.74							3.95	4.47		4.55
Z0306M01	Barcode 6	AD1418-AD1585				4.17		3.52		3.58	4.4		4.53
Z062m001	Oslo Vaterland	AD1384-AD1512	4.72	6.92	5.45	5.99	5.22	5.86	6.64	4.85	9.51		9.47
Z071m004	Barcode 08	AD1304-AD1595	7.16	4.93	4.04	4.12	5.25	6.71	3.78	5.87	6.68		6.99
Z096M001	Bispevika 2 SHORT	AD1378-AD1517	4.63	6.61	5.65	7.13	3.63	6.82	7.18		10.57		10.66
21015M02	A7739 B&W 24 tree mean	AD1305-AD1743	4.99	5.6	3.79	4.5	3.6	8.51	4.72	6.06	8.51	5.21	9.21
2101M001	A7739 B&W 2 3 9 11 32 43	AD1487-AD1743	4.23	3.97						5.36	4.94	3.69	5.76

Table A5 Abbey Strand pine: Sample details ('be?' indicates uncertainty about presence of bark edge)

Sample no.	No. rings	Pith	Outer rings	Sapwood	Calendar date	Felling date
A3	112				AD 1413 - 1524	tpq 1524
A4	161					
A5	110					
A6	141	Pith			AD 1406 - 1546	tpq 1546
A7	138	-			AD 1404 - 1541	tpq 1541
A11	177	Pith			AD 1329 - 1505	tpq 1505
A13	164					
A14	158					
A15	195	Pith			AD 1350 - 1544	tpq 1544
AX1	43		be			
B1	106		be?	Y		
B2	128		nr be?	Y		
B3	92					
B4	119		be?	Y		
B5	114+5		nr be?	Y		
B6	163					
B7	165					
B8	87					
B9	119	Pith				
B10	112	Pith				
B11	121					
B12	96					
B13	161		be?			
B17	92		be?			
B18	95		be?			
B20	92					

Table A6 Abbey Strand pine: Correlations between pairs and groups of sequences

(a)		**A11**	**A15**		
	A11	/			} A1115mn
	A15	12.2	/		}
(b)		**B6**	**B7**	**B5**	
	B6	/			}
	B7	10.68	/		} B567mn
	B5	12.29	7.98	/	}
(c)		**B1**	**B2**	**B4**	
	B1	/			}
	B2	10.9	/		} B124mn
	B4	16.07	13.18	/	}
(d)		**B11**	**B12**	**B13**	
	B11	/			}
	B12	14.42	/		} B11_13mn
	B13	15.89	16.04	/	}
(e)		**A3**	**A6**		
	A3	/			} A36mn
	A6	5.94	/		}
(f)		**B9**	**B10**	**B8**	
	B9	/			}
	B10	7.68	/		} B8910mn
	B8	7.05	5.77	/	}
(g)		**B17**	**B18**		
	B17	/			} B1718mn
	B18	5.39	/		}

Table A7 Abbey Strand pine: Statistical correlations with foreign and Scottish chronologies

			A1115M	**A36M**	**A7**	**ASPMNx5**
		At end year	*1544*	*1546*	*1541*	*1546*
Chronology	**Location**	**Calendar range**				
Norwegian chronologies						
NOMK0908	W and E Agder, S Norway	AD 1121 - 1863			4.51	
Thomas Bartholin pers comm						
99200010	SE Norway	AD 871 - 1986			3.54	4.34
Terje Thun pers comm						
99700010	Mid-Norway - Trondelag	AD 552 1979				
Terje Thun pers comm						
99500010	SW Norway	AD 765 - 1996	5.16			4.4
Terje Thun pers comm						
N007m005	Bolvaerk, Oslo	AD 1471 - 1622		4.09	4.21	4.53
Aoife Daly pers comm						
VAuAaseralPISY2	East Agder	AD 1353 - 1936	4.05	3.9	4.17	4.73
Neils Bonde pers comm						
K010301s	Lower Saxony (Norwegian)	AD 1395 - 1706			5.23	6.09
Sigrid Wrobel pers comm						
Swedish chronologies						
DALARNAB	S Sweden	AD 1391 - 1888	4.29		4.43	5.28
Thomas Bartholin pers comm						
E GOTLAND	E Sweden	AD 1469 - 1840				
Thomas Bartholin pers comm						
GOTLANDB	E Sweden	AD 1490 - 1987				
Thomas Bartholin pers comm						

Table A7 (Cont'd)

			A1115M	**A36M**	**A7**	**ASPMNx5**
		At end year	*1544*	*1546*	*1541*	*1546*
Chronology	**Location**	**Calendar range**				
Scottish 'import' chronologies						
SSPINEx15	Stirling Palace	AD 1476 - 1671				
QBCPINEx6	Stirling Palace	AD 1370 - 1535		4.27	6.1	5.53
BHMNx5	Bay Horse Inn	AD 1401 - 1583	4.14			4.61
UNKMNx5	Gp 1-10 (unknown location)	AD 1412 - 1602		4.11		3.98
LMMNx11	302-4, Lawnmarket	AD 1445 - 1605				
LCKMNx6	Law's Close, Kirkcaldy	AD 1489 - 1619	5.29			4.56
LHLMNx6	Lambs House, Leith	AD 1408 - 1608	4.69	3.8		5.17

Table A8 Carnock House: Sample details

Beam	No. rings	Outer rings	Calendar date	Felling date	Season of felling
AR4	89 +1	be	1500 - 1588 AD	1589	Spring
AR5	266 + 21 +1	be	1317 - 1566 AD	1588 or 1589	Spring
AR8	129 +1	be	1460 - 1588 AD	1589	Spring
AR9	85	-	*undated*		
BR9	77	h/s?	1500 - 1576 AD	See AR4	
BR10	117	-	*undated*		
CR4	141	be	*undated*		
CR11	224 +1	be	1365 - 1588 AD	1589	Spring
CR12	107 +1	be	1482 - 1588 AD	1589	Spring
CR13	192 +1	be	1397 -1588 AD	1589	Spring
TR2	129 +1	be	1460 - 1588 AD	1589	Spring

Table A9 Carnock House: CARNOCKx8 t-val matrix

	AR5	CR11	CR12	CR13	AR8_TR2	AR4_BR9	
AR5	/						)
							)
CR11	5.55	/					)
							) CARNCKx4
CR12	5.61	5.36	/				)
							)
CR13	5.24	8.26	4.71	/			)
AR8_TR2	-	3.72	-	-	/		-
AR4_BR9	-	5.11	-	-	-	/	4.8

Table A10 **Carnock House: Statistical correlations with Scottish 'import' chronologies (those chronologies shaded in light grey are Norwegian in origin, those in dark grey are southern Scandinavian, i.e. Swedish or Danish, and those which are unshaded have a generic Scandinavian provenance)**

	AR5	*CR11*	*CR12*	*CR13*	CARNCKx4	AR8_TR2	AR4_BR9	CARNCKx8
At end year	*1566*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*
Scottish import chronologies								
DUNTARVIE (1385 - 1529 AD)		4.50		6.09	5.75	4.23		6.78
Duntarvie Castle, West Lothian								
DTHMNX2 (1360 - 1509 AD)	5.57	8.20		6.48	9.26			8.32
Townhouse, Dunbar, East Lothian								
EDINCAS2 (1358 - 1509 AD)	4.28	7.01		7.33	8.22	5.41		9.92
Edinburgh Castle, Great Hall								
375HSMN (1338 - 1570 AD)	4.30	5.50		4.31	6.03	3.55		6.57
375 High St, Edinburgh								
FTMAS2 (1318 - 1572 AD)	6.51	8.45	5.30	11.39	10.86	3.53	3.72	10.30
Fenton Tower, East Lothian								
BRECHIN1 (1359 - 1470 AD)		5.50		6.09	5.25			5.69
Brechin, Angus								
QMBH01 (1423 - 1550 AD)		5.66		7.87	7.39			6.92
Queen Mary's Bathhouse, Holyrood								
JKNOXH1 (1466 - 1560 AD)	4.70			6.04	6.60			4.79
John Knox House, Edinburgh								
OCHMN (1373 - 1563 AD)	5.25	6.29	3.92	4.73	7.13			6.71
Old Craighouse, Edinburgh								
STSERFx7 (1377 - 1511 AD)		5.57		8.88	6.92	4.21		7.26
St Serfs Church, Dysart, Fife								
PANLKL39 (1366 - 1569 AD)		4.30	3.50	4.16	5.20			5.22
Panel, NMS Edinburgh								
ACMNx8 (1428 - 1590 AD)		4.31		3.53	3.60	7.27	4.03	6.47
Advocates Close, Edinburgh								

Table A10 (Cont'd)

	AR5	*CR11*	*CR12*	*CR13*	CARNCKx4	AR8_TR2	AR4_BR9	CARNCKx8
At end year	*1566*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*
Scottish import chronologies								
ASOMNx9 (1370 - 1564 AD)	4.30	4.66	5.07	8.10	6.69			6.57
Abbey Strand, Edinburgh								
SEP21505 (1355 - 1505 AD)		5.00			3.95			4.63
Stirling Palace								
SEP31538_9 (1366 - 1538 AD)		5.70		5.39	5.36			5.21
Stirling Palace								
SEP31539 (1361 - 1539 AD)				5.37	4.74			4.78
Stirling Palace								
SEP41592 (1390 - 1592 AD)			3.85	6.25	6.36		6.00	6.18
Stirling Palace								
FTMAS1 (1366 - 1547 AD)				4.76	4.35			4.55
Fenton Tower, East Lothian								
MIDHOPE (1265 - 1505 AD)		3.83		4.42	4.08			4.36
Midhope Castle, West Lothian								
GAROOF1 (1348 - 1464 AD)		3.56			3.70			4.05
Guthrie Aisle, Angus								
GAROOF2 (1350 - 1458 AD)		4.21		3.55				
Guthrie Aisle, Angus								
BRECHIN2 (1451 - 1575 AD)		4.61		3.52		5.27	3.88	
Brechin, Angus								
GLB1_56A (1475 - 1544 AD)		4.98		4.48	4.06	5.18		6.23
Gardyne's Land, Dundee								
GLA3_2 (1376 - 1595 AD)					4.35		4.16	5.09

Table A10 (Cont'd)

	AR5	*CR11*	*CR12*	*CR13*	CARNCKx4	AR8_TR2	AR4_BR9	CARNCKx8
At end year	*1566*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*
Scottish import chronologies								
Gardyne's Land, Dundee								
GLB3_4ST (1500 - 1660 AD)			3.88					3.73
Gardyne's Land, Dundee								
LHLA_08 (1424 - 1608 AD)		3.53				3.59		5.19
Lambs House, Leith								
OSU1NEW (1391 - 1520 AD)				3.89	4.11			4.56
Old Student Union, St Andrews								

Table A11 Carnock House: Statistical correlations with foreign chronologies

			AR5	CR11	CR12	CR13	CARNCKx4	AR8_TR2	AR4_BR9	CARNCKx8
		At end year	*1566*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*
Chronology	**Location**	**Calendar range**								
Danish chronologies										
2X900001	Sjælland	AD830-AD1997		4.83		4.81	5.85		3.86	6.27
9M456784	West Denmark	109BC-AD1986							3.54	
JUTLAND6	Jutland	AD846-AD1793		5.39	5.55	6.04	7.70		4.63	6.71
Swedish chronologies										
SM000012	W Sweden	AD1125-AD1720		3.83		4.38	3.81		4.31	4.39
SM100001	Ystad, S Sweden	AD1310-AD1539	4.04			4.87	5.50			5.16
Norwegian chronologies										
Grimstad	Eide kirke, Grimstad town, S Norway	AD1403-AD1731	4.83	6.09	4.63	6.74	9.10		4.57	7.71
N053N027	Vennesla and Bjorvatn, S Norway	AD1480-AD1678	3.91	5.01	6.17	4.95	7.11	4.49		8.70
N-all01	Agder - Denmark - Germany-Scotland	AD1264-AD2005	7.82	11.43	6.88	11.89	14.30	5.79	5.89	14.61
N-hist03+rec	Agder 208 timber mean	AD1208-AD2005	5.43	7.55	3.68	5.56	8.22	4.43	6.07	9.50
Norwegian ship chronologies										
00651m02	A7739 B&W mean 2	AD1352-AD1568				5.27	4.41	6.64		5.51
Z010m001	Larvik 5 and 6	AD1480-AD1727	4.54	4.03	5.55	4.40	7.03			4.69
Z0306M01	Barcode 6	AD1418-AD1585				4.15	4.47		4.00	4.90
Z062m001	Oslo Vaterland	AD1384-AD1512	3.83	5.32		8.11	7.31			7.10
Z071m004	Barcode 08	AD1304-AD1595	6.71	7.53	4.94	7.60	8.83	4.00	4.96	8.99

Table A11 (Cont'd)

			AR5	CR11	CR12	CR13	CARNCKx4	AR8_TR2	AR4_BR9	CARNCKx8
		At end year	*1566*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*	*1588*
Chronology	**Location**	**Calendar range**								
Z096M001	Bispevika 2 SHORT	AD1378-AD1517	3.66	4.69	4.03	7.99	6.82			6.88
21015M02	A7739 B&W 24 tree mean	AD1305-AD1743	5.95	7.88	5.44	8.67	8.63	3.56	5.61	8.55
2101M001	A7739 B&W 2 3 9 11 32 43	AD1487-AD1743	3.55	5.71	5.88	5.10	7.29		5.00	7.25

Table A12 Advocate's Close: Sample details

Beam	No. rings	Outer rings	Calendar date	Felling date	Season of felling
B2	134	bark edge	AD 1456 - 1589	compressed outer rings	
B3	112	bark	AD 1477 - 1588	1588/89	Winter/Early spring
B4	87	bark edge	AD 1502 - 1588	1588/89	Winter/Early spring
B6	*52*	*h/s?*	*not measured*		
B8	104	bark edge	AD 1486 - 1589	1589/90	Winter/Early spring
B9	79	bark edge	AD 1510 - 1588	1588/89	Winter/Early spring
B11	154	bark	AD 1437 - 1590	1590/91	Winter/Early spring
B12	162	bark	AD 1428 - 1589	1589/90	Winter/Early spring
B17	130	bark edge	AD 1459 - 1588	1588/89	Winter/Early spring

Table A13 Advocate's Close: ACMNx8 t-val matrix

	B17	B2	B3	B4	B8	B9	B11	B12
B17	*							
B2	-	*						
B3	3.11	4.92	*					
B4	3.26	-	-	*				
B8	5.42	-	4.12	3.83	*			
B9	5.29	3.99	3.83	4.06	-	*		
B11	3.11	-	-	-	-	-	*	
B12	3.46	-	5.69	-	3.76	3.51	-	*

Table A14 **Advocate's Close: Statistical correlations with Scottish 'import' chronologies (those chronologies shaded in light grey are Norwegian in origin, those in dark grey are southern Scandinavian, i.e. Swedish or Danish, and those which are unshaded have a generic Scandinavian provenance)**

	B2	B3	B4	B8	B9	B12	B11	B17	ACMNx8
At end year	*1589*	*1588*	*1588*	*1589*	*1588*	*1589*	*1590*	*1588*	*1590*
Scottish import chronologies									
DUNTARVIE (1385 - 1529 AD)		4.38		3.78		5.53	4.15		5.70
Duntarvie Castle, West Lothian									
DTHMNX2 (1360 - 1509 AD)									
Townhouse, Dunbar, East Lothian									
EDINCAS2 (1358 - 1509 AD)		5.18				5.00	6.35	3.88	8.29
Edinburgh Castle, Great Hall									
375HSMN (1338 - 1570 AD)						3.82			
375 High St, Edinburgh									
FTMAS2 (1318 - 1572 AD)	3.58	3.86	5.88	4.65		5.54		3.62	6.44
Fenton Tower, East Lothian									
BRECHIN1 (1359 - 1470 AD)									
68-74 High St, Brechin									
QMBH01 (1423 - 1550 AD)				3.94					
Queen Mary's Bathhouse, Holyrood									
JKNOXH1 (1466 - 1560 AD)									
John Knox House, Edinburgh									
OCHMN (1373 - 1563 AD)						4.16			
Old Craighouse, Edinburgh									
STSERFx7 (1377 - 1511 AD)	3.5	5.14				5.64			4.57
St Serfs Church, Dysart, Fife									
PANLKL39 (1366 - 1569 AD)						5.58			
Panel, NMS Edinburgh									
CARNOCKx8 (1317 - 1588 AD)	4.26	5.79	4.72	5.94	4.40	5.96	3.66	4.28	6.48
Carnock House, Stirling (*ex-situ*)									
ASOMNx9 (1370 - 1564 AD)		4.07	5.26	3.72		6.33			6.17

Table A14 (Cont'd)

	B2	B3	B4	B8	B9	B12	B11	B17	ACMNx8
At end year	*1589*	*1588*	*1588*	*1589*	*1588*	*1589*	*1590*	*1588*	*1590*
Abbey Strand, Edinburgh (*ex situ*)									
SEP1505 (1355 - 1505 AD)									
Stirling Palace									
SEP31538_9 (1366 - 1538 AD)									
Stirling Palace									
SEP31539 (1361 - 1539 AD)									
Stirling Palace									
SEP41592 (1390 - 1592 AD)									
Stirling Palace									
FTMAS1 (1366 - 1547 AD)									
Fenton Tower, East Lothian									
MIDHOPE (1265 - 1505 AD)									
Midhope Castle, West Lothian									
GAROOF1 (1348 - 1464 AD)									
Guthrie Aisle, Angus									
GAROOF2 (1350 - 1458 AD)									
Guthrie Aisle, Angus									
BRECHIN2 (1451 - 1575 AD)	4.33	6.52		3.98	3.92	5.06	3.64	5.12	5.40
68-74 High St, Brechin									
GLB1_56A (1475 - 1544 AD)	5.49	4.70	3.94		4.14	4.42	4.48	3.58	7.25
Gardyne's Land, Dundee									
GLA3_2 (1376 - 1595 AD)									
Gardyne's Land, Dundee									

Table A14 (Cont'd)

	B2	B3	B4	B8	B9	B12	B11	B17	ACMNx8
At end year	*1589*	*1588*	*1588*	*1589*	*1588*	*1589*	*1590*	*1588*	*1590*
GLB3_4ST (1500 - 1660 AD)									
Gardyne's Land, Dundee									
LHLA_08 (1424 - 1608 AD)						4.23			4.54
Lambs House, Leith									
OSU1NEW (1391 - 1520 AD)									
Old Student Union, St Andrews									

Table A15 Advocate's Close: Statistical correlations with foreign chronologies

			B2	B3	B4	B8	B9	B12	B11	B17	ACMNx8
		At end year	*1589*	*1588*	*1588*	*1589*	*1588*	*1589*	*1590*	*1588*	*1590*
Chronology	**Location**	**Calendar range**									
Danish chronologies											
2X900001	Sjælland	AD830-AD1997		3.56				4.54			3.74
9M456784	West Denmark	109BC-AD1986									
JUTLAND6	Jutland	AD846-AD1793		4.36				5.29			4.26
Swedish chronologies											
SM000012	W Sweden	AD1125-AD1720									
SM100001	Ystad, S Sweden	AD1310-AD1539									
Norwegian chronologies											
Grimstad	Eide Kirke, Grimstad Town, S Norway	AD1403-AD1731						5.4			5.12
N053N027	Vennesla and Bjorvatn, S Norway	AD1480-AD1678	4.82	4.31	4.21	4.15	3.6	4.89	4.33		6.9
N-all01	Agder - Denmark - Germany - Scotland	AD1264-AD2005	3.98	5.51	5.07	5.55	4.04	7.9		4.03	8.74
N-hist03+rec	Agder 208 timber mean	AD1208-AD2005		4.25	4.75	4.32	4.49	5.1			6.23
Norwegian ship chronologies											
00651m02	A7739 B&W mean 2	AD1352-AD1568	3.59	4.43	3.8		4.65	5.8	3.67		8.23
Z010m001	Larvik 5 and 6	AD1480-AD1727	4.58	3.59				4.01			4.1
Z0306M01	Barcode 6	AD1418-AD1585						4.08			
Z062m001	Oslo Vaterland	AD1384-AD1512		3.59				3.92			4.16
Z071m004	Barcode 08	AD1304-AD1595		4.5	4.82	5.01	3.62	6.7	4.11		6.74
Z096M001	Bispevika 2 SHORT	AD1378-AD1517						4.85			5.22
21015M02	A7739 B&W 24 tree mean	AD1305-AD1743	3.71	5.34	4.36	4.65	4.5	8.25			5.68
2101M001	A7739 B&W 2 3 9 11 32 43	AD1487-AD1743	4.83	5.29	3.85	5.35	4.32	4.9		3.82	7.19

Table A16 Bay Horse Inn: Sample details

Dendro tag	Sample no.	No. rings	Outer rings	Calendar date	Felling date	notes
BHI1	BL/BC5	98	bark	*undated*		
BHI2	BL/BC7	127	be	*undated*		
BHI3	BL/BC8	168+	be	1407 - 1574	*tpq* 1574	Outer rings too compressed to measure
	BL/BC9	c50	be	*not measured*		
BHI4	BL/BC12	105	be	1479 - 1583	1583/4	
BHI5	BR1	132	bark	*undated*		
	BR2	c40	be	*not sampled*		
BHI6	BR5	181 +1	be	1401 - 1581	1582	
	BR6	c60	be	*not sampled*		
BHI7	BR16	194	be	*undated*		
BHI8	CR6c	48 + 27+	be	1494 - 1541	*tpq* 1568	Outer rings worm-eaten and only counted
BHI9	CR6d	60	be	1524 - 1583	1583	

Table A17 Bay Horse Inn: BHIMNx5 t-val matrix

	BHI3	BHI6	BHI4	BHI8	BHI9
BHI3	/				
BHI6	5.45	/			
BHI4	4.30	4.17	/		
BHI8	3.52	5.75	6.06	/	
BHI9	-	-	-	-	/

Table A18 Bay Horse Inn: Statistical correlations with foreign and Scottish chronologies

			BHIMNx4	BHI9	BHIMNx5
		At end year	*1583*	*1583*	*1583*
Chronology	**Location**	**Calendar range**			
Norwegian chronologies					
NOMK0908	W and E Agder, S Norway	AD 1121 - 1863	5.73	4.51	6.85
Thomas Bartholin pers comm					
99200010	SE Norway	AD 871 - 1986	3.55	-	4.15
Terje Thun pers comm					
99700010	Mid-Norway - Trondelag	AD 552 1979			
Terje Thun pers comm					
99500010	SW Norway	AD 765 - 1996			
Terje Thun pers comm					
N007m005	Bolvaerk, Oslo	AD 1471 - 1622	-	4.94	3.59
Aoife Daly pers comm					
VAuAaseralPISY2	East Agder	AD 1353 - 1936	6.95	3.81	7.88
Neils Bonde pers comm					
K010301s	Lower Saxony (Norwegian)	AD 1395 - 1706	-	-	4.16
Sigrid Wrobel pers comm					
Swedish chronologies					
DALARNAB	S Sweden	AD 1391 - 1888	3.79	-	-
E GOTLAND	E Sweden	AD 1469 - 1840			
GOTLANDB	E Sweden	AD 1490 - 1987			
Scottish 'import' chronologies					
SSPINEx15	Stirling Palace	AD 1476 - 1671	-	3.65	4.16
QBCPINEx6	Stirling Palace	AD 1370 - 1535			
ASPMNx5	Abbey Strand	AD 1329 - 1546	4.47		4.64
UNKNX6	Gp 1-10 (unknown location)	AD 1412 - 1602			
LMMNx11	302-4, Lawnmarket	AD 1445 - 1605	3.76	4.08	4.13
LCKMNx6	Law's Close, Kirkcaldy	AD 1489 - 1619	5.41		5.17
LHLMNx6	Lambs House, Leith	AD 1408 - 1608	4.1	-	4.74

Table A19 Gp 1-10: Sample details

Dendro tag	Sample no.	No. rings	Outer rings	Calendar date	Felling date
UNK1	AR1 (8)	205	be	Undated	
UNK2	*AR2 (9)*	*c60-70*	*be*	*Not sampled*	
UNK3	AR3 (6)	93 +1	be	1509 - 1601	1602
UNK4	AR7 (4)	13+191	be	1412 - 1602	1602
UNK5	BR15 (10)	109+	?	1492 - 1600	
UNK6	CR7 (2)	195	be	1405 - 1599	1599
UNK7	CR8 (7)	136	be	1467 - 1602	1602
UNK8	CR9 (3)	190	be	Undated	
UNK9	CR10 (5)	163	bark	Undated	

Table A20 Gp 1-10: UNKMNx5 t-val matrix

	UNK4	UNK7	UNK6	UNK3	UNK5
UNK4	/				
UNK7	5.56	/			
UNK6	3.82	5.27	/		
UNK3	-	3.64	-	/	
UNK5	-	-	-	4.39	/

Table A21 Gp 1-10: Statistical correlations with foreign and Scottish chronologies

			UNKMNx3	UN-K3_5MN	UNKMNx5
		At end year	*1602*	*1601*	*1602*
Chronology	**Location**	**Calendar range**			
Norwegian chronologies					
NOMK0908	W and E Agder, S Norway	AD 1121 - 1863	4.95	4.69	5.46
Thomas Bartholin pers comm					
99200010	SE Norway	AD 871 - 1986			
Terje Thun pers comm					
99700010	Mid-Norway - Trondelag	AD 552 1979			
Terje Thun pers comm					
99500010	SW Norway	AD 765 - 1996			
Terje Thun pers comm					
N007m005	Bolvaerk, Oslo	AD 1471 - 1622		3.55	
Aoife Daly pers comm					
VAuAaseralPISY2	East Agder	AD 1353 - 1936	3.79	4.37	4.09
Neils Bonde pers comm					
K010301s	Lower Saxony	AD 1395 - 1706		4.02	
Sigrid Wrobel pers comm					
Swedish chronologies					
DALARNAB	S Sweden	AD 1391 - 1888			
Thomas Bartholin pers comm					
E GOTLAND	E Sweden	1469 - 1840			
Thomas Bartholin pers comm					
GOTLANDB	E Sweden	1490 - 1987			
Thomas Bartholin pers comm					
Scottish 'import' chronologies					
SSPINEx15	Stirling Palace	AD 1476 - 1671		3.67	
QBCPINEx6	Stirling Palace	AD 1370 - 1535			
ASPMNx5	Abbey Strand	AD 1329 - 1546			3.98
BHMNx5	Bay Horse Inn	AD 1401 - 1583			
LMMNx11	302-4, Lawnmarket	AD 1445 - 1605	5.21	4.61	5.23
LCKMNx6	Law's Close, Kirkcaldy	AD 1489 - 1619	6.45	4.12	5.97
LHLMNx6	Lamb's House, Leith	AD 1408 - 1608	6.88		5.74

Table A22 Lawnmarket: Sample details

Dendro tag	Sample no.	No. rings	Outer rings	Calendar date	Felling date
***IN SITU* TIMBERS**					
2nd Floor					
LM1	2065	77+	/		
LM2	2066	121+	/	1445 - 1565	
LM3	2076	105+	/	1480 - 1584	
LM4	2077	126+	/		
LM5	2078	140+	/		
	2080a	*not measured*			
3rd Floor					
LM6	3020	143+	/		
LM7	3021	96+	/	1492 - 1587	
LM8	3023	103+	/	1503 - 1605	
LM9	3024	205+	/		
LM10	3025	100+	be?	1504 - 1603	1603
LM11	3026	86+	/	1503 - 1588	
LM12	3046	249	be		
***EX SITU* TIMBERS**					
LM13	AA	170	be		
LM14	BR3	79	/	1505 - 1583	
LM15	BR7	106 +1 unm	be	1486 - 1590	1591
LM16	BR8	60 +1 unm	be	1543 - 1602	1603
LM17	BR11	108	be	1482 - 1589	1589
LM18	BR12	61	be	1541 - 1601	1601
	BR14	*not sampled*			
LM19	CC11	87	be		
LM20	TR3	156	be		

Table A23 Lawnmarket: LMMNx11 t-val matrix

	LM14	LM3	LM8	LM11	LM10	LM15	LM2	LM16	LM18	LM7	
LM14	/									]	]
										]	]
LM3	7.52	/								]	]
										]	]
LM8	3.17	3.98	/							]	]
										]	]
LM11	3.02	3.73	6.06	/						] **LMMNx7**	]
										]	]
LM10	3.46	4.04	4.76	4.22	/					]	]
										]	]
LM15	3.54	4.96	3.34	3.4	3.12	/				]	**] LMMNx11**
										]	]
LM2	-	-	3.09	-	4.88	5.42	/			]	]
											]
LM16	-	-	-	-	-	-	-	/			]
											]
LM18	-	-	-	-	-	-	-	4.62	/		]
											]
LM7	-	3.01	-	-	-	-	-	-	-	/	]
											]
LM17	-	-	-	-	-	-	-	3.02	-	-	]

Table A24 Lawnmarket: Statistical correlations with foreign and Scottish chronologies

			LMMNx7	LM16_18	LM7	LM17	LMMNx11
		At end year	*1605*	*1602*	*1587*	*1589*	*1605*
Chronology	**Location**	**Calendar range**					
Norwegian chronologies							
NOMK0908	W and E Agder, S Norway	AD 1121 - 1863	4.66	3.60	5.34	3.95	6.02
Thomas Bartholin pers comm							
99200010	SE Norway	AD 871 - 1986					
Terje Thun pers comm							
99700010	Mid-Norway - Trondelag	AD 552 1979					
Terje Thun pers comm							
99500010	SW Norway	AD 765 - 1996					
Terje Thun pers comm							
N007m005	Bolvaerk, Oslo	AD 1471 - 1622	4.66	5.73	5.05	4.75	6.24
Aoife Daly pers comm							
VAuAaseralPISY2	East Agder	AD 1353 - 1936	4.95	4.8	5.62	4.47	7.15
Neils Bonde pers comm							
K010301s	Lower Saxony (Norwegian)	AD 1395 - 1706		4.24	3.63	3.75	4.51
Sigrid Wrobel pers comm							
Swedish chronologies							
DALARNAB	S Sweden	AD 1391 - 1888					
Thomas Bartholin pers comm							
E GOTLAND	E Sweden	AD 1469 - 1840		3.85			3.5
Thomas Bartholin pers comm							
GOTLANDB	E Sweden	AD 1490 - 1987		5.61			
Thomas Bartholin pers comm							

Table A24 Lawnmarket: Statistical correlations with foreign and Scottish chronologies

			LMMNx7	LM16_18	LM7	LM17	LMMNx11
		At end year	*1605*	*1602*	*1587*	*1589*	*1605*
Chronology	**Location**	**Calendar range**					
Scottish 'import' chronologies							
SSPINEx15	Stirling Palace	AD 1476 - 1671		4.92			
QBCPINEx6	Stirling Palace	AD 1370 - 1535					
ASPMNx5	Abbey Strand	AD 1329 - 1546			3.54		
BHMNx5	Bay Horse Inn	AD 1401 - 1583	4.98				4.13
UNKMNx5	Gp 1-10 (unknown location)	AD 1412 - 1602	5.57		4.96	4.99	5.23
LCKMNx6	Law's Close, Kirkcaldy	AD 1489 - 1619	8.11				7.96
LHLMNx6	Lambs House, Leith	AD 1408 - 1608	4.77		3.54		4.22

Table A25 Kirkcaldy: Sample details

Sample no.	Component	No. rings	Outer rings	Calendar date	Felling date
LCK2E1	Ceiling board (1st floor)	86			
LCK2E2	Ceiling board (1st floor)	116			
LCK2E3	Ceiling board (1st floor)	97+	be?	AD 1524 - 1619	1619
LCK2E4	Ceiling board (1st floor)	84			
LCK2E5	Ceiling board (1st floor)	74	be?		
LCK2E7	Ceiling board (1st floor)	87	be?	AD 1490 - 1576	
LCK2E10C	2nd floor joist	119	be	AD 1499 - 1617	1617
LCK2E11	2nd floor joist	86			
LCKWGAB	2nd floor joist	143			
LCKR9	Rafter	75			
LCKR14	Sole plate	112		AD 1489 - 1600	
LCKR14X	Ashlar plate	103		AD 1498 - 1600	
LCKR14Y	Sole plate	89	be		
LCKR15	Rafter	125	be?	AD 1494 - 1618	1618
LCKR16X	Sarking board (?)	102			
LCKR16Y	Rafter	262	be		
LCKR16Z	Rafter	264	be		
LCKR17	Rafter	170			
LCKR22	Rafter	91			

Table A26 Kirkcaldy: Pair-masters

(a)		**LCK2E7**	**LCK2E10C**		
	LCK2E7	/			} **LCK2E7E10C**
	LCK2E10C	6.99	/		}
(b)		**LCKR14**	**LCKR14X**		
	LCKR14	/			} **LCK14MAS**
	LCKR14X	5.08	/		}
(c)		**LCKR16Y**	**LCKR16Z**		
	LCKR16Y	/			} **LCK16YZ**
	LCKR16Z	20.55	/		}

Table A27 Kirkcaldy: Statistical correlations with foreign and Scottish chronologies

			LCK14MAS	LCKE7E10C	LCK2E3	LCKR15	LCKMNx6
		At end year	*1600*	*1617*	*1619*	*1618*	*1619*
Chronology	**Location**	**Calendar range**					
Norwegian chronologies							
NOMK0908	W and E Agder, S Norway	AD 1121 - 1863				3.58	4.04
Thomas Bartholin pers comm							
99200010	SE Norway	AD 871 - 1986					
Terje Thun pers comm							
99700010	Mid-Norway - Trondelag	AD 552 1979					
Terje Thun pers comm							
99500010	SW Norway	AD 765 - 1996					
Terje Thun pers comm							
N007m005	Bolvaerk, Oslo	AD 1471 - 1622					4.12
Aoife Daly pers comm							
VAuAaseralPISY2	East Agder	AD 1353 - 1936				4.43	4.52
Neils Bonde pers comm							
K010301s	Lower Saxony (Norwegian)	AD 1395 - 1706			4.14		3.75
Sigrid Wrobel pers comm							
Swedish chronologies							
DALARNAB	S Sweden	AD 1391 - 1888					
Thomas Bartholin pers comm							
E GOTLAND	E Sweden	AD 1469 - 1840			3.68		
Thomas Bartholin pers comm							
GOTLANDB	E Sweden	AD 1490 - 1987			6.17		
Thomas Bartholin pers comm							

Table A27 Kirkcaldy: Statistical correlations with foreign and Scottish chronologies

			LCK14MAS	LCKE7E10C	LCK2E3	LCKR15	LCKMNx6
		At end year	*1600*	*1617*	*1619*	*1618*	*1619*
Chronology	**Location**	**Calendar range**					
Scottish 'import' chronologies							
SSPINEx15	Stirling Palace	AD 1476 - 1671			3.90		4.10
QBCPINEx6	Stirling Palace	AD 1370 - 1535					
ASPMNx5	Abbey Strand	AD 1329 - 1546	3.87			3.62	4.56
BHMNx5	Bay Horse Inn	AD 1401 - 1583	3.50	4.17			5.17
UNKNX6	Gp 1-10 (unknown location)	AD 1412 - 1602	4.00	5.04			5.97
LMMNx11	302-4, Lawnmarket	AD 1445 - 1605	4.45	4.65		5.84	7.96
LHLMNx6	Lamb's House, Leith	AD 1408 - 1608	4.49			4.25	4.87