AN OAK CHRONOLOGY FOR SOUTH CENTRAL SCOTLAND

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ABSTRACT

The chronology presented was constructed in the hope of answering two specific questions. It was intended to assess the potential of dendrochronology in an area where no previous investigations had taken place. In addition it was necessary as a step towards assessing the cross agreements between different areas within the British Isles. The resulting 1030 year chronology has shown the potential usefulness of the method in Scotland and allowed the suggestion of larger tree-ring areas within the British Isles than have previously been supposed.

Cette chronologie a été construite pour répondre à deux questions spécifiques. Tout d'abord, il fallait vérifier la possibilité d'effectuer des études dendrochronologiques dans une région où aucun travail n'avait été accompli jusqu'à présent. Ensuite, une telle chronologie était nécessaire pour vérifier la possibilité de réaliser des interdatations dans différentes régions des Iles Britanniques. La chronologie de 1030 années a montré la possibilité d'utiliser la méthode en Ecosse. Il semble possible également d'appliquer la dendrochonologie à des régions plus vastes qu'il n'avait été admis précédemment.

Die im folgenden vorgestellte Jahrringchronologie wurde zur Beantwortung von zwei spezifischen Fragen aufgebaut. Sie sollte die Möglichkeit der Dendrochronologie für ein Gebiet aufzeigen, in dem bislang noch keine Untersuchungen durchgeführt worden sind. Darüber hinaus sollte sie im Hinblick auf die dendrochronologische Übereinstimmung zwischen verschiedenen Regionen der britischen Inseln ausgewertet werden. Die vorliegende, 1030 Jahre umfassende Eichenchronologie hat die Eignung der Methode für Schottland bestätigt und zu dem Vorschlag geführt, größere Jahrring-Regionen innerhalb der britischen Inseln auszuweisen als es bisher vermutet worden ist.

INTRODUCTION

In Scotland the importance of dendrochronology was appreciated by archaeologists before work on a chronology was begun. Thus, when it was suggested that a chronology might easily be constructed, if suitable timbers were available, the opportunity was seized with enthusiasm.

The background to the offer to build a Scottish chronology lay in the discovery that long lived modern oaks were available in southern Scotland. Previous experience in Ireland had shown that modern oak trees rarely reached 300 years due to historical factors (Baillie 1973). Thus it was with surprise that a group of trees from Lockwood, Dumfriesshire, was found to contain examples which had started life as early as A.D. 1571. Subsequent information led to the sampling of 10 trees from the ancient Cadzow forest near Hamilton. These oaks, felled or blown down over the last few decades, consistently yielded ring patterns back to A.D. 1500 and in one case, Q.U.B. 2818, back to A.D. 1444. This leap back in time made it logical to attempt the extension of the chronology for dating purposes. Consequently approaches were made to archaeologists and architectural historians, people who might have access to timbers

removed from historic buildings during excavation or renovation. These contacts proved highly successful and in a single trip to Scotland in 1976, in company with Dr. Jon Pilcher, timbers of the 13th, 14th, 15th, and 16th centuries were examined for chronology building purposes. Samples from 25 timbers were taken back to Belfast for study. Twenty of these, in conjunction with the modern timbers, above, gave an outline chronology for southern Scotland for the period A.D. 946 to 1975. Subsequent visits in 1977 provided additional material for consolidation of the chronology.

Prior to 1976 no serious dendrochronological study had been undertaken for oak in Scotland. This has to be seen against the background of other work in the north and west of the British Isles where the basic approach had been essentially isolationist. Areas were treated as different, from a tree-ring viewpoint, until proven otherwise. At a developmental stage this isolationist attitude was conditioned to avoid the possible complication of working with non-matching material. For example, the Belfast chronology (Baillie 1973, 1977a) should be independent of any outside considerations. However, when work was begun on the construction of the chronology for southern Scotland, the pre-existing Belfast, Dublin (Baillie 1977b) and England-Wales border chronologies (V. Giertz, personal communication) could not be ignored. Once a site master chronology was produced for a group of Scottish material it was run against these established chronologies using the Belfast CROS program to test for significant agreement (Baillie and Pilcher 1973). The result was that, with the exception of the modern material which was fixed by known felling dates, each site master was placed in time by cross agreement with existing absolute chronologies.

SOURCES

Modern

The two oakwoods at Lockwood and Hamilton (Figure 1) provided useful information on the degree of cross agreement which could be expected within southern Scotland. Despite being 60 km apart and separated by extensive uplands the respective site chronologies showed good cross agreement; t = 5.0 and 6.4 for the 18th and 19th centuries. In addition the agreement between the existing north of Ireland chronology (Baillie 1973) and the combined Lockwood-Hamilton chronology was excellent. The correlation values for the 17th, 18th and 19th centuries being t = 4.3, 4.3 and 11.4 respectively. The agreement between these chronologies for the 19th century is visually outstanding and is equally good when only the Belfast and Hamilton chronologies are compared, the year to year detail and the trends being of almost equal magnitude. This is of particular interest since the Belfast master contained trees from widely scattered sources within an area 140 km E-W by 60 km N-S. The Hamilton trees by contrast had all grown within a few hundred metres of one another. Obviously these two very different groups of trees were responding to the same, presumably climatic, signal. In this case site factors must have played a relatively minor role in distorting the 'true' signal.

In addition to the Belfast chronology, for the period 1710 to 1970 there are chronologies for Yorkshire (R. Morgan, personal communication), Maentwrog in Wales (Leggett el al 1978) and Winchester (Barefoot 1975). For each of these the cross correlations with the Scottish chronology were t = 5.9, 3.4 and 3.6 respectively. At the very least these results suggest that there is statistically significant positive correlation with all of the long British Isles modern oak chronologies. Some implications of these findings are discussed elsewhere (Baillie 1978).

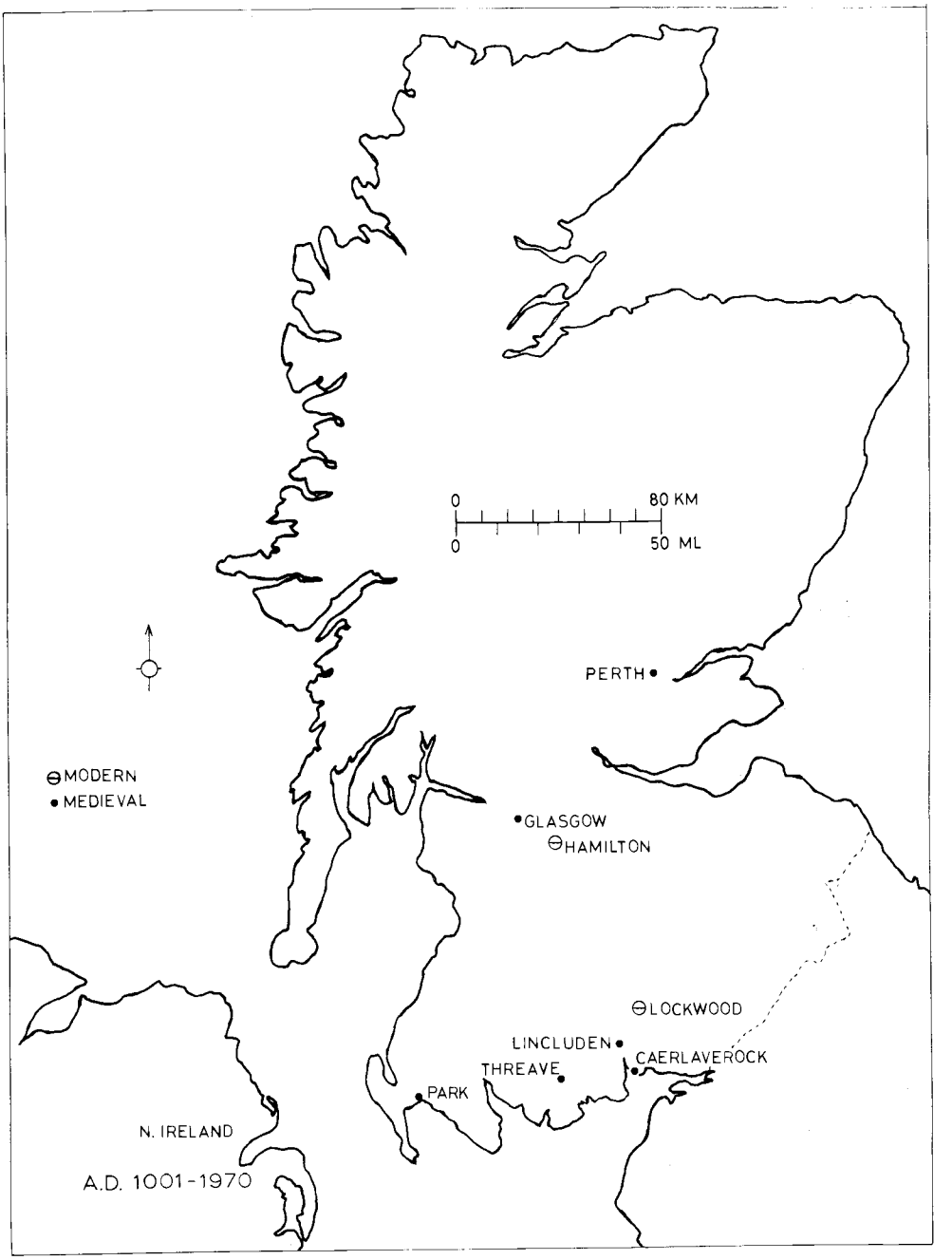

Figure 1. Scotland showing the sources of timber.

16th Century

For the purposes of chronology building it was necessary to obtain timbers of the 16th century. Castle of Park, Kirkcudbright had recently been extensively renovated by the Department of Environment. The castle, a late tower house, was historically well dated. A carved stone panel over the entrance gave the day of the month in the year A.D. 1590 when building had commenced. The renovations to the building entailed the removal of the main floor beams and replacement of those whose ends had deteriorated. Samples of five timbers were obtained and the ring patterns of these were found to agree. Unfortunately none of the samples retained its sapwood and only one Q.U.B. 2923 had a clear heartwood-sapwood boundary. The 202 year Park chronology crossdated extremely well with the Belfast, Dublin, and England-Wales Border chronologies with cross correlation values t = 7.1, 9.4 and 6.8 respectively covering the years A.D. 1350 to 1551. The cross agreement with the Scottish modern chronology back to A.D. 1444 is not of this calibre but for half its length depends on the ring pattern of a single tree, Q.U.B. 2818. Figure 2 shows the Hamilton and Park master chronologies plotted against the overall Scottish index chronology.

Allowing for missing sapwood (Baillie 1973), an estimate of the felling date of the Park timbers would be A.D. 1583 ± 9. This dating is consistent with the recorded building date.

15th Century

A single, radially split, oak panel originally with painted decoration is housed in the Dumfries Museum. It is known to have come from a choir stall from Lincluden College, Dumfries. The remainder of the stall is housed in the National Museum of Antiquities of Scotland in Edinburgh and is believed to be of 15th century date on stylistic grounds.

It was possible to extract the ring pattern from a wedge removed from the non-painted surface of the Dumfries Museum panel. This yielded a ring pattern, Q.U.B. 2928, which spanned 367 years, apparently ending in A.D. 1434 on the basis of a tentative overlap with the Castle of Park chronology. Because of the importance of timbers of this date range, spanning the 14th century, a visit was made to the National Museum early in 1977. The Lincluden stall was dismantled and the polished ends of five further panels were photographically recorded. It was possible to measure the ring patterns of four of these from the resultant photographs. Each of the panels crossdated with Q.U.B. 2928, and confirmed the cross agreement with Castle of Park, the outer rings being A.D. 1434, 1452, 1456 and 1467.

The Lincluden master chronology gave a correlation value of t = 3.1 against the Park chronology with its outer year A.D. 1467. When compared with the Belfast A.D. 1001 to 1970 and Dublin A.D. 1357 to 1556 chronologies the cross agreements were t = 5.7 and 6.8 respectively. In both cases the Lincluden chronology ended in A.D. 1467. Thus the Lincluden chronology spans the years A.D. 1068 to 1467.

In additon the Lincluden chronology cross matched with the Dublin A.D. 855 to 1306 chronology giving t = 4.9 for an overlap of 239 years. This confirmed the relative positions in time of the Dublin early and late medieval chronologies previously fixed on separate evidence (Baillie 1978).

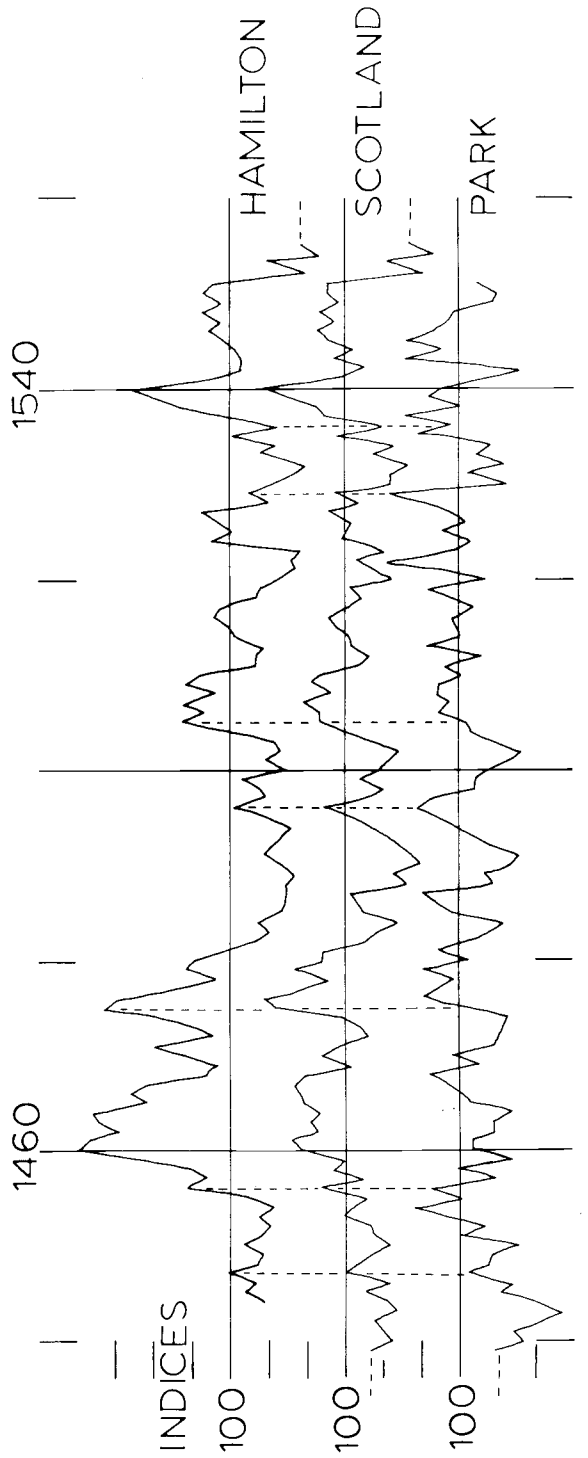

Figure 2. Overlap of the Hamilton and Park index chronologies plotted with the Scottish index chronology.

14th and 13th Centuries

An important group of timbers from Glasgow Cathedral allowed the consolidation and further extension of the Lincluden chronology. The roof of the Cathedral was extensively repaired in the early years of this century (Oldrieve 1916). At that time a series of structural beams were removed and subsequently stored in Newark Castle, Greenock. Samples were removed from 20 of these timbers of which 14 turned out to be of use. The individual timbers cross matched to give a 415 year chronology containing timbers of two clear phases (Figure 3). This chronology crossdated with the Lincluden chronology with t = 8.5 at an overlap of 293 years. Thus the Glasgow chronology covered the period A.D. 946 to 1360. One of the timbers Q.U.B. 2648 extends back to A.D. 896, however, a series of narrow rings between A.D. 920 and 940 rendered this extension unsuitable for inclusion in the master chronology.

The 1030 year chronology

One further group of timbers, from the moat of Caerlaverock Castle, Dumfriesshire, is included in the Scottish index master. These timbers, to be the subject of a separate article, spanned the years A.D. 1010 to 1370. The Caerlaverock master chronology gave a cross correlation value of t = 9.9 against the Glasgow Cathedral master with an overlap of 351 years (Figure 4).

The Scottish index chronology is listed in Table 1. The reasons for the choice of this format are given elsewhere (Baillie 1977a). It is made up from the six site chronologies as shown in Figure 5. The chronology contains the complete ring patterns

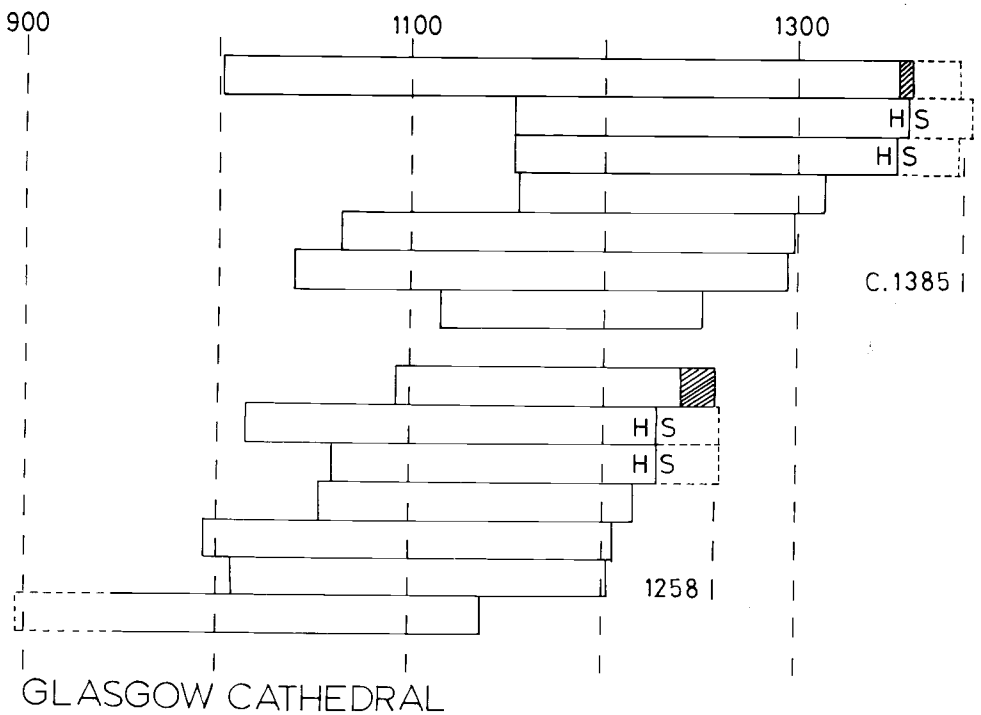

Figure 3. The individual Glasgow timbers showing two clear building phases within the random group.

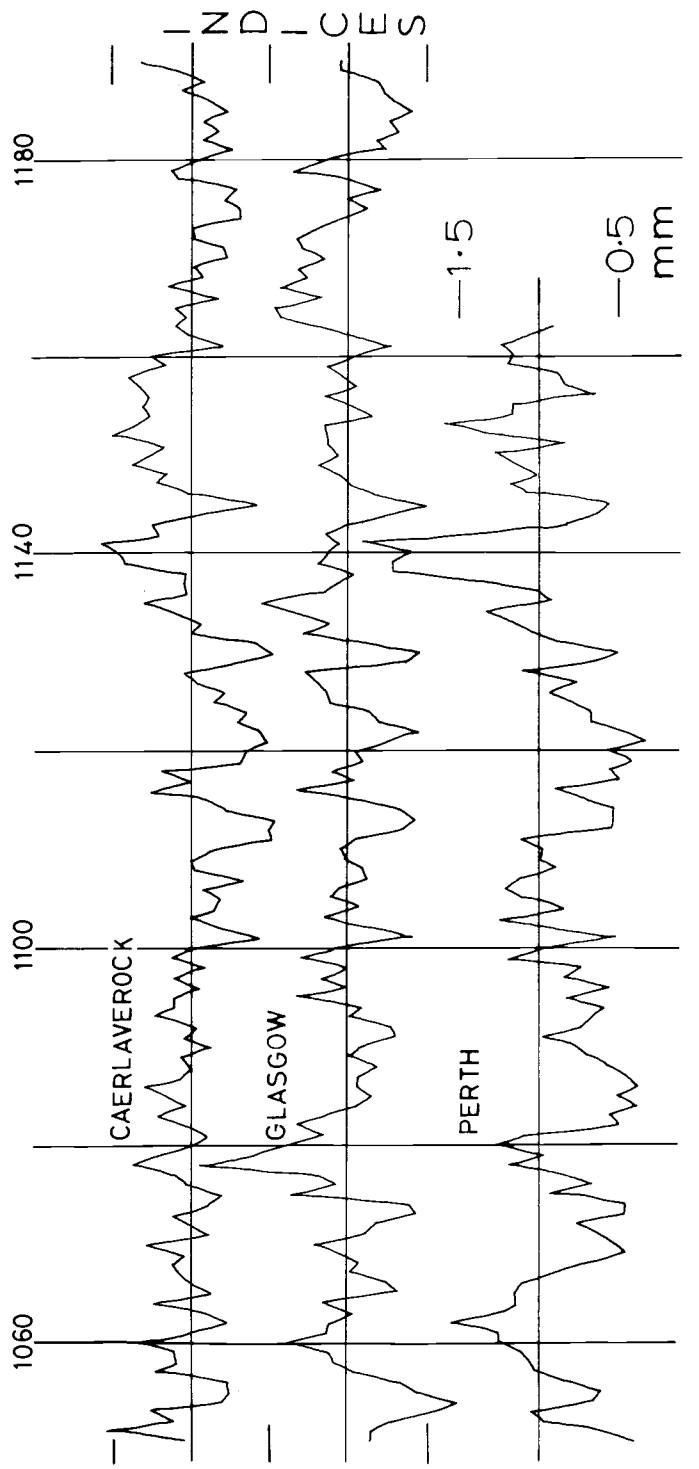

Figure 4. The Caerlaverock and Glasgow index chronologies plotted with Perth timber Q.U.B. 3183.

of 62 trees, each tree being given equal weight by the production of indices, and covers the years A.D. 946 to 1975.

Since its completion the chronology has been used to establish 15th century dates for timbers from Threave Castle, Kirkcudbrightshire — an important Douglas stronghold in the south of Scotland. In addition it has dated material from as far north as Perth (Figure 1) where extensive excavations within the medieval city have turned up timbers of the late 12th century. For example, two planks, Q.U.B. 3183 and Q.U.B. 3184 gave correlation values of $t = 6.9$ and 5.3 with overlaps of 215 and 141 years respectively against the index chronology. Part of the ring pattern of Q.U.B. 3183 is shown in Figure 4 with the index submasters for Glasgow and Caerlaverock.

CONCLUSION

Under different circumstances, for example not working from a distance, it would have been possible to devote more time and effort to obtaining additional late medieval timbers to augment the material covering the 16th century. In the meantime the chronology presented here represents a basic working master for at least the southern half of Scotland. As more timbers are cross matched with the chronology their ring patterns can be added to it to produce a more refined version.

The most important factor is that, for the medieval period, workers in archaeology and architectural history in the area can now be reasonably assured of obtaining dendrochronological dates where suitable oak timbers are available. Equally important are the implications of the cross agreements between southern Scotland, northern Ireland, the Dublin and England-Wales Border areas. It would appear that

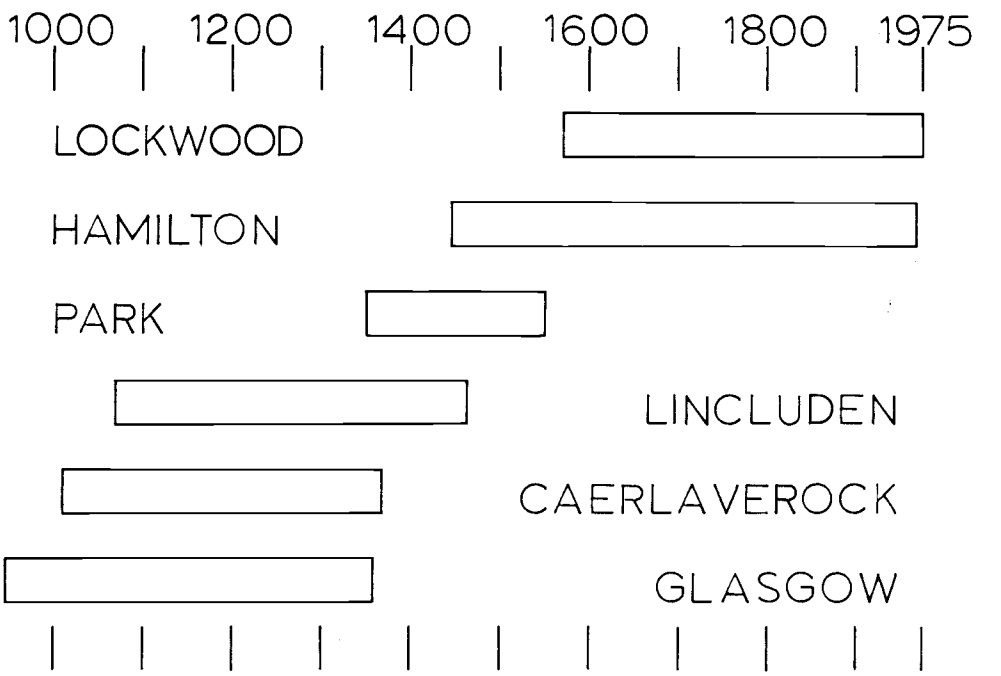

Figure 5. The site chronologies used in the construction of the Scottish master index chronology.

Table 1. Southwest Scotland oak master chronology.

	Tree Ring Indices										Number of Samples									
Date	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
946							51	61	92	102							1	1	1	1
950	123	138	113	103	98	123	93	134	134	103	1	1	1	1	1	1	1	1	1	1
960	109	155	114	125	104	52	89	89	120	94	1	1	1	1	1	1	1	1	1	1
970	79	100	110	63	84	63	48	85	101	138	1	1	1	1	1	1	1	1	1	1
980	170	112	117	139	128	128	145	113	113	151	1	1	1	1	1	1	1	1	1	1
990	118	147	137	131	92	92	130	120	117	122	1	2	2	3	3	3	3	3	3	3
1000	104	127	133	144	91	43	39	79	101	93	3	3	4	4	4	4	4	4	5	6
1010	78	87	97	108	79	106	86	96	91	87	7	7	7	7	7	8	8	8	8	8
1020	90	118	128	105	97	106	113	80	85	78	8	8	8	8	8	8	8	8	8	8
1030	105	102	85	62	63	91	96	128	113	115	8	8	8	8	8	8	8	9	9	10
1040	115	111	110	108	112	111	111	97	114	117	10	10	10	11	11	11	11	12	13	13
1050	94	110	90	77	58	70	76	104	108	109	13	13	13	14	14	14	14	14	15	15
1060	129	108	97	96	114	80	86	101	104	107	15	16	16	16	17	17	17	17	18	19
1070	123	93	93	88	80	106	104	110	152	132	19	19	19	20	20	20	20	20	20	20
1080	115	103	114	114	102	102	112	102	95	103	20	20	20	20	20	20	20	20	20	21
1090	94	92	90	106	101	116	99	110	97	118	21	21	21	22	22	22	22	22	22	22
1100	103	64	86	105	91	99	101	84	96	102	22	22	22	22	22	22	22	22	22	22
1110	100	81	68	65	78	96	125	102	111	85	22	22	22	22	22	22	22	22	22	22
1120	86	72	67	81	83	100	99	109	115	76	22	22	22	22	22	22	22	22	22	22
1130	61	83	110	103	117	132	107	104	101	124	22	22	22	22	22	22	22	22	22	22
1140	123	124	114	113	82	66	94	107	109	122	22	22	22	22	22	22	22	22	23	23
1150	114	112	127	121	107	112	117	112	116	111	23	22	22	23	24	24	25	25	25	25
1160	110	80	100	110	119	121	99	121	108	110	25	25	25	25	25	24	24	24	24	24
1170	97	102	110	107	88	83	90	80	105	117	24	24	24	24	24	24	24	24	24	24
1180	100	76	87	79	84	75	82	92	88	104	25	25	25	25	25	25	25	25	25	25
1190	115	106	100	109	122	132	112	87	103	111	25	26	26	26	26	26	26	26	26	26
1200	96	106	94	114	82	86	88	73	85	106	26	26	26	25	25	25	24	24	24	24
1210	135	128	90	86	96	90	117	100	83	83	24	24	24	23	23	23	23	21	21	21
1220	80	101	97	100	105	105	99	84	103	105	21	21	22	22	22	22	22	22	22	21
1230	106	84	82	77	84	97	89	102	99	92	21	21	21	21	21	21	21	21	21	21
1240	96	89	97	98	99	96	89	94	89	97	21	21	21	21	21	21	21	21	21	21
1250	98	106	96	87	108	109	131	115	109	116	20	20	19	18	18	18	18	18	18	19
1260	103	115	108	92	84	102	90	105	103	100	19	19	19	19	18	18	18	18	18	18
1270	85	103	97	110	96	104	119	113	125	104	18	18	18	18	18	18	17	17	16	16
1280	120	115	109	102	98	108	117	110	125	101	16	16	16	16	16	16	16	16	16	16

Table 1. (continued)

	Tree Ring Indices										Number of Samples									
Date	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1290	116	127	123	101	109	114	93	109	99	82	16	16	16	16	16	16	15	15	14	14
1300	104	92	97	83	74	97	94	91	95	98	14	14	14	14	14	14	14	14	14	14
1310	108	103	102	106	97	99	121	89	104	88	14	14	14	14	14	13	13	13	13	13
1320	87	101	93	94	89	85	93	95	117	101	13	13	13	13	13	13	13	13	13	13
1330	96	97	100	101	92	95	80	79	82	98	14	13	13	13	12	11	11	10	10	10
1340	87	92	107	105	103	118	94	109	105	121	10	10	10	10	10	10	10	10	10	10
1350	93	112	130	126	120	101	101	115	102	100	11	11	10	11	11	11	11	11	10	10
1360	78	83	76	90	116	84	93	90	67	106	10	9	10	10	10	10	10	10	9	9
1370	85	77	91	72	97	95	93	80	100	103	9	8	8	8	8	8	8	8	8	8
1380	94	96	82	86	101	95	112	85	104	101	8	8	8	8	8	8	8	8	8	8
1390	97	97	87	110	91	98	113	93	108	103	8	8	8	8	8	8	8	8	8	8
1400	117	94	74	86	93	130	110	102	111	114	8	8	8	8	8	8	8	8	8	8
1410	108	86	115	101	111	104	96	120	136	88	8	8	8	8	8	8	8	8	8	8
1420	153	119	118	132	115	114	112	85	92	109	8	8	8	8	8	8	8	8	8	8
1430	102	108	133	119	137	133	109	124	96	88	8	8	8	8	8	6	6	6	6	6
1440	77	81	84	76	78	88	80	100	91	86	6	6	6	6	7	7	7	7	7	7
1450	78	86	88	99	95	91	115	91	105	103	7	7	7	6	6	7	7	6	6	6
1460	126	128	118	119	115	121	124	126	119	97	6	6	6	6	6	6	6	6	5	5
1470	113	106	89	90	100	138	141	127	111	125	5	5	5	5	5	5	5	5	5	5
1480	110	111	90	83	74	90	95	97	68	71	5	5	5	5	5	5	5	4	4	4
1490	61	63	72	78	84	96	112	92	79	89	4	4	4	4	4	4	5	5	5	5
1500	83	75	71	80	97	112	113	120	110	118	5	5	5	5	6	6	6	8	8	8
1510	111	94	86	97	98	100	105	101	93	97	8	8	8	8	8	8	8	8	8	8
1520	76	80	92	78	104	103	100	108	91	105	8	8	8	8	8	8	8	8	8	9
1530	75	76	68	85	77	108	79	108	114	135	9	9	9	9	10	10	9	9	9	9
1540	143	101	88	103	100	110	112	107	111	101	9	9	9	9	9	9	9	8	8	8
1550	108	108	57	78	51	70	43	57	70	104	8	8	7	7	7	7	7	7	7	7
1560	81	92	105	97	121	76	54	84	83	92	7	7	7	7	7	7	7	7	7	7
1570	125	141	102	130	139	103	113	127	111	115	7	8	8	8	8	8	8	8	8	8
1580	125	111	72	103	123	102	131	102	104	138	8	8	8	8	8	8	8	8	8	8
1590	95	72	90	127	132	134	103	111	87	68	8	8	8	8	8	8	8	9	9	9
1600	78	82	68	80	107	128	128	164	126	100	9	9	9	9	9	9	9	9	9	9
1610	117	134	130	142	149	132	94	84	98	114	9	9	9	9	9	9	9	9	9	9
1620	135	107	139	162	125	69	60	67	89	144	9	9	9	9	9	9	9	9	9	9
1630	116	77	65	49	50	73	97	124	139	77	9	9	9	9	9	9	9	9	9	9

Table 1. (continued)

	Tree Ring Indices										Number of Samples									
Date	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1640	112	132	103	82	81	86	116	104	88	78	9	9	9	9	9	9	9	9	9	9
1650	59	58	58	90	100	116	131	107	94	96	9	9	10	10	10	10	10	10	10	10
1660	110	98	109	108	80	105	103	96	74	101	10	10	10	10	10	10	10	10	10	10
1670	99	107	109	106	81	60	85	97	89	93	10	10	10	10	10	10	10	10	10	10
1680	86	102	120	95	135	80	79	88	92	106	10	10	10	10	10	10	10	10	10	10
1690	71	73	81	101	120	101	101	99	96	78	10	11	11	11	13	13	13	13	13	13
1700	62	63	74	104	92	91	82	114	106	95	13	13	13	13	13	13	13	13	13	13
1710	81	94	99	102	99	107	91	109	104	129	13	13	13	13	13	13	14	15	15	15
1720	108	101	91	102	112	93	104	148	114	114	15	15	15	16	16	16	16	16	16	16
1730	100	121	101	112	110	100	108	105	101	96	16	16	16	17	17	17	17	17	17	17
1740	87	85	61	87	101	95	117	117	85	92	17	17	17	19	19	19	19	19	19	19
1750	87	93	105	117	103	96	103	106	107	116	19	19	19	19	19	19	19	19	19	19
1760	117	116	121	148	129	122	119	88	110	99	19	19	19	19	19	19	19	19	19	19
1770	80	92	128	112	107	82	93	93	94	113	19	19	19	19	19	19	19	19	19	19
1780	117	109	114	105	105	90	86	72	86	114	20	20	20	20	21	21	21	21	21	21
1790	98	94	102	77	84	82	59	78	87	107	21	21	21	21	21	21	21	21	21	21
1800	102	92	79	78	86	95	99	105	113	91	21	21	21	21	21	22	22	22	22	22
1810	90	111	112	116	111	106	95	77	128	104	22	22	22	22	22	22	22	22	22	22
1820	91	79	92	108	91	105	93	114	107	130	22	22	22	22	23	23	23	23	23	23
1830	123	132	110	105	135	132	103	101	115	96	23	23	23	23	23	23	23	23	23	23
1840	73	89	105	109	89	105	124	134	126	115	23	24	24	24	24	24	24	24	24	24
1850	123	94	106	104	103	120	97	93	107	103	24	24	24	24	24	24	23	23	23	23
1860	103	112	93	77	95	109	89	78	81	74	23	23	23	23	23	23	23	23	23	23
1870	101	97	99	92	85	95	91	84	88	100	23	23	23	23	23	23	23	23	23	23
1880	70	85	73	80	86	97	108	114	87	86	23	24	24	24	24	24	24	24	24	24
1890	122	101	123	92	84	82	93	101	83	106	24	24	24	24	24	23	23	23	23	23
1900	104	110	88	107	119	102	99	75	79	81	23	23	23	23	22	22	22	20	20	20
1910	93	108	107	105	121	115	118	122	107	97	20	20	20	20	20	20	20	20	20	20
1920	86	104	102	99	95	90	92	86	65	89	20	19	18	18	18	18	18	17	17	17
1930	97	89	78	106	119	109	111	118	98	99	17	17	17	17	17	17	17	17	17	17
1940	102	106	71	78	79	80	85	121	88	95	17	16	16	16	16	16	16	16	16	16
1950	124	98	116	110	92	108	85	78	94	98	16	16	16	16	16	16	16	16	16	14
1960	104	102	112	99	108	89	92	109	92	101	14	13	12	12	12	11	11	11	11	11
1970	96	113	120	113	87	123					11	10	10	7	4	4				

we are dealing with a relatively large tree-ring area – possibly, if the results for the modern chronologies are realistic, as large as the whole British Isles – within which good cross agreements between *master* chronologies can be expected. If, as now seems likely, this is a true picture it lends hope that an adequate tree-ring grid for the British Isles may be available within a few years for the medieval period at least.

Two other points need to be mentioned. Firstly, the overall area to which the Scottish chronology applies needs to be determined. Conservative opinion would suggest that the north and east of Scotland may well be 'different' in some way. The simplest solution is empirical testing of modern and medieval timbers and some work in this direction is already under way. Secondly, the possibilities of extending this chronology back in time must be explored. Problems in the dating of Dark Age and Iron Age sites need to be resolved throughout the British Isles. Even a few precise dates would help in this direction. One obvious snag in Scotland is the dearth of sources of long lived 11th or 12th century oak timbers. At the present time no obvious suggestions are forthcoming. In the north of Ireland an 800 year floating chronology is in existence covering approximately the first eight centuries A.D. (Baillie 1975). The Belfast and Dublin chronologies stop in A.D. 1001 and A.D. 855 respectively. There is a serious need for long lived timbers of the 10th to 12th centuries in these areas to tie down the floating chronology. In the light of the cross agreements between these areas, Scottish material might be just as useful as Irish in achieving the desired result.

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REFERENCES

Baillie, Michael G.L.

1973 A recently developed Irish tree-ring chronology. *Tree-Ring Bulletin* 33:15-28.

1975 A horizontal mill of the eighth century A.D. at Drumard, Co. Derry. *Ulster Journal of Archaeology* 38:25-32.

1977a The Belfast oak chronology to A.D. 1001. *Tree-Ring Bulletin* 37:1-12.

1977b Dublin medieval dendrochronology. *Tree-Ring Bulletin* 37:13-20.

1978 Dendrochronology for the Irish Sea province. In Proceedings of the Isle of Man Conference, 1977, *British Archaeological Reports* (in press).

Baillie, M. G. L. and J. R. Pilcher

1973 A simple crossdating program for tree-ring research. *Tree-Ring Bulletin* 33:7-14.

Barefoot, A. C.

1975 A Winchester dendrochronology for 1635 to 1972 A.D.: Its validity and possible extension. *Journal of the Institute of Wood Science* 7:25-32.

Leggett, P., M. K. Hughes, and F. A. Hibbert

1978 A modern oak chronology for northern Wales and its interpretations. In Proceedings of the First International Symposium on Dendrochronology in Northern Europe, edited by J. M. Fletcher and S. McGrail. *British Archaeological Reports* (in press).

Oldrieve, W. T.

1916 The ancient roof of Glasgow Cathedral. *Proceedings of the Society of Antiquaries of Scotland* 50:155-73.