The Dendrochronological Dating of Buildings in Southern England

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THIS PAPER briefly outlines earlier work in southern England and discusses particular problems associated with the tree-ring dating of building timbers in the region. Specific examples from recent research not only highlight these problems, but show the success that may also be achieved. A new regional chronology for southern England, constructed entirely from building timbers, is presented and its use and further development discussed.

Whilst dendrochronological methods of dating have become well established in many regions since *c.* 1900, as recently as 1971 it was believed that there was no obvious internal homogeneity amongst tree-ring series from English buildings and that future development of dendrochronology in England would require a 'massive onslaught' of work.[1] A major problem in southern England is that most structural timbers have only 50 to 70 annual rings, usually considered insufficient for dating by dendrochronology. In addition the series are 'complacent', that is their ring-widths show little year-to-year variation. In an attempt to overcome these problems the most active worker in this region during the 1970s and early 1980s, the late Dr J. M. Fletcher, concentrated his efforts on oak samples which yielded long 'sensitive' series. The sources of such oak were mostly radially-split boards from panel paintings, manuscript-boards, chests and cupboards.[2,3,4] Although it was assumed that this oak was of English origin, the individual items were generally dated against continental reference chronologies. A complex hypothesis was proposed[5] in an attempt to account for the differences found between these 'art-historical' ring-width curves and those produced from building timbers in other parts of the British Isles, including the SW. of England.[6] No equivalent differences could be found in living oaks.[7,8]

This phase of research in dendrochronology in southern England has been eloquently summarized by Dr M. Baillie.[9] Following the recognition by Fletcher that many or all of the previous chronologies were constructed from oak of foreign origin,[10] there remains a gap in our published information for oak grown in southern England in historical time. Fletcher published dates for over twenty buildings,[11] but the raw data he gained were not separated from the art-historical work, and are not

therefore available. Extensive research in northern England by Miss J. Hillam has led to published chronologies for both England as a whole,[12] and SW. England,[13] but only from A.D. 404 to 1216.

PROBLEMS WITH DATING BUILDINGS IN SOUTHERN ENGLAND

Southern England shares all the problems encountered elsewhere and familiar to dendrochronologists, for example, problems of access to timbers, and variation in sapwood ring numbers. Certain drawbacks not encountered to the same extent elsewhere are found in this region. For example, work on living oaks in the region[14,15,16] has shown that crossmatching between the majority of trees is readily achieved. The problem with oak from historic structures is that even relatively large timbers often contain few rings, for example, eight cores from New Hall barn, High Roding, Essex, three of which were too short to measure, the remaining five having 82, 71, 56, 47 and 41 rings respectively; and Westington Court, Docklow, Herefs. in which five cores had 72, 68, 52, 50 and 45 rings. The individual series in both cases were generally complacent. Such examples are typical amongst vernacular buildings in southern England.

Since this technique of dating depends upon being able to crosssmatch ring-width series with certainty, recognizing the unique patterns of growth associated with particular periods, the longer the series, the greater the potential for dating. A short sequence may statistically crossmatch at a number of positions, and the chances of such a series being confidently dated are fewer. This reinforces the need for the primary requirement of visual crossmatching, the results of which are then assessed by statistical means. This methodology was adopted in the cases discussed below. Any secondary evidence, such as documentary dates, should only be considered subsequently as a means of either reinforcing the dendrochronological date, or as raising a point of interest as to the possible reasons for any discrepancy. The use of secondary evidence should not narrow the period in which crossmatching is attempted to the point where one is tempted to accept a visual match because it falls within a preconceived time period. It is hazardous to use very short sequences, especially of the order of 20 rings, even with independent evidence, although such practices have been reported in the past,[17] as has dating different species against oak reference material, without establishing that this is a valid procedure.

Variability in the numbers of sapwood rings from tree to tree also mediates against dating such short sequences. Sapwood variability in oaks has been discussed elsewhere,[18] and the author's research on living oaks in E. Anglia has again shown this variation.[19] Assuming a 'date' in such circumstances may obscure other events such as differing phases of work or repairs.

Apparent differences in the general characteristics of southern timbers in their complacency and rapid growth may well be explained by climatic factors. Dr K. Briffa[20] has suggested that temperature may limit oak growth more frequently in the north, whereas rainfall is more often the limiting factor in the south.

Where suitable timbers are encountered at individual sites, there are often individual samples which will not crossmatch with the rest, despite the architectural evidence for their contemporaneity. This situation is found throughout Britain, for

example at Clayton Hall and Peel Hall by Dr P. Leggett,[21] at Glasgow Cathedral by Baillie,[22] and by the author in the case of the Abbey Barn at Glastonbury, Somerset. A number of reasons may be put forward to explain this phenomenon, including natural variation and competition between trees, microsite variation, and the effects of insect defoliation on individual trees. The reuse of timbers is another possible reason, but such activities are generally apparent at the time of sampling.

Sometimes the ring series show signs of major growth disturbances such as may be caused by pollarding, as detected at Caldecotte mill, Bucks.[23] and Legges Mount in the Tower of London.[24] Shredding, a variation of pollarding, is a likely cause of the failure of some timbers from Brittany to crossdate.[25] It seems likely that less drastic forms of management, not common to all trees, could also be responsible for the non-matching of some timbers in all regions. It is rare for any record of the provenance of the timbers to survive, and the possibility exists that some individuals, though contemporary, are of a different source, and hence do not readily crossmatch.

Even when several crossmatching timbers are found, the resulting site chronology cannot always be dated. This has been found for chronologies from a roof of Sherborne Abbey, Dorset, and the belfry of Birling church, Kent, both of which are well-replicated series. Although a particular disturbance factor common to all the trees at each site may be responsible for this failure to date some chronologies, it may be that the lack of tree-ring data for specific periods in some regions is responsible. Baillie[26] has discussed these poorly replicated periods in chronologies. One such time in British series occurs in the mid 14th century. The chronology presented in this paper includes data from two sites which span this period; St Cuthbert's, Wick, Worcs. (1255 to 1496), and Rectory Cottages, Bletchley, Bucks. (1306 to 1446), as well as data from other sites covering parts of the century.

DATING AT INDIVIDUAL SITES

Despite the problems outlined above, some 20% of the buildings investigated in southern England have been successfully dated. A similar level of success is being found by Dr F. Guibal in Brittany.[27] There appears to be a positive correlation between the social status of the building and the suitability of its timbers for tree-ring dating, although how such a relationship should be interpreted is open to question. The provenance of the timbers in the buildings investigated has not been established in any single case. The chronology presented below is however restricted to building timbers. Data from slow-grown radially-split oak boards, as found in the bishop's throne, Exeter Cathedral, Devon, have not been included because of the likelihood of their having been imported. Sites sampled but not dated are shown in Table 2.

In the case of the remains of cruck blades from the barn at Bradwell Abbey, Bucks. tree-ring dating represented the only practical means of accurately dating the meagre remnants of a once fine roof, and yielded the earliest tree-ring data yet established by the author (1083 to 1279). The extensive remains of the magnificent roof of another abbey barn, that of Glastonbury, ended years of speculation about its date, placing it firmly in the 14th century.[28]

Dunstable, Beds. grew up around an established priory, although the date at which the town was founded is unclear. The position of a timber-framed structure on

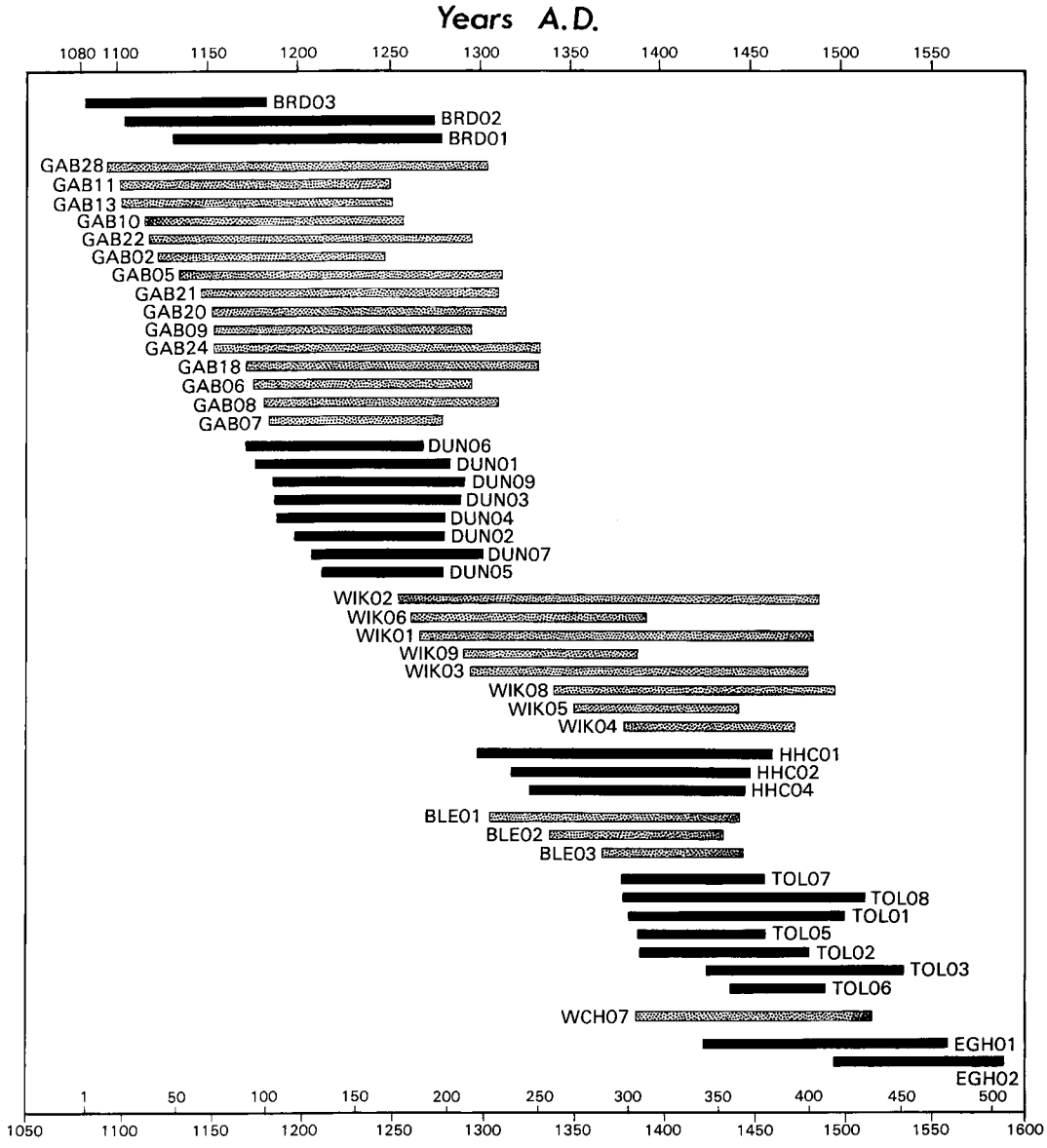

FIG. 1

Bar diagram showing the years spanned by each sample included in the regional chronology, along with its laboratory identification code. The code letters represent the following sites: BRD — Abbey barn, Bradwell, Bucks.; GAB — Abbey barn, Glastonbury, Som.; DUN — 30 Middle Row, Dunstable, Beds.; WIK — St Cuthbert's, Lower Wick, Worcs.; HHC — St Mary the Virgin, High Halden, Kent; BLE — Rectory Cottages, Bletchley, Bucks.; TOL — Martin Tower, Tower of London; WCH — W. aisle S. transept, Winchester Cathedral, Hants; EGH — Guildhall, Exeter, Devon

TABLE I

TREE-RING CHRONOLOGY FOR OAK FROM BUILDINGS IN SOUTHERN ENGLAND, A.D. 1083 TO 1589. THE VALUES ARE RING-WIDTH INDICES, AND THEY ARE SHOWN ALONG WITH THE NUMBER OF SAMPLES FOR EACH YEAR

	Tree-Ring Indices										*No. of Samples*									
Year	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1083				198	133	118	83	104	71	130				1	1	1	1	1	1	1
1090	118	139	241	236	267	184	164	179	193	161	1	1	1	1	1	2	2	2	2	2
1100	124	137	179	213	202	179	177	163	190	158	2	2	3	4	4	5	5	5	5	5
1110	137	157	159	166	185	176	144	118	171	145	5	5	5	5	5	5	6	6	7	7
1120	130	99	106	176	160	140	126	112	124	94	7	7	7	8	8	8	8	8	8	8
1130	117	109	106	93	85	103	106	84	114	87	8	8	9	9	9	10	10	10	10	10
1140	150	130	81	90	90	89	81	85	111	121	10	10	10	10	10	10	10	11	11	11
1150	98	113	88	111	109	90	109	101	67	109	11	11	11	12	14	14	14	14	14	14
1160	98	95	99	91	86	97	78	74	101	120	14	14	14	14	14	14	14	14	14	14
1170	104	103	98	102	104	106	119	74	83	95	14	14	16	16	16	16	17	18	18	18
1180	79	96	106	84	69	103	91	126	73	94	18	18	19	19	18	19	19	20	21	22
1190	131	130	93	150	118	118	99	92	83	90	22	22	22	22	22	22	22	22	22	23
1200	111	129	124	123	103	114	96	74	94	76	23	23	23	23	23	23	23	23	24	24
1210	113	104	93	121	104	106	104	99	88	110	24	24	24	24	25	25	25	25	25	25
1220	105	109	84	91	87	77	100	85	94	124	25	25	25	25	25	25	25	25	25	25
1230	92	71	70	86	87	95	74	108	92	94	25	25	25	25	25	25	25	25	25	25
1240	80	75	79	102	82	85	90	90	80	106	25	25	25	25	25	25	25	25	25	24
1250	115	104	90	119	115	137	98	124	106	107	24	24	23	22	22	23	23	24	24	23
1260	113	114	113	94	87	85	87	81	98	90	23	23	23	23	23	23	23	24	24	24
1270	103	114	92	114	107	91	79	83	75	93	23	23	23	23	23	23	22	22	22	22
1280	96	89	101	92	85	81	80	76	61	86	21	19	17	17	17	16	16	16	16	16
1290	91	77	106	112	108	85	90	87	82	86	16	16	16	15	15	16	16	13	13	14
1300	91	99	100	97	99	100	111	124	116	111	14	14	14	13	13	13	13	13	13	13

1310	115	98	105	116	127	149	143	141	117	135	13	13	11	11	10	10	9	9	10	10
1320	133	142	141	140	111	103	78	106	112	128	10	10	10	10	10	10	10	10	11	11
1330	103	85	81	90	108	120	114	87	92	111	11	11	11	11	10	9	9	9	9	10
1340	113	111	112	95	97	116	119	106	99	126	10	11	11	11	11	11	11	11	11	11
1350	121	126	119	120	106	80	70	102	92	86	11	11	12	12	12	12	12	12	12	12
1360	62	65	78	106	98	81	75	77	72	97	12	12	12	12	12	12	12	12	13	13
1370	96	83	93	83	88	86	83	75	88	100	13	13	13	13	13	13	13	13	13	14
1380	98	93	97	105	91	107	139	122	124	118	16	16	16	17	17	17	17	18	18	19
1390	110	124	95	115	100	114	120	125	142	123	19	19	19	18	18	18	18	18	18	18
1400	125	117	91	102	120	99	112	93	113	118	18	18	18	18	18	18	18	18	18	18
1410	116	110	106	100	94	100	84	85	95	86	18	18	18	18	18	18	18	18	18	18
1420	112	101	93	124	112	94	78	79	96	93	18	18	18	18	19	19	20	20	20	20
1430	105	104	133	91	97	103	84	79	85	70	20	20	20	20	20	20	19	19	19	20
1440	87	96	92	84	84	80	83	85	87	83	20	20	20	20	19	19	18	17	16	16
1450	76	85	82	76	83	83	82	91	75	71	15	15	15	15	15	15	15	15	15	13
1460	77	75	69	75	66	72	76	76	91	89	13	13	13	13	13	13	13	13	13	13
1470	85	76	74	75	85	106	95	76	72	82	13	13	13	13	13	12	12	12	12	12
1480	90	107	85	89	87	73	70	71	85	89	12	12	11	10	10	9	9	9	8	8
1490	97	71	70	76	87	94	117	86	74	85	8	8	7	7	7	7	7	6	6	6
1500	67	71	77	89	94	95	117	84	81	86	6	6	6	5	5	5	5	5	5	5
1510	78	77	87	105	124	91	71	68	114	123	5	5	5	5	4	4	4	4	3	3
1520	88	96	148	97	97	89	92	100	118	104	3	3	3	3	3	3	3	3	3	3
1530	99	136	102	103	90	114	146	120	115	117	3	3	3	3	3	2	2	2	2	2
1540	118	132	102	134	127	99	94	108	99	110	2	2	2	2	2	2	2	2	2	2
1550	82	97	99	81	108	99	51	83	68	57	2	2	2	2	2	2	2	2	2	1
1560	66	79	77	75	83	93	79	71	66	98	1	1	1	1	1	1	1	1	1	1
1570	104	111	96	103	89	85	69	71	87	97	1	1	1	1	1	1	1	1	1	1
1580	116	89	87	68	101	121	104	108	109	133	1	1	1	1	1	1	1	1	1	1

TABLE 2

LIST OF THE OTHER ARTEFACTS INVESTIGATED WHICH HAVE FAILED TO YIELD A SITE CHRONOLOGY. THE LIST IS ARRANGED BY COUNTY

Avon

Timbers from a wide range of buildings from the Bristol area in store at the Bristol City Museum and Art Gallery.

Bedfordshire

Blackburn Hall, Thurleigh
The Peacock, Leighton Buzzard
Clawdershill Farm, Shillington
wealden-type house at Little Barford
cottage at Blunham
several properties in the village of Elstow

Berkshire

barn at Moor Farm, Holyport, Maidenhead
series of waterfronts beside the R. Kennett, Reading

Buckinghamshire

Guildhall, hospital and chantry of St Margaret and St Katherine, Fenny Stratford
Long Crendon Manor
St John's Manor, North Marston
wealden-type house at Haddenham

Cambridgeshire

gatehouse, Downhall Farm, Abington Pigotts

Devon

9 The Close, Exeter
Polsloe Priory, Exeter
Bishop of Crediton's residence, Exeter
Nave Roof, Exeter Cathedral
41/42 High Street, Exeter
quayside buildings, Exeter
house at Bowhill, Exeter
house at St Thomas, Exeter
house in West Street, Exeter
Manor House Hotel, Cullompton

Essex

Widdington Tithe Barn
Bushmead Priory
New Hall barn, High Roding

Hampshire

Andover Town Hall (pine)
Titchfield Tithe Barn
barn and farmhouse, Manor Farm, Chalton
Tudor House Museum, Southampton

Herefordshire

'Clearbrook', Pembridge
Leominster Priory
Hay Castle
Westington Court, Docklow
Llanwerne Church

Humberside

St Peter's Church, Barton-on-Humber

Kent

belfry, Birling church
barn, Scott's Farm, Rainham

Northamptonshire

Earls Barton Church
cottage at Bozeat

Somerset

Rowland's Farmhouse, Ashill, Yeovil
Long Sutton Court House
West Newton Manor, North Petherton
King John's Hunting Lodge, Axbridge

Warwickshire

buildings at the Avoncroft Museum

Worcestershire

Leigh Court Barn, Bransford
Ankerdine Farmhouse, Knightwick
Royal Exchange Hotel, Droitwich
67 High Street, Bewdley

the edge of the market place in Dunstable indicates that the terrace of which it forms a part probably represents some of the earliest buildings in the town. Tree-ring evidence dates the building to the first quarter of the 14th century, and is important to the local history of the area.

The roof of the porch to the Guildhall in High Street, Exeter, Devon has a documented date of construction of 1596. This reinforced the date obtained from the site chronology of only two timbers for which the visual and statistical agreement was good, the ring-width series spanning the period 1424 to 1589. Hillam[29] in her studies in Exeter found good agreement between her earlier samples and Irish tree-ring data, although this was not the case here.

In all, over six and a half thousand rings from 50 timbers have been used in the construction of the southern England chronology presented (Table 1, Fig. 1). The raw data have been indexed using standard dendrochronological techniques[30] so that individual series do not exert undue influence over the final chronology, and so that large changes in values are avoided when relatively wide or narrow ringed series are added in.

FUTURE DATING PROSPECTS

The establishment of the regional chronology (Table 1) should be of great value in dating future sites, and indeed has already proved so.[31] The extension of the period covered is one of the major aims of continuing research in the region. The addition of new site data which strengthen the existing chronology will require the updating of the chronology at suitable intervals. Another site whose data bridge the 14th-century gap, a church roof from High Halstow, Kent, has been dated using the chronology, and these data will be included in a later revision.

Dendrochronology in southern England has suffered from early gloomy predictions of its failure. It has passed through a perhaps over-optimistic phase in its ability to date vernacular buildings, to a state where it is now recognized that this relatively cheap,[32] unambiguous method is in many cases the only practical means of dating oak structures. It has to be remembered however that the requirement for a large number of rings, and the usefulness of sample replication, still means that dating is not always possible by dendrochronology as practised now.

The study of other physical properties of tree-rings, such as the density of annual rings, the isotope ratios of their chemical constituents, and the ratio of the cell wall to lumen area may all be of use in the future. Financial constraints, however, may make such studies unsuitable to their application to questions of dating alone.

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None of this work would be possible without the permission of the owners and guardians of the numerous structures studied.

NOTES

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[22] M. Baillie, *Tree-ring dating and archaeology* (London, 1982).
[23] M. Petchey and B. Giggins, 'The excavation of a late seventeenth-century water-mill at Caldecotte, Bow Brickhill, Bucks.', *Post-Medieval Archaeol.*, 17 (1983), 65–94.
[24] Bridge, op. cit. in note 7.
[25] F. Guibal, pers. comm.
[26] Baillie, op. cit. in note 22.
[27] Dr F. Guibal, in association with Dr J. Pilcher and Professor G. I. Meirion-Jones is engaged in dating buildings in Brittany.
[28] M. Bridge and R. Dunning, 'The Abbey Barn, Glastonbury', *Proc. Somerset Archaeol. Natur. Hist. Soc.*, 125 (1981), 120.
[29] Hillam, op. cit. in note 6.
[30] H. Fritts, *Tree rings and climate* (London, 1976).
[31] J. Pilcher has reported dating buildings in England, and in association with F. Guibal, both have used the chronology for dating buildings in Brittany.
[32] The author is not aware of any published costs for dendrochronological dating. However, after the cost of sampling, which is dependent on accessibility, the cost of analysis per sample is usually about one-quarter of the cost of a radiocarbon date. This obviously varies from laboratory to laboratory.