

**UNIVERSITY OF CAMBRIDGE
NATURAL RADIOCARBON MEASUREMENTS XI**

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The measurements presented in this paper were carried out at the University Radiocarbon Dating Research Laboratory during the second half of 1971 using carbon dioxide counting. The counting equipment used was substantially that described by Switsur, Hall, and West (1970). Oxidation of samples of sufficiently high carbon content was performed in a stainless steel high pressure combustion bomb, developed at this laboratory, otherwise by 'wet' oxidation using acidified permanganate solutions for lake mud and samples of low organic content.

The measured activities were converted to ages using the conventional Libby half-life of 5568 ± 30 years with uncertainties expressed in terms of one standard deviation of the counting statistics. Studies made during this period were mainly concerned with dating pollen zones at various sites within the British Isles.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

British Isles

Pollen Zone Boundary determinations (Nant Ffrancon series)

Third site of project of F. A. Hibbert and V. R. Switsur to determine extent of synchronicity for pollen zone boundaries in British Isles and N Europe. Core of lacustrine sediments in glacial basin in a straight valley extending 5.6 km SSE from Bethesda, Caernarvonshire, Wales ($53^{\circ} 2' N$ Lat, $4^{\circ} 9' W$ Long, Natl. Grid Ref. SH 632633). Two or three samples, indicated by depth in pollen diagram, taken as thin slices at each boundary, and at intermediate points corresponding to significant changes in pollen diagram. Samples were from 10 cm core, except for Q-890 and Q-890 bis, which were from 5 cm core a few m from main 10 cm coring site (depths given for Q-890 and Q-890 bis refer to correlated depth in main core). Lower layers were mud of low organic content, which increased up the core. For general description of area, see Seddon (1962). Samples were oxidized as suspension, after acid and alkali pretreatment, in hot acidified potassium permanganate, and CO_2 was rigorously purified before counting.

Sequence extends from near beginning of Flandrian to late Flandrian. Results will be discussed elsewhere, and compared with results from Tregaron SE Bog (Switsur and West, 1972) in this area and with other sites in this investigation such as Red Moss (Hibbert, Switsur, and West, 1971). Coll. and pollen analysis by F. A. Hibbert; radiocarbon measurements by V. R. Switsur.

- | | |
|--|---------------------|
| | 10,080 ± 220 |
| Q-890. Nant Ffrancon, 608 to 620 cm | 8130 B.C. |
| 12 cm silty lake mud representing 1st organic deposition. <i>Juniperus</i> pollen curve rising. In <i>Betula-Pinus-Juniperus</i> pollen assemblage zone. | |
| | 9915 ± 220 |
| Q-890 bis. Nant Ffrancon, 597 to 608 cm | 7965 B.C. |
| 10 cm silty lake mud, in <i>Betula-Pinus-Juniperus</i> pollen assemblage zone, at peak of <i>Juniperus</i> curve. | |
| | 9820 ± 200 |
| Q-891. Nant Ffrancon, 587 to 591 cm | 7870 B.C. |
| 4 cm lake mud at decline of <i>Juniperus</i> pollen curve, in <i>Betula-Pinus-Juniperus</i> pollen assemblage zone. | |
| | 9745 ± 200 |
| Q-892. Nant Ffrancon, 584 to 587 cm | 7795 B.C. |
| 3 cm lake mud taken near end of fall of <i>Juniperus</i> pollen curve, in <i>Betula-Pinus-Juniperus</i> pollen assemblage zone. | |
| | 9631 ± 200 |
| Q-893. Nant Ffrancon, 570 to 573 cm | 7681 B.C. |
| 3 cm lake mud taken near end of fall of <i>Juniperus</i> pollen curve, to check Q-892. In <i>Betula-Pinus-Juniperus</i> pollen assemblage zone. | |
| | 9098 ± 180 |
| Q-894. Nant Ffrancon, 562 to 565 cm | 7148 B.C. |
| 3 cm lake mud at point where <i>Corylus</i> expansion begins. Opening of <i>Betula-Pinus-Corylus</i> pollen assemblage zone. | |
| | 8932 ± 170 |
| Q-895. Nant Ffrancon, 557 to 560 cm | 6982 B.C. |
| 3 cm lake mud, check on Q-894, dating beginning of <i>Ulmus</i> curve. In <i>Betula-Pinus-Corylus</i> pollen assemblage zone. | |
| | 8809 ± 170 |
| Q-896. Nant Ffrancon, 551 to 554 cm | 6859 B.C. |
| 3 cm lake mud, dating rise of <i>Corylus</i> . In <i>Betula-Pinus-Corylus</i> pollen assemblage zone. | |
| | 8642 ± 150 |
| Q-897. Nant Ffrancon, 546 to 549 cm | 6692 B.C. |
| 3 cm lake mud dating beginning of <i>Corylus-Pinus</i> pollen assemblage zone. | |

- Q-898. Nant Ffrancon, 528 to 531 cm** **8455 ± 150**
6505 B.C.
3 cm lake mud at opening of *Pinus-Corylus-Ulmus* pollen assemblage zone. *Alnus* curve begins here.
- Q-899. Nant Ffrancon, 509 to 512 cm** **8118 ± 120**
6168 B.C.
3 cm lake mud, in *Pinus-Corylus-Ulmus* pollen assemblage zone, at level of *Corylus* peak in this zone. Q-894 to 899 date closely course of *Corylus* rise.
- Q-899 bis. Nant Ffrancon, 502 to 508 cm** **8162 ± 120**
6212 B.C.
6 cm lake mud check on Q-899.
- Q-900. Nant Ffrancon, 420 to 423 cm** **6884 ± 110**
4934 B.C.
3 cm lake mud, slightly more organic than lower part of core. Onset of rise of *Alnus* pollen curve, and beginning of *Quercus-Ulmus-Alnus* pollen assemblage zone.
- Q-901. Nant Ffrancon, 410 to 413 cm** **6790 ± 100**
4840 B.C.
3 cm organic lake mud. *Alnus* pollen rising rapidly in *Quercus-Ulmus-Alnus* pollen assemblage zone.
- Q-902. Nant Ffrancon, 400 to 403 cm** **6726 ± 100**
4776 B.C.
3 cm organic lake mud at completion of *Alnus* rise in *Quercus-Ulmus-Alnus* pollen assemblage zone.
- Q-903. Nant Ffrancon, 215 to 218 cm** **5160 ± 70**
3210 B.C.
3 cm organic lake mud immediately before *Ulmus* decline. First of 3 samples dating this decline.
- Q-904. Nant Ffrancon, 207 to 210 cm** **5054 ± 70**
3104 B.C.
3 cm coarse wood peat. *Ulmus* pollen declining and weed pollen increasing in frequency.
- Q-905. Nant Ffrancon, 190 to 193 cm** **4870 ± 60**
2920 B.C.
3 cm organic lake mud with wood fragments. Last of 3 samples defining *Ulmus* decline, see Q-903, Q-905.
- Q-906. Nant Ffrancon, 170 to 172 cm** **4422 ± 60**
2472 B.C.
3 cm wood fragments with organic lake mud. The frequency of *Ulmus* pollen shows a slight recovery.
- Q-907. Nant Ffrancon, 164 to 166 cm** **4256 ± 50**
2306 B.C.
2 cm wood peat. *Ulmus* pollen lower than Q-906 with weeds of cultivation reaching high frequencies. Onset of major deforestation.

General Comment: results are internally consistent and fully comparable with those obtained at Scaleby Moss (R., 1959, v. 1, p. 63-65), Red Moss (R., 1970, v. 12, p. 590-598) and Tregaron (R., 1972, v. 14, p. 240-242).

Loch Maree series (West Ross)

Core of lake muds from Loch Maree, West Ross, Scotland (57° 41' N Lat, 5° 30' W Long, Natl. Grid Ref. 28/915714). Coll. by H. H. Birks and V. R. Switsur, Sub-dept. Quat. Research, Univ. Cambridge, to study dates of pollen zone boundaries in Scotland. Area of present and past native pine forest, differing from other areas investigated. Core taken by 5 cm diam. Mackereth type borer July 1969. Samples id. by depth in pollen diagram. All were of low organic content and were oxidized in hot acidified potassium permanganate suspension.

Q-1005. Loch Maree, M1, 200 to 212 cm **4206 ± 55**
2256 B.C.

12 cm lake mud at point in pollen diagram showing marked decrease in *Pinus sylvestris* pollen, assoc. with peaks of *Pteridium aquilinum* spores and increase of pollen and spores of *Calluna vulgaris*, *Sphagnum* and other bog plants, and start of a continuous curve of *Plantago lanceolata*. This horizon probably reflects 1st major deforestation of region.

Q-1006. Loch Maree, M1, 250 to 260 cm **5150 ± 65**
3200 B.C.

10 cm lake mud at point where pollen diagram shows slight but definite decline of *Ulmus* frequencies with 1st appearance of *Plantago lanceolata*.

Q-1007. Loch Maree, M1, 319 to 326 cm **6513 ± 65**
4563 B.C.

7 cm lake mud taken at point where *Alnus glutinosa* pollen increases.

Q-1008. Loch Maree, M1, 377 to 391 cm **8250 ± 100**
6300 B.C.

14 cm lake mud taken at point where *Pinus sylvestris* pollen increases.

Q-1009. Loch Maree, M1, 424 to 435 cm **8951 ± 120**
7001 B.C.

11 cm silty lake mud taken at point where *Betula* and *Corylus* pollen increases simultaneously with rapid decline of *Juniperus*.

Q-1010. Loch Maree, M1, 435 to 445 cm **9085 ± 120**
7135 B.C.

10 cm lake mud taken after peak of *Juniperus* pollen near beginning of Flandrian stage. *Comment:* dates are internally consistent and exhibit a high correlation with depth. They agree well with those from Loch Clair, 16 km S of Loch Maree and with those from Loch Sionascaig ca. 80 km N, thus placing chronology of region on a firm basis. Alder rise appears to be much later in Scotland than in England (Birks, 1972).

Bodmin Moor series

Samples coll. from Hawks Tor and Dozmary Pool by A. P. Brown and V. R. Switsur, Sub-dept. Quat. Research, Univ. Cambridge, to date classical pollen zone boundaries and pollen assemblage zones for SW England for 1st time. Dates inter-relate SE England, the rest of Great Britain, and Europe in terms of vegetational changes during late Weichselian and Early Flandrian. For earlier work at Hawks Tor, see Godwin and Willis (1959a).

Hawks Tor 2 series

Monolith of peat 10 cm², coll. from face in China clay quarry by A. P. Brown in April 1970 at Hawks Tor (50° 33' N Lat, 4° 37' W Long, Natl. Grid Ref. SX/153747) Cornwall, and sampled in lab for pollen analysis: radiocarbon analysis V. R. Switsur. Samples pretreated with acid and alkali and oxidized in high pressure combustion bomb. Samples id. by depth in pollen diagram.

- | | |
|--|---------------------|
| | 11,069 ± 220 |
| Q-1015. Hawks Tor, 199 to 201 cm | 9199 B.C. |
| 2 cm slice peat monolith containing <i>Betula</i> wood, at end of <i>Cyperaceae-Potentilla</i> pollen assemblage zone. | |
| | 10,884 ± 210 |
| Q-1016. Hawks Tor, 179 to 181 cm | 8934 B.C. |
| 2 cm silty, moderately humified sedge peat, at base of <i>Cyperaceae-Rubiaceae</i> pollen assemblage zone. | |
| | 9654 ± 190 |
| Q-1017. Hawks Tor, 153 to 155 cm | 7704 B.C. |
| 2 cm coarse unhumified sedge peat, at lower boundary of <i>Rumex acetosa</i> sub-zone of <i>Gramineae-Cyperaceae</i> pollen assemblage zone. | |
| | 9544 ± 180 |
| Q-1018. Hawks Tor, 150 to 152 cm | 7594 B.C. |
| 2 cm moderately humified sedge peat, in <i>Rumex acetosa</i> sub-zone of <i>Gramineae-Cyperaceae</i> pollen assemblage zone. | |
| | 9295 ± 180 |
| Q-1019. Hawks Tor, 143 to 145 cm | 7345 B.C. |
| 2 cm moderately humified sedge peat, in <i>Empetrum</i> sub-zone of <i>Gramineae-Cyperaceae</i> pollen assemblage zone. | |
| | 9061 ± 160 |
| Q-1020. Hawks Tor, 141 to 143 cm | 7111 B.C. |
| 2 cm fen wood peat containing fresh <i>Betula</i> twigs. Lower boundary of <i>Betula-Corylus</i> pollen assemblage zone. | |

Dozmary Pool series

Three cores taken by Livingstone borer 5 cm diam. through raised bog at SW end of Dozmary Pool, Cornwall (50° 33' N Lat, 4° 33' W Long, Natl. Grid Ref. SX/192744). Coll. by A. P. Brown, August 1971.

Samples oxidized in high pressure combustion bomb; id. by depth in pollen diagram.

Q-1021. Dozmary Pool, 230 to 235 cm **9053 ± 120**
7103 B.C.
5 cm organic silt at base of organic deposition, resting on kaolin clay and gravel. Base of *Gramineae* pollen assemblage zone.

Q-1022. Dozmary Pool, 219 to 223 cm **8829 ± 100**
6879 B.C.
4 cm fine detritus mud at base of *Cyperaceae* sub-zone of *Corylus-Gramineae* pollen assemblage zone. Continuous curve of *Ulmus* pollen starts here.

Q-1023. Dozmary Pool, 205 to 209 cm **7925 ± 100**
5975 B.C.
4 cm *Salix* fen wood peat, in lower part of *Corylus*-type pollen assemblage zone.

Q-1024. Dozmary Pool, 187 to 191 cm **6793 ± 70**
4843 B.C.
4 cm covering junction of sedge peat with raised bog peat containing charcoal, in *Corylus*-type *Pteridium* pollen assemblage zone. *Alnus* pollen makes 1st appearance here.

Q-1025. Dozmary Pool, 183 to 189 cm **6451 ± 65**
4501 B.C.
6 cm raised bog peat with *Eriophorum vaginatum* and *Calluna vulgaris* twigs and leaves. Sample spans alder rise.

General Comment: dates compare well in chronology they provide with others from other W British sites (Hibbert, Switsur, and West, 1971). Q-1017, Q-1018 suggest a non-sequence at opening of Flandrian since dates are later than beginning of Pollen Zone IV in W (ca. 10,300 B.P.). Admixture of older material during post Allerød solifluction (Hawks Tor *Rubiaceae* pollen assemblage zone) may be responsible for similarity of Q-1016 and Q-1015, which are separated by 20 cm sedge peat. *Ulmus* expansion occurred ca. 200 yr after that of *Quercus*, reverse of situation in rest of Britain but similar to SW France (Oldfield, 1964).

Chesil Beach (Abbotsbury) series

Large rafts of peat (3 × 3 × 1 m) eroded from beach from ca. -2 m O.D. thrown up on beach December 1970, (50° 39' N Lat, 2° 36' W Long, Natl. Grid Ref. 576831). Dates required to relate rafts to peat beds below pebble beach. Coll. by M. W. Blackley; subm. by A. P. Carr, Unit Coastal Sedimentation, Taunton, Somerset.

Q-1028. Abbotsbury, peat **4234 ± 60**
2284 B.C.
Peat containing *Phragmites* and pieces of pine, birch, and oak.

Q-1029. Abbotsbury, humic**4251 ± 60**
2301 B.C.

Extract of peat as in Q-1028 with sodium hydroxide solution. Material precipitated by hydrochloric acid was dated.

Q-1030. Abbotsbury, wood**5058 ± 70**
3108 B.C.

Wood, unid., derived from peat raft.

General Comment: samples dated in connection with discrepancy of dates for peat from Isotopes Teledyne (I-5670, 5270 ± 110 B.P.) and East Kilbride Scottish Reactor Centre (SRRC-12, 4023 ± 50 B.P. and SRRC-31, 4095 ± 60 B.P.) radiocarbon labs. Q-1028 and Q-1029 agree well, indicating no peat fractionation. The wood is probably derived.

Featherbed Moss series, Snake Pass, Derbyshire

Upper layers of ombrogenous (blanket) peat in S Pennines typically exhibit a series of alternating horizontal bands of fresh *Sphagnum* peat and of more highly humified *Ericaceae* or *Cyperaceae* peat. Pollen analysis indicates that several of these *Sphagnum* peat layers are roughly contemporary between one site and another, and correspond to recognized recurrence surfaces; and thus are climatically determined. The *Sphagnum* peat layers occur in definable positions relative to anthropogenic effects (clearance phases) apparent in the pollen diagrams, and thus can be used to date them.

Samples were all slices 1 cm thick cut from a peat monolith from Featherbed Moss, at summit of Snake Pass (53° 26' N Lat, 1° 52' W Long, Natl. Grid Ref. SK/091928) at alt. 500 m. Coll. 1965 by J. H. Tallis, Univ. Manchester. Depths are measured from ground surface (Tallis, 1964; Hicks, 1971).

Q-849. Featherbed Moss 1**491 ± 50**
A.D. 1459

Fresh *Sphagnum* peat from depth 25 cm. Sample dates beginning of peat growth.

Q-850. Featherbed Moss 2**717 ± 50**
A.D. 1233

Fresh *Sphagnum* peat from depth 32.5 cm immediately underlying highly humified peat formed during 'Little Climatic Optimum'.

Q-851. Featherbed Moss 3**1023 ± 50**
A.D. 927

Fresh *Sphagnum* peat from depth 42 cm at base of layer. Coincides with rise of weed pollen frequencies of Viking and Early Mediaeval times.

Q-852. Featherbed Moss 4**1400 ± 50**
A.D. 550

Fresh *Sphagnum* peat from depth 82 cm at base of series of ill-defined bands coinciding with decline of weed pollen frequencies.

- Q-853. Featherbed Moss 5** **2028 ± 50**
78 B.C.
Humified peat from 115 cm, where weed pollen frequencies begin to rise.
- Q-854. Featherbed Moss 6** **2251 ± 50**
301 B.C.
Fresh *Sphagnum* peat from 120 cm at top of band underlying highly humified peat.
- Q-855. Featherbed Moss 7** **2685 ± 50**
735 B.C.
Fresh *Sphagnum* peat from depth 130 cm from base of 'upper peat' (Conway, 1954) at Classical Zone VIIb/VIII boundary.
General Comment: dates will provide a broad chronology for correlation of many pollen diagrams in area.

Scottish Tree Stump series

- Q-1031. Inverpolly Pine Trunk** **4674 ± 60**
2724 B.C.
Wood (*Pinus sylvestris*) from middle of trunk sec., semi-submerged in water of small lochan close to N shore Loch Sionascaig (58° 4' 15" N Lat, 5° 8' 45" W Long, Natl. Grid Ref. NC/127146). Dates former pine forest in area now covered by blanket bog. Coll. 1970 by R. V. Collier, Nature Conservancy. Subm. by H. H. Birks.

II. ARCHAEOLOGIC SAMPLES

Somerset Levels, SW England

Continuation of collaboration between F. A. Hibbert, Liverpool College Technol.; V. R. Switsur, and J. M. Coles, Dept. Archaeol. and Anthropol. Univ. Cambridge, in excavation and dating of complex of prehistoric trackways in Somerset Levels.

- Q-1027. Honeygore (West) W** **4742 ± 50**
2792 B.C.
- Q-1028. Honeygore (West) B** **4780 ± 50**
2830 B.C.

Check samples for date of Honeygore track. Both determinations were from one sample of *Betula* wood from trackway (51° 11' N Lat, 2° 50' W Long, Natl. Grid Ref. ST/416428). Q-1027 was oxidized using acidified permanganate solution while Q-1028 was oxidized with high pressure oxygen in the combustion bomb. Dates agree within one standard deviation of each other and with other dates of this trackway, see Q-999 (Switsur and West, 1972).

Burtle Bridge Track series

Another Neolithic trackway discovered 1971 at Edington Burtle, Somerset (51° 11' N Lat, 2° 52' W Long, Natl. Grid Ref. ST/393426), a multi-layered construction with assoc. Neolithic pottery. Birch wood

from track coll. by C. F. Clements from beneath 65 cm peat. The 3 pieces dated overlay one another.

Q-1038. Burtle Bridge Track (A)

Wood of track overlying Q-1036.

4327 ± 60

2377 B.C.

Q-1036. Burtle Bridge Track (B)

Wood of track, overlying Q-1035.

4231 ± 60

2281 B.C.

Q-1035. Burtle Bridge Track (C)

Lowest layer of track, resting on peat.

4355 ± 60

2405 B.C.

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