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UNIVERSITY OF CAMBRIDGE NATURAL RADIOCARBON MEASUREMENTS X

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Measurements reported in this paper were obtained in the Cambridge Radiocarbon Dating Laboratory during 1970-71. For most determinations, pure carbon dioxide at a pressure of 2 atm was used to fill the copper proportional counters, of 0.5 L or 1.5 L volume. The counters were protected by a massive lead shield and a plastic scintillation anticoincidence screen (Switsur, Hall, and West, 1970). Modern sample gas was obtained from the 1845 to 1855 growth rings of a locally grown oak tree which was felled in 1950. Background was prepared from Welsh anthracite. The contemporary standard is compared frequently with the activity of the International NBS oxalic acid standard. Sample ages are calculated using the conventional half-life of 5568 ± 30 years and the uncertainty stated in terms of one standard deviation of the counting statistics.

Most samples were pretreated to remove non-contemporary carbonaceous contamination. This involved the manual removal of rootlets during microscopic examination, followed by boiling the shredded sample with 1% hydrochloric acid solution for one hour, washing and vacuum filtering, and normally, boiling with 1% sodium hyroxide solution before finally washing and drying. Certain samples (noted in the text) produced an unfilterable colloidal solution when treated with sodium hydroxide solution so that this step had to be omitted.

Combustion of most samples was effected cleanly and rapidly in high pressure purified oxygen in the combustion bomb (R., 1970, v. 12, p. 590-598). Some difficult samples of low carbon content were oxidized using a 'wet' chemical method with acidified permanganate as the oxidizing agent. A system was constructed to control foaming and to oxidize under slightly elevated pressure, using a carrier gas for bleeding the oxidation products into the purification system (Birks and Switsur, ms. in preparation).

We have continued to focus on research projects with other members of the University Sub-department of Quaternary Research and Department of Archaeology and Anthropology, which, in 1970 included dating of pollen zone boundaries from Wales, Isle of Skye lake deposits, and of archaeologic sites in Scotland, SW England and Crete.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

British Isles

Pollen zone boundary determinations (Tregaron S.E. Bog series)

Core of peat 10 cm diam., taken with a Pilcon piston sampler, from raised bog, Tregaron S.E. bog Cardiganshire, Wales (52° 15′ N Lat, 3° 55′ W Long, Nat. Grid Ref. 22/687623) has been subjected to pollen analysis and radiocarbon dating. Two or three peat samples were taken as thin slices at each boundary and at intermediate points corresponding to significant changes in the pollen diagram. Samples pretreated to remove contaminants and combusted in pure oxygen. Sequence extends from near beginning of Flandrian to late Flandrian. Results will be discussed elsewhere, and compared with those from Red Moss (Hibbert, Switsur, and West, 1971) and other sites in this investigation (ms. in preparation). Coll. and pollen analysis by F. A. Hibbert; radiocarbon measurements by V. R. Switsur.

Samples id. by depth in pollen diagram.

Q-930. Tregaron S.E. Bog, 413 to 416 cm — **10,205 ± 220 / 8255 B.C.**

3 cm detritus mud representing beginning of organic deposition. *Betula-Pinus-Juniperus* zone.

Q-931. Tregaron S.E. Bog, 404 to 406 cm — **9747 ± 220 / 7797 B.C.**

2 cm fen peat at end point of detritus mud. *Betula-Pinus-Corylus* zone opens.

Q-932. Tregaron S.E. Bog, 398 to 400 cm — **9550 ± 200 / 7600 B.C.**

2 cm fen peat, middle of *Corylus* rise. *Ulmus* curve becomes continuous.

Q-933. Tregaron S.E. Bog, 390 to 392 cm — **9303 ± 190 / 7353 B.C.**

2 cm fen peat at end of *Corylus* rise. *Corylus-Pinus* zone opens.

Q-934. Tregaron S.E. Bog, 354 to 356 cm — **8285 ± 150 / 6335 B.C.**

2 cm fen peat with pine wood. Pollen frequencies of *Pinus* begin to exceed those of *Betula*. *Pinus-Corylus-Ulmus* zone opens.

Q-935. Tregaron S.E. Bog, 348 to 350 cm — **8152 ± 150 / 6202 B.C.**

2 cm fen peat. Check sample on Q-934.

Q-936. Tregaron S.E. Bog, 248 to 250 cm — **7128 ± 180 / 5178 B.C.**

2 cm fen peat admixed with birch and pine wood. First of a series of 3 samples dating *Alnus* rise. *Alnus* curve becomes continuous.

6991 ± 180

Q-937. Tregaron S.E. Bog, 242 to 244 cm **5041 B.C.**

2 cm fen peat, at mid point of rise of *Alnus* pollen curve. See Q-936. *Quercus-Ulmus-Alnus* zone begins.

6978 ± 140

Q-938. Tregaron S.E. Bog, 236 to 238 cm **5028 B.C.**

2 cm fen peat. *Alnus* pollen curve continues to rise. See Q-936.

6526 ± 110

Q-939. Tregaron S.E. Bog, 228 to 230 cm **4576 B.C.**

2 cm fen peat, admixed with wood. End of *Alnus* rise.

5979 ± 100

Q940. Tregaron S.E. Bog, 214 to 216 cm **4029 B.C.**

2 cm ombrogenous peat. Deposit here indicated a raised bog characterized by humified *Sphagnum* and *Calluna* peat. *Tilia* curve becomes continuous.

5110 ± 70

Q-941. Tregaron S.E. Bog, 172 to 174 cm **3160 B.C.**

2 cm *Sphagnum-Eriophorum-Calluna* peat. Beginning of main *Ulmus* decline and 1st of 3 samples dating this decline.

4990 ± 70

Q-942. Tregaron S.E. Bog, 167 to 169 cm **3040 B.C.**

2 cm *Sphagnum-Eriophorum-Calluna* peat from mid-point of *Ulmus* decline. See Q-941. *Quercus-Alnus* zone opens.

4893 ± 70

Q-943. Tregaron S.E. Bog, 163 to 165 cm **2943 B.C.**

2 cm *Sphagnum-Eriophorum-Calluna* peat. Last of series dating *Ulmus* decline. See Q-941.

4715 ± 55

Q-944. Tregaron S.E. Bog, 152 to 154 cm **2765 B.C.**

2 cm *Sphagnum-Eriophorum-Calluna* peat. Pollen curve shows increase of frequency of *Plantago,* indicating a maximum of anthropogenic effect.

4695 ± 52

Q-945. Tregaron S.E. Bog, 144 to 146 cm **2745 B.C.**

2 cm humified *Sphagnum-Eriophorum-Calluna* peat. Pollen diagram shows rise in *Ulmus* and *Fraxinus.*

3336 ± 50

Q-946. Tregaron S.E. Bog, 86 to 88 cm **1386 B.C.**

2 cm fresh ombrogenous peat. Increase in *Plantago* pollen indicating a maximum anthropogenic effect.

2922 ± 50

Q-947. Tregaron S.E. Bog, 62 to 64 cm **972 B.C.**

2 cm ombrogenous peat, more humified than Q-946. This level shows a further anthropogenic effect.

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

Isle of Skye series

Limnic mud used in study of Late Weichselian and present vegetation of the Isle of Skye, in collaboration with H. J. B. Birks, Sub-department of Quaternary Research, Univ. of Cambridge (Birks, 1969), coll. 1968 from 3 sites by H. J. B. Birks, H. H. Birks, R. G. West, and K. Rybnicek (Brno) with a 5 cm sq. rod piston sampler (Wright, 1967). Pollen analysis by H. J. B. Birks and radiocarbon determinations by V. R. Switsur. Much sulphur was present, though not all was evolved as hydrogen sulphide during prolonged boiling with hydrochloric acid. Preparation of samples for combustion were difficult, especially for that of Loch Fada, which could not be treated with sodium hydroxide due to formation of colloidal material. Samples were all of very low organic content and the method of obtaining a sample of pure CO_2 from them is described elsewhere (Birks and Switsur, ms. in preparation).

10,254 ± 220

Q-955. Lochan Coir 'A' Ghobhainn, No. 1 8304 B.C.

Fine diatomaceous detritus mud from depth 380 to 382.5 cm (57° 11′ N Lat, 6° 18′ W Long, Nat. Grid Ref. 18/417183); beginning of organic mud deposition. Pollen diagram shows expansion of *Betula* and *Juniperus*.

9691 ± 150

Q-956. Lochan Coir 'A' Ghobhainn, No. 2 7741 B.C.

Diatomaceous mud from depth 362.5 to 365 cm (57° 11′ N Lat, 6° 18′ W Long, Nat. Grid Ref. 18/417183). Dates beginning of influx by amorphous solifluction processes of silt and fine soil.

9420 ± 150

Q-957. Lochan Coir 'A' Ghobhainn, No. 3 7470 B.C.

Fine detritus mud from 335 to 337.5 cm (57° 11′ N Lat, 6° 18′ W Long, Nat. Grid Ref. 18/417183). Dates end of solifluction and solid instability and beginning of vegetational stabilization.

8650 ± 150

Q-958. Lochan Coir 'A' Ghobhainn, No. 4 6700 B.C.

Fine detritus mud from 315 to 317.5 cm (57° 11′ N Lat, 6° 18′ W Long, Nat. Grid Ref. 18/417183). Pollen curve for *Corylus* shows rapid rise at this point.

9655 ± 150

Q-959. Loch Cill Chriosd 7705 B.C.

Fine detritus mud from depth 395 to 400 cm (57° 13′ N Lat, 5° 58′ W Long, Nat. Grid Ref. 18/605203). Pollen diagram shows expansion of *Betula* which is characteristic of pollen diagrams from W Britain for the Flandrian. Sample dates this event.

Q-960. Loch Meodal **9482 ± 150**
7532 B.C.

Fine detritus mud from 725 to 730 cm (57° 8′ N Lat, 5° 5′ W Long, Nat. Grid Ref. 18/656112). Dates lower sediments at site and expansion of *Corylus* pollen.

Q-961. Loch Fada **7500 ± 120**
5550 B.C.

Silty and clayey limnic muds from fen at S end of Loch at contact between muds and underlying clays and silts (57° 27′ N Lat, 6° 12′ W Long, Nat. Grid Ref. 18/494494). Date is minimum for these clays and silts.

Q-929. Loch Mealt Borehole **10,820 ± 350**
8870 B.C.

Inorganic limnic muds from depth 834 to 852 cm in borehole in a marginal fen at Loch Mealt (57° 36′ N Lat, 6° 8′ W Long, Nat. Grid Ref. 18/505650). Five m of sediments below, probably Late Weichselian, were sampled using a 10 cm diam. piston corer. Radiocarbon age is later than anticipated. Coll. by H. J. Birks and R. G. West.

General Comment (H.J.B.B.): dates provide time scale for ordering of various pollen assemblage zones at sites investigated. Q-961 appears rather young.

II. ARCHAEOLOGIC SAMPLES

Somerset Levels series, S W England

Collaboration of F. A. Hibbert and V. R. Switsur, Sub-dept. Quaternary Research, with J. M. Coles Dept. Archaeol. and Anthropol., Univ. of Cambridge, in the excavations and dating of prehistoric trackways of the Somerset Levels has continued in order to obtain precise correlation between the numerous tracks in the area.

Q-991. Sweet Track, Shapwick Heath **4887 ± 90**
2937 B.C.

Corylus wood from trackway underlying 1.5 m peat (51° 09′ N Lat, 2° 50′ W Long, Nat. Grid Ref. ST 422403). This track is the only known Neolithic roadway between Polden Hills and Westhay Meare Is. and may have been constructed partly of timbers of a dismantled Neolithic house on an adjacent sand bed (Coles and Hibbert, 1972).

Q-999. Honeygore Track, Westhay Level **4757 ± 60**
2807 B.C.

Corylus wood from trackway underlying 2 m peat (51° 11′ N Lat, 2° 50′ W Long. Nat. Grid Ref. ST 416428). Check sample for date of Honeygore track. Identification of track may not be certain due to large number in area. Previous dates are Q-431: 4750 ± 130, Lu-297: 4760 ± 65, Q-909: 4773 ± 80. Agreement is very good (Coles and Hibbert, 1972).

4230 ± 60

Q-987. Baker Field Platform **2280 B.C.**

Alnus wood from large platform near complex system of trackways, possibly a landing stage or bridge across a persistently wet bog margin (51° 11′ N Lat, 2° 50′ W Long, Nat. Grid Ref. ST 416428). Possibly contemporary with Bell trackway system 20 m S. It overlies 1.30 m fen wood peat and underlies 0.50 m ombrogenous peat. Check sample from another part of the platform was dated at Lund Univ. Lu-238, 4280 ± 65 B.P. (Coles, Hibbert, and Clements, 1970).

6115 ± 110

Q-928. Morton, Fife, T59/T50 **4165 B.C.**

Wood charcoal from upper midden surface sealed beneath 0.5 m earth (56° 25′ N Lat, 2° 52′ W Long, Nat. Grid Ref. NO/467257). Part of investigation of earliest traces of man in Scotland. See Q-948, Q-981, Q-988, Q-989. Coll. 1970 by J. M. Coles (1971).

6382 ± 120

Q-981. Morton Fife, T50-5, T57-2 **4432 B.C.**

Wood charcoal from depth 45 to 75 cm into shell midden, sealed by 1 m earth, resting directly on emerged beach at 9.7 m (32 ft) O.D. (56° 25′ N Lat, 2° 52′ W Long, Nat. Grid Ref. NO/467257). May be assoc. with Mesolithic stone industry at top of volcanic bluff ca. 100 m away. New Zealand Radiocarbon Lab. obtained different result from material of this midden, (Ref. No. 2826/4 12,200 ± 240 B.P.). Coll. by J. M. Coles (See Q-948 6735 ± 180 B.P. for Mesolithic stone industry, Coles, 1971).

6147 ± 90

Q-988. Morton, Fife, T50-1 and 3 **4197 B.C.**

Wood charcoal from lower and middle layers of shell midden sealed by 30 to 50 cm earth, contemporary with adjacent Mesolithic occupation site (56° 25′ 20″ N Lat, 2° 51′ 50″ W Long, Nat. Grid Ref. NO/468258). Coll. by J. M. Coles (1971).

6450 ± 80

Q-989. Morton, Fife, T53-1 **4500 B.C.**

Wood charcoal from hearth *in situ* on sand surface of stone industry assoc. with Q-988. Very little overlying soil, but no visible contamination. Hearth was dated by thermoluminescence method at Natl. Mus. of Scotland (6000 B.P. ± 1000) and duplicate sample of charcoal was dated by New Zealand Radiocarbon Lab., Ref. No. 2826/3; 6400 ± 125 B.P. The 2 dates agree well. Coll. by J. M. Coles.

3209 ± 75

Q-990. The Culbin Sands, Morayshire **1259 B.C.**

Wood charcoal from dense, black wood remains 1.3 m from surface stratified between 2 midden deposits, all apparently contemporary (57° 38′ 20″ N Lat, 3° 41′ 40″ W Long, Nat. Grid Ref. NH 991622).

This area of Scotland yielded several sites with pottery and metal work comparable with that of the Culbin site, but so far little knowledge of economy. Animal bones and shell in these middens will now make available hitherto unknown dating evidence. Coll. by J. M. Coles and J. J. Taylor, Dept. Archaeol. and Anthropol., Univ. of Cambridge (Coles, 1972).

Myrtos series, Crete

More samples (see R., 1970, v. 12, p. 590-598) from site of Early Minoan II settlement at Myrtos, on hilltop on S coast of Crete, 11 km W of Herapetra (35° 00′ N Lat, 25° 36′ E Long). Like many such settlements, Myrtos was destroyed by fire, which should be dated. Samples were near surface and contaminated by many modern rootlets which were removed by hand-picking by O. Rackham and V. R. Switsur prior to chemical pretreatment. Alkaline solution could not be boiled since colloidal solutions were formed by test samples of all the specimens. Coll. by P. M. Warren, British School of Archaeol., Athens.

Q-951. Myrtos, Rm. 76 **3835 ± 80** **1885 B.C.**

Carbonized wood from depth 1.8 m in destruction debris at center of room.

Q-952. Myrtos, Rm. 77 **4172 ± 70** **2222 B.C.**

Carbonized wood from depth 1.2 m in debris near a corner of a walled room containing burnt earth and fragments of roof plaster.

Q-954. Myrtos, Building 96, The Well **300 ± 60** **A.D. 1650**

Charcoal from floor of depression in ground, which may have been a well, from light gray burnt earth 0.22 m below modern surface under a stone filling. Well is ca. 20 m below Minoan settlement.

Q-1002. Myrtos, Rm. 32 **3965 ± 80** **2015 B.C.**

Carbonized wood from a large charcoal patch ca. 40 cm diam., probably remains of one piece of wood. It lay 0.28 m from modern surface, 0.20 m above natural sandstone rock near summit of hill, adjacent to wall of room containing much burnt mud-brick and pottery.

Q-1003. Myrtos, Rm. 32 **3907 ± 80** **1957 B.C.**

Carbonized wood from level lower than Q-1002 in same room, 1.15 m from modern surface, from inside smashed remains of large clay jar (original height ca. 1.2 m) lying in burnt debris of room. Jar possibly contained oil since burning in room was very severe and surroundings appeared oily.

3986 ± 80
Q-1004. Myrtos, Rm. 32 **2036 B.C.**

Carbonized wood immediately above clay floor, 0.5 below modern surface.

General Comment (P.M.W.): all samples except Q-954 are from burnt contexts of final destruction of Early Minoan II settlement. Series internally consistent and with dendrochronologic calibration produces dates within archaeologic date range of settlement ca. 2600 to 2170 B.C. (Early Minoan II). Corrected results suggest final destruction date for settlement not later than (and probably before) 2150 B.C., which confirms archaeologic date ca. 2170 B.C. Q-954 indicates that the circular construction on plain NW of settlement was open and used in medieval times. (See Warren, 1968, 1969.) The final report will appear later.

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