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NATIONAL PHYSICAL LABORATORY RADIOCARBON MEASUREMENTS VII

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The following list comprises measurements made since those reported in Radiocarbon, 1969, v. 11, p. 130-136. No changes have been made in measurement technique or in the method of calculating the results described in Radiocarbon, 1965, v. 7, p. 156-161. It was necessary during 1968 to replace all the geiger counters used in the anti-coincidence rings, but the long term stability of background and standard count rates implicit in the use of a 20-week rolling mean has been maintained.

Ages are given relative to A.D. 1950 and have been calculated using a half-life of 5568 yr. Measurements, corrected for fractionation relative to the P.D.B. standard, are referred to 0.950 times the activity of the NBS oxalic acid as contemporary reference standard. The quoted uncertainty is one standard deviation and includes an additional uncertainty, taken to be equivalent to a standard deviation of 80 yr, for the de Vries effect, but excludes the uncertainty of the half-life. Should a net sample count rate be less than 4 times the standard error of the difference between the sample and background count rates a lower limit to the age would be reported corresponding to a net sample count rate of 4 times the standard error of this difference.

I. SOIL SAMPLES

England

Rothamsted series, Hertfordshire

Soil samples at Rothamsted Experimental Station (51° 48′ N Lat, 00° 23′ W Long), Harpenden, Herts. Subm. by D. S. Jenkinson, Rothamsted Experimental Sta.

NPL-149. Broadbalk 1 — **1385 ± 140**, **A.D. 565**, $\delta C^{13} = -25.8‰$

Soil from Broadbalk Plot 3; continuous wheat; sample depth 0 to 9 in. Coll. 1881 by H. Gilbert.

NPL-154. Broadbalk 2 — **1950 ± 130**, **A.D. 0**, $\delta C^{13} = -26.0‰$

Soil from Broadbalk Plot 3; continuous wheat; sample depth 9 to 18 in. Coll. 1881 by H. Gilbert.

NPL-153. Broadbalk 3 — **3670 ± 130**, **1720 B.C.**, $\delta C^{13} = -22.2‰$

Soil from Broadbalk Plot 3; continuous wheat; sample depth 18 to 27 in. Coll. 1881 by H. Gilbert.

NPL-161. Broadbalk 4 **875 ± 120** **A.D. 1075** $\delta C^{13} = -26.4‰$

Soil from Broadbalk Plot 3; continuous wheat; sample depth 0 to 9 in. Coll. 1965 by D. S. Jenkinson.

NPL-150. Park Grass 1 **1040 ± 125** **A.D. 910** $\delta C^{13} = -26.7‰$

Soil from Park Grass Plot 3; continuous grass; sample depth 0 to 9 in. Coll. 1886 by H. Gilbert.

NPL-151. Park Grass 2 **280 ± 125** **A.D. 1670** $\delta C^{13} = -26.3‰$

Soil from Park Grass Plot 3; continuous grass, limed; sample depth 0 to 9 in. Coll. 1965 by D. S. Jenkinson.

NPL-155. Park Grass 3 **390 ± 120** **A.D. 1560** $\delta C^{13} = -27.5‰$

Soil from Park Grass Plot 3; continuous grass, unlimed; sample depth 0 to 9 in. Coll. 1965 by D. S. Jenkinson.

NPL-156. Park Grass 4 **290 ± 125** **A.D. 1660** $\delta C^{13} = -27.0‰$

Soil from Park Grass Plot 3; continuous grass, limed; sample depth 0 to 9 in. Coll. 1965 by D. S. Jenkinson.

NPL-214. Geescroft 27 **1870 ± 125** **A.D. 80** $\delta C^{13} = -27.2‰$

Sub-soil, Batcombe series, from 9 to 18 in. layer of soil on Plots 3 and 4 of Geescroft continuous beans experiment. Coll. 1883 by H. Gilbert.

NPL-215. Geescroft 28 **3180 ± 135** **1230 B.C.** $\delta C^{13} = -25.4‰$

Sub-soil, Batcombe series, from 18 to 27 in. layer of soil on Plots 3 and 4 of Geescroft continuous beans experiment. Coll. 1883 by H. Gilbert.
General Comment (D.S.J.): samples dated as part of program of work on turnover of organic matter in soils from some of the experimental fields at Rothamsted. As agricultural soils contain organic matter of different age, ranging from fresh plant roots to relatively resistant humic materials, radiocarbon dates obtained on such soils are best regarded as "equivalent ages." Equivalent age is defined as "the age of the organic C in a chronologically homogeneous sample having the same normalized C^{14} abundance (Δ) as that of the (heterogeneous) soil sample analysed." The main findings so far from radiocarbon measurements are:
(1) the equivalent age of organic carbon in arable top-soil is much greater

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than that suggested by earlier calculations (Jenkinson, D. S., 1963) based on measurements of rate of accumulation of organic matter in soil (NPL-149).

(2) ages of organic carbon in soils sampled in 1880's, from two arable fields ca. ½ mi. apart on same soil series, were similar all the way down profiles (NPL-154, 153, 214, 215). This suggests that age of organic matter in these soils is a characteristic of the soil.

(3) as amount of organic carbon decreases down profile, age increases (NPL-149, 154, 153).

(4) all samples from Park Grass contain coal, in contrast to Geescroft and Broadbalk samples, which contain little, if any, coal or charcoal. The 1886 sample from Plot 3 of Park Grass (NPL-150) contained 0.16% coal carbon and 1966 sample (NPL-155) 0.13% coal carbon. Calculated equivalent age of coal-free soil organic carbon in 1886 sample is 600 yr, that of 1966 sample, 50 yr, assuming that the coal contains no radiocarbon.

(5) samples taken in 1966 from both Park Grass and Broadbalk date much younger than corresponding samples taken from same plots in 1880's (NPL-149 and 161, 150 and 155). This difference is attributed to entry of radiocarbon from thermonuclear explosions into soil organic matter. From amount of thermonuclear radiocarbon in atmosphere over last decade (Nydal, 1968) it is possible to calculate amount of organic matter entering soil each yr from the difference between pre-bomb and post-bomb results. For Broadbalk Plot 3 this amounts to 0.41 tons organic carbon per acre per yr: for Park Grass Plot 3 from 1.01 to 0.78 tons, exact figure depending on assumptions about life span of grass roots. For comparison, amount of organic carbon harvested each yr from Broadbalk (Plot 3) is 0.54 tons per acre (grain + straw), from Park Grass (Plot 3) 0.27 tons per acre (2 hay crops).

II. ARCHAEOLOGIC SAMPLES

England

St. Eval series, Cornwall

NPL-134. St. Eval **3060 ± 95**
1110 B.C.
$\delta C^{13} = -24.5‰$

Oak wood charcoal, Sample 34 T/168 from NW side of Hut A floor at St. Eval (50° 28′ 41″ N Lat, 04° 58′ 43″ W Long), Cornwall. Coll. 1955/56 by E. Greenfield and subm. by L. Biek, Ministry of Public Bldg. and Works. *Comment* (A. M. ApSimon): should date late phase (Trevisker Style 4 pottery) of long occupation of house and site by regional Bronze age group characteristic of SW England. Date suggested on archaeologic grounds was ca. 1200 to 1000 B.C. Good agreement with NPL-21, 3070 ± 103 (1120 B.C.) for comparable but perhaps earlier material from Gwithian, Cornwall.

NPL-135. St. Eval **2135 ± 90**
185 B.C.
$\delta C^{13} = -23.8‰$

Wood charcoal (unidentified) Sample 5 from floor of Hut 2 at St. Eval (50° 28′ 41″ N Lat, 04° 58′ 43″ W Long), Cornwall. Coll. 1955/56 by E. Greenfield and subm. by L. Biek. *Comment* (A.M.ApS.): dates occupation of later pre-Roman Iron age house with Glastonbury style pottery. Expected age, based on assocs. in Somerset with material of Late La Tène (= La Tène *III*) character, not before 1st century B.C. Sample might correspond to beginning of settlement. Use of present best value for half-life *viz.* 5730 yr would give age difficult to accept within limits of current archaeologic chronology.

NPL-141. Snail Down, Nr. Everleigh, Wiltshire **3490 ± 90**
1540 B.C.
$\delta C^{13} = -25.2‰$

Oak charcoal, Sample A, Site III, site of funeral pyre at Snail Down (51° 16′ N Lat, 01° 41′ W Long), Wiltshire. Coll. 1955 by N.E.W. Thomas; subm. by L. Biek. *Comment* (N.E.W.T.): 1540 ± 90 B.C. is highly satisfactory archaeologically. Urn which contained primary cremation burial assoc. with funeral pyre from which sample was obtained, was removed in 1805 by Hoare, but from his descriptions it is likely to have been early Bronze age of our collared series. Since a faience bead, generally dated in Britain at 1550/1500 to ca. 1400 B.C., was found with a secondary burial in this barrow, the 1σ date range of 1630 to 1450 B.C. for funeral pyre, burnt just before construction of barrow, places latter with British Early Bronze Age I, for which period 1650/1600 to ca. 1550/1500 B.C. is at present widely accepted.

NPL-133. Brightwell Heath, Suffolk **3720 ± 130**
1770 B.C.
$\delta C^{13} = -25.2‰$

Oak charcoal from Urn C.28 in Primary Barrow C, at Devils Ring group of round barrows (52° 03′ 07″ N Lat, 01° 18′ 04″ E Long), Brightwell Heath, Nr. Ipswich, Suffolk. Coll. 1953 by R. Gilyard-Beer, subm. by L. Biek. *Comment* (R. Robertson-Mackay): sample assoc. with primary burial from Barrow C. Date 1770 ± 130 B.C. is inconsistent with its being typologically early in Secondary Series of collared urns, although it was stratigraphically earlier than Urn C.40, which must belong to end of Primary Series (ca. 1400 B.C.). Whole series of urns from Barrows C and D would appear to belong around this period. Local overlap makes end of Primary Series slightly later than beginning of Secondary Series. Nonetheless 1770 ± 130 B.C. seems too early for this urn.

Durrington Walls series, Wiltshire

NPL-191. Durrington Walls **4400 ± 150**
2450 B.C.
$\delta C^{13} = -25.6‰$

Charcoal, mainly oak, found under bank at Late Neolithic enclosure

at depth 2 ft 6 in. (51° 12′ N Lat, 01° 47′ W Long), Durrington Walls, Wiltshire. Coll. 1966 by G. J. Wainwright; subm. by L. Biek. *Comment* (G.W.): date applied to pottery and stone tools of Middle Neolithic type found under bank of Late Neolithic enclosure (Antiquaries Journal XLVII 1967). Measurement consistent with assoc. archaeologic evidence.

NPL-192. Durrington Walls **4270 ± 125**
2320 B.C.
$\delta C^{13} = -25.0‰$

Wood charcoal from occupation debris on hut floor (Fe. 122) at Durrington Walls (51° 11′ N Lat, 01° 47′ W Long), Wiltshire. To date oval hut floor terraced into side of hill and surrounded by stake holes. Such huts in Late Neolithic period are very rare. Coll. 1967 by G. J. Wainwright; subm. by L. Biek. *Comment* (G.W.): date obtained from midden deposit within henge monument which produced Late Neolithic pottery and stone tools. (Antiquity, v. XLII, 1968, p. 20-26). Date earlier than expected on archaeologic grounds.

NPL-199. Arne, Dorset **3690 ± 90**
1740 B.C.
$\delta C^{13} = -28.0‰$

Charcoal, partly oak, from Pit II Burial II at Worgret Barrow (50° 40′ 57″ N Lat, 02° 08′ 29″ W Long), Arne, Dorset. Pit from which charcoal recovered is sealed by turf mound. Coll. 1964 by G. J. Wainwright; subm. by L. Biek. *Comment* (G.W.): date assoc. with bucket urn of Late Bronze age type found under round barrow. (Proc. Dorset Archaeol. and Nat. History Soc. 1966, v. 87, p. 119-125). Measurement considerably earlier (ca. 700 yr) than expected and is inconsistent with assoc. archaeologic evidence.

III. GEOLOGIC SAMPLES

A. Scotland

NPL-127. Carey, Abernethy, Perthshire **7605 ± 180**
5655 B.C.
$\delta C^{13} = -28.2‰$

Peat from buried peat bed exposed in S bank of R. Earn near Carey Farm (56° 20′ 19″ N Lat, 03° 20′ 22″ W Long), ca. 1 mi WNW of Abernethy, Perthshire. Peat bed 2 ft thick, overlain by ca. 19 ft gray silty clay ("carse clay") and rests on deposit of gray silty sand believed to be of estuarine origin and to be assoc. with extensive buried raised beach in vicinity. Sample taken from extreme top of peat bed at site dated by Isotopes, Inc. (I-2796, 9640 ± 140 B.C.). Pollen anal. by S. E. Durno, Macauly Inst., Aberdeen, dates base of peat as Zone IV; insufficient pollen obtained to date extreme top of peat, but analysis of sample 14 cm from top suggests Zone V or early Zone VI. Coll. 1965 by R. A. Cullingford, Exeter Univ., and subm. J. B. Sissons, Edinburgh Univ. *Comment* (R.A.C.): dates are in agreement with pollen evidence and provide an age for burial of peat by carse clay at this point during

Main Postglacial transgression (NPL-127), and minimum age for raised beach in vicinity (I-2796).

B. England

NPL-122. Red Tarn Moss, Great Langdale, Westmorland **3890 ± 90 1940 B.C.**

$\delta C^{13} = -26.4‰$

Wood (*Betula* Sp.) probably pubescens (Silver Birch) from contact between former overlying blanket peat at alt. 1700 ft at high level valley containing Red Tarn between Wrynose Pass and Oxendale (54° 25′ N Lat, 03° 07′ W Long), Great Langdale, Westmorland. Site described by Pennington (1965). Coll. 1965 and subm. by Winifred Pennington (Mrs. T. G. Tutin), Univ. of Leicester. *Comment* (W.P.): date 3890 ± 90 B.P., shows that growth of peat began at this site much earlier than supposed, *i.e.*, much earlier than shift to cooler and wetter climate at opening of Sub-Atlantic period. It suggests that replacement of high-level forests in Lake District by bog came about at different times during Postglacial period in response to soil degradation, rather than as synchronous process in response to change in climate.

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