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NATIONAL PHYSICAL LABORATORY RADIOCARBON MEASUREMENTS III

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The following list comprises measurements made since those reported in NPL II and is complete to the end of November 1964.

Ages are relative to A.D. 1950 and are calculated using a half-life of 5568 yr. The measurements have been corrected for fractionation and referred to 0.950 times the activity of the NBS oxalic acid as a contemporary reference standard. The quoted uncertainty is one standard deviation derived from a proper combination of the parameter variances, viz. those of the standard and background measurements over a rolling twenty-week period, of the sample measurements from at least three independent fillings, of the δC^{13} measurements and of the de Vries effect (assumed to contribute an additional uncertainty equivalent to a standard deviation of 80 yr). Because of the apparent variety of the methods in use for reporting age uncertainties we think it important to give the expressions used by us when calculating results.

Let N_S = gross mean sample rate, N_M = gross mean modern rate, N_B = mean background rate } corrected for dead-time and barometric pressure effect

$\sigma^2 (N_S)$ = observed variance sample

$\sigma^2 (N_M)$ = observed variance modern

$\sigma^2 (N_B)$ = observed variance background

α = dilution factor, ($\alpha > 1$) applicable when a sample is diluted with inactive material

$\sigma^2 (\alpha)$ = estimate of variance when appropriate

δC^{14}, Δ, δC^{13} } as defined in Lamont VIII (Broecker and Olson, 1961)

$\sigma^2 (\delta C^{13})$ = variance derived from abundance measurements

$$\text{Then } \delta C^{14} = \left\{ \frac{\alpha (N_S - N_B)}{0.95 (N_M - N_B)} - 1 \right\} \times 1000$$

$$\sigma^2 (\delta C^{14}) = \left[\frac{10^3 \alpha}{0.95 (N_M - N_B)} \right]^2 \times \left\{ \sigma^2 (N_S) + \left[\frac{N_S - N_B}{N_M - N_B} \right]^2 \times \sigma^2 (N_M) + \left[\frac{N_S - N_M}{N_M - N_B} \right]^2 \times \sigma^2 (N_B) + \frac{(N_S - N_B)^2}{\alpha^2} \times \sigma^2 (\alpha) \right\}$$

$$\Delta = \delta C^{14} - (2 \delta C^{13} + 50) \left(1 + \frac{\delta C^{14}}{1000} \right)$$

$$\sigma^2 (\Delta) = \left[1 - \frac{(2 \delta C^{13} + 50)}{1000} \right]^2 \times \sigma^2 (\delta C^{14}) + 4 \left[1 + \frac{\delta C^{14}}{1000} \right]^2 \times \sigma^2 (\delta C^{13})$$

$$\text{Age (T)} = 8033 \log_e \frac{1}{1 + \Delta \times 10^{-3}}$$

$$\text{Limits of age } (T + t_1, T - t_2) = 8033 \log_e \frac{1}{1 + [\Delta \pm \sigma(\Delta)] \times 10^{-3}}$$

when $t_1 \simeq t_2 = t$ the final result is reported as $T \pm (t^2 + 80^2)^{1/2}$

If $(N_S - N_B)$ is $< 4[\sigma^2(N_S) + \sigma^2(N_B)]^{1/2}$ we report a minimum age calculated using

$$(N_S - N_B) = 4[\sigma^2(N_S) + \sigma^2(N_B)]^{1/2}.$$

Any uncertainty in the C^{14} half-life has been excluded so that relative C^{14} ages may be correctly compared. It is however proper to include this uncertainty and to use the best value for the C^{14} half-life when comparing a C^{14} age with that derived from some other method.

The description of each sample is based on information provided by the person submitting the sample to the Laboratory.

The work reported forms part of the research programme of the Laboratory and is published by permission of the Director.

A. British Isles

NPL-62. Shustoke, B 1, Warwickshire **410 ± 90**
A.D. 1540

Leaves, twigs and nuts from layer of plant debris and sand, 2 ft thick, underlying 4 ft of clayey silt at Shustoke (52° 31′ 00″ N Lat, 01° 40′ 30″ W Long), Warwickshire. Coll. 1963 by P. J. Osborne; subm. by F. W. Shotton, Univ. of Birmingham. This riverbank section is latest of two sites in alluvium yielding extensive flora and many insects. The earlier, Shustoke A 2, NPL-39, was dated to 4830 ± 100 (NPL I). *Comment* (F.W.S.): there has been locally extremely rapid alluviation in the last 400 yr. Pollen analysis suggested Zone VIII and Post-Roman (British System), but sample must date from very late in this zone.

NPL-69. Bleasdale, Lancashire **3760 ± 90**
1810 B.C.

Wood, reported as oak, from barrow timber-circle at Bleasdale (53° 54′ 32″ N Lat, 02° 38′ 40″ W Long), Lancashire. Coll. 1901 by B. Pritchard; subm. by T. G. E. Powell, Univ. of Liverpool. Sample probably only surviving material from old excavation (Dawkins, 1900), untreated with preservative. Whether from inner or outer timber circle unknown. *Comment* (T.G.E.P.): date appears somewhat early for inner structure associated with cremation urns of 'Pennine' type (Varley, 1938), but it strengthens view that monument is composite, with older outer circle.

NPL-73. Seamer Moor, Yorkshire **5030 ± 90**
3080 B.C.

Wood charcoal (*Q. robur*) from old land surface under collapsed stone wall destroyed by superimposed reputed long barrow at East Ayton (54° 15′ 48″ N Lat, 27° 05′ 03″ W Long), Yorkshire. Coll. 1960 by F. J. de M.

Vatcher; subm. by L. Biek, Ministry of Public Bldg. and Works. *Comment* (L.B.): excavation showed barrow to be not long but round. However, result confirms Neolithic date.

NPL-74. Wilsford, Wiltshire — **3330 ± 90 / 1380 B.C.**

Waterlogged wood (*Prunus, Alnus, Crataegus, Fraxinus* and *Quercus*) from chalk rubble at depth of 100 ft in pond barrow shaft at Wilsford (51° 10′ 20″ N Lat, 01° 50′ 45″ W Long), Wiltshire. Coll. 1962 by Paul Ashbee; subm. by L. Biek. *Comment* (L.B.): shaft, cut by antler pick and broad-blade bronze axe, was filled by natural silting recording environment of later Bronze Age, within two centuries of completion of nearby Stonehenge (Ashbee, 1963).

Amesbury series, Wiltshire

Wood charcoal from round barrow (Goddard's Amesbury 71) at Earl's Farm Down (51° 10′ N Lat, 01° 44′ W Long), Amesbury, Wiltshire. Coll. 1961 by P. M. Christie; subm. by L. Biek.

General Comment (L.B.): mound had been truncated and subsequently enlarged in Chalcolithic and Early Bronze Age times, respectively. Site also used for burial purposes throughout Middle and Late Bronze Age.

NPL-75. Earl's Farm Down, Sample 10 — **3590 ± 90 / 1640 B.C.**

Wood charcoal (*Q. robur*) from fire at depth of 3 ft 10 in. from barrow top.

NPL-77. Earl's Farm Down, Sample 26 — **3960 ± 110 / 2010 B.C.**

Powdered wood charcoal (unidentifiable) from 6 ft grave pit, i.e., 13 to 14 ft below barrow top.

NPL-76. Hambledon Hill, Dorset — **4740 ± 90 / 2790 B.C.**

Wood charcoal (*Quercus robur, Corylus avellana* and possibly *Betula*) from bottom of inner ditch of Neolithic causewayed camp, Hambledon Hill (50° 54′ 30″ N Lat, 02° 12′ 50″ W Long), Dorset. Coll. 1958 by D. J. Bonney; subm. by L. Biek. *Comment* (L.B.): pottery associated with first phase of camp of general Windmill Hill family but more akin to earlier Hembury-Maiden Castle variety.

NPL-78. Teindland, Aberdeenshire — **28,140 +480 −450 / 26,190 B.C.**

Buried soil at depth of 6 to 8 ft at Teindland gravel pit (57° 35′ N Lat, 03° 11′ W Long), Aberdeenshire. Coll. 1963 by E. A. Fitzpatrick; subm. by J. Tinsley, Univ. of Aberdeen. *Comment* (J.T.): this example of buried soil is at present unique in Britain in indicating podsolising soil conditions at this date.

NPL-80. Mullock Bridge, Pembrokeshire — **37,960 +1700 −1400 / 36,010 B.C.**

Shell fragments (lamellibranch and gastropod) from gravel pit in raised

beach deposit near Dale (51° 43′ 40″ N Lat, 05° 10′ 10″ W Long), Pembrokeshire. Coll. 1963 and subm. by B. S. John, Univ. of Oxford. *Comment* (B.S.J.): some doubt existed that beach was of Monastirian age. Radiocarbon confirmation suggests two possibilities: (a) that several other high raised beaches in S Britain may have been wrongly termed Monastirian, (b) that Pembrokeshire has suffered isostatic uplift since last glaciation.

NPL-81. Church Stretton, Shropshire **11,790 ± 140**
9840 B.C.

Detritus peat at depth of 6 ft underlying solifluction gravel at Church Stretton (52° 32′ 30″ N Lat, 02° 48′ 15″ W Long), Shropshire. Coll. 1963 by P. Rowlands; subm. by F. W. Shotton, Univ. of Birmingham. Sample appeared Late-Glacial but could have been Zone I or Zone III. *Comment* (F.W.S.): result indicates Zone I and dates overlying solifluction layer.

B. Australia

NPL-63. Fromm's Landing 9, South Australia **3450 ± 90**
1500 B.C.

Wood charcoal underlying NPL-29 (3170 ± 94, NPL II) by 3 ft 2 in. from layer 16, Shelter 6, Fromm's Landing (34° 47′ S Lat, 139° 34′ E Long), South Australia. Coll. 1963 and subm. by D. J. Mulvaney, Univ. of Melbourne. *Comment* (D.J.M.): result dates one of earliest ocupation layers of this shelter (Mulvaney 1960, 1961; New Zealand I-V; NPL II).

NPL-64. The Tombs 6, Queensland **9410 ± 100**
7460 B.C.

Wood charcoal underlying NPL-31 (3600 ± 93, NPL I) by 3 ft 6 in. from layer 5, The Tombs Rock Shelter (25° 06′ S Lat, 147° 51′ E Long), Queensland. Coll. 1962 and subm. by D. J. Mulvaney. *Comment* (D.J.M.): result dates earliest occupation of this site and associated industry (NPL I).

Kenniff Cave series, Queensland

Wood charcoal from excavation of evenly stratified floor of Kenniff Cave, Mt. Moffat Sta. (24° 51′ S Lat, 148° 01′ E Long), Queensland. Coll. 1962 and subm. by D. J. Mulvaney.

General Comment (D.J.M.): dates confirm NPL-32, NPL-33 (2550 ± 90, 12,900 ± 70, NPL I); NPL-68 represents earliest occupation of man in Australia known at present.

NPL-65. Kenniff Cave, Sample 1, Layer 6A **3830 ± 90**
1880 B.C.

Sample from 2 ft 6 in. to 2 ft 9 in. below floor, 3 in. to 6 in. below NPL-32.

NPL-66. Kenniff Cave, Sample 3, Layer 8 **5020 ± 90**
3070 B.C.

Sample from 4 ft to 4 ft 3 in. below floor, 2 ft below NPL-32.

NPL-67. Kenniff Cave, Sample 8, Layer 10/11 **12,610 ± 110**
10,660 B.C.

Sample from 5 ft 7 in. to 5 ft 8 in. below floor, 6 in. above NPL-33.

NPL-68. Kenniff Cave, Sample 13, Layer 13A **16,130 ± 140**
14,180 B.C.

Sample from 7 ft 5 in. to 7 ft 8 in. below floor, 10 in. to 12 in. below NPL-33.

C. Canada

NPL-58. Wolstenholme Valley, Quebec **6900 ± 130**
4950 B.C.

Marine shell (*Mya truncata, Hiatella arctica, Macoma calcarea, Macoma balthica*) from 271 ft ASL in 363 ft raised beach, Wolstenholme Valley, Erik Cove (62° 32′ N Lat, 77° 25′ W Long), Arctic Quebec. Coll. 1962 and subm. by Barry Matthews, McGill Univ. *Comment* (B.M.): result compares favorably with dates (I-726, I-729) obtained by Isotopes Inc. (unpub.) for shells of similar provenance between Sugluk and Cape Wolstenholme, indicating general marine invasion of this coastal area ca. 7000 to 8000 yr ago at onset of classical Hypsithermal period (Matthews, 1963, 1964).

NPL-59. Willow Valley, Quebec **525 ± 100**
A.D. 1425

Detritus peat from frozen layer at base of ice-cored peat mound 248 ft ASL Willow Valley, 40 mi S of Deception Bay (61° 46′ N Lat, 74° 05′ W Long), Quebec. Coll. 1962 and subm. by Barry Matthews. *Comment* (B.M.): result agrees with estimated data, A.D. 1350-1550, of slight climatic amelioration in Ungava indicated in the pollen diagrams produced for writer by D. D. Bartley, Univ. of Leeds and Geol. Surv. of Canada. Pollen analyses of peat samples from R. Saule (Williow) Valley immediately above the dated layer show high percentage of bog species and development of alder-spruce outliers. This suggests relatively moist and milder climate during early fifteen century.

NPL-71. Deception Bay, Quebec **3900 ± 125**
1950 B.C.

Marine shell (*Mya truncata, Mya arenaria, Clinocardium ciliatum, Serripes groenlandicus*) from 34 ft ASL in 40 ft raised beach at mouth of Black Fox River, Deception Bay (62° 07′ N Lat, 74° 38′ W Long), Arctic Quebec. Coll. 1962 and subm. by Barry Matthews. *Comment* (B.M.): result dates period of highest post-glacial sea temperatures in this area since *Aporrhais occidentalis* (Beck), *Thyasira trisinuata* (D'Orbigny), *Gemma gemma* (Totten) also identified in sample (Farrand and Gajda, 1962; Matthews, 1962).

D. British West Indies

NPL-79. St. Lucia Island **39,050 $^{+1450}_{-1230}$**
37,100 B.C.

Charcoal from base of highest pumice flow deposit, ca. 40 ft ASL on coastal cliffs, St. Lucia Island (13° 46′ 39″ N Lat, 61° 03′ 11″ W Long), West Indies. Coll. 1963 and subm. by J. F. Tomblin, Univ. of Oxford. *Comment* (J.F.T.): while date is older than expected from fresh appearance of pumice deposit, it is corroborated by another sample (R 545/1) from lower

horizon measured by New Zealand Geol. Survey and Inst. of Nuclear Sci. and reported (pers. commun.) older than 50,000 yr.

E. Spain

NPL-70. Rio Tinto Mines, Huelva **1810 ± 95**
A.D. 140

Wood charcoal (*Q. encina*) from old silver slag heap No. 5 at Dehesa opencast, E end of North Lode (37° 42′ N Lat, 06° 35′ W Long), Huelva. Coll. 1963 by L. U. Salkield; subm. by D. F. Miller, R.T.Z. Services Ltd., London. *Comment* (L.U.S.): date corroborates Diego Delgado's report to Philip II in 1556, that local legend held the mines to have been worked for silver and gold to pay tribute to Rome. However, two older and distinct silver slags underlie sample.

F. Turkey

NPL-61. Mount Ararat, Turkey **1190 ± 90**
A.D. 760

Oak wood of uncertain species (variously identified as *Q. pedunculata, Q. Leucobalanus, Q. castanifolia* or *Q. cerris*) from very large timber structure under ice at 14,000 ft ASL on NW face of Mount Ararat (39° 20′ N Lat, 44° 00′ E Long). Turkey. Coll. between 1950 and 1955 by Fernand Navarra; subm. by D. H. E. Woodward, Walker and Woodward Ltd., Birmingham (Navarra, 1956). *Comment*: evidently not the Ark.

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