

**BRITISH MUSEUM  
NATURAL RADIOCARBON MEASUREMENTS VI**

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Dates listed below are based on measurements made up to May 1968, and cover a period during which the technique of gas proportional counting using CO<sub>2</sub> was gradually replaced by liquid scintillation counting using benzene. The gas counting measurements were carried out by the method and techniques previously described (Barker and Mackey, 1968) the only modifications being the replacement of some old electronic units by more stable solid-state equipment; proportional counting results are indicated in the text by (P) at the end of the relevant sample descriptions. Liquid scintillation counting, which is now the preferred method in this laboratory, is carried out using a Packard Tri-Carb liquid scintillation spectrometer model 3315/AES fitted with selected low-noise quartz-faced photomultipliers. Normally 3 ml of benzene is prepared from each sample. This is dissolved in 12 ml of scintillation grade toluene containing 5 gm/liter of scintillator (PPO) and the solution is measured in a standard low-potassium glass vial at a temperature of 0°C. Photomultiplier E.H.T., amplifier, and channel width settings are optimized for C<sup>14</sup>, and measurements are carried out at ca. 65% efficiency of detection for C<sup>14</sup> to eliminate interference from any tritium which may be present in the benzene. Under these circumstances the background is approx. 8.6 cpm and the modern (95% A<sub>ox</sub>) is approx. 24.0 cpm. Samples are counted in groups of 3 to 5 together with background and modern reference samples and are measured for at least one week, the instrument being set to cycle at 100 min intervals. In this period, the counts accumulated are such that the background is always measured to a statistical accuracy of better than 1% and most other samples to a higher accuracy than this. Background and modern counts used in the calculation of each result are only those relevant to the period of measurement of that particular sample. Statistical analysis of groups of replicate measurements made under these conditions over a very long period of time has demonstrated the excellent long-term stability of the equipment and indicates that the technique is quite capable of achieving results of very high statistical accuracy when required.

The synthesis of benzene follows broadly the procedure described by Noakes, Kim, and Stipp (1965), *i.e.*, acetylene is prepared from CO<sub>2</sub> via lithium carbide as described by Barker (1953; Barker and Mackey, 1959) and this is converted into benzene using a silica-alumina catalyst activated with vanadium pentoxide. The yield at each stage of the synthesis is very high and the over-all conversion efficiency from CO<sub>2</sub> to benzene ranges from 92 to 95%.

Adoption of the liquid scintillation technique has also coincided with the development of a new approach to combustion of samples (Barker *et al.*, 1969) in which samples are burnt in oxygen at high pressure within

a thick-walled stainless steel pressure vessel. This procedure, which is semi-automatic, has several advantages over the conventional system using a combustion tube furnace; in particular, it saves considerable operator time and yields, without further purification CO<sub>2</sub>, which is low in oxides of nitrogen and sulphur even when prepared from materials rich in protein such as the organic fraction of bones and antler.

Ages are calculated on the basis of a half-life of 5568 years and unless otherwise stated, the error terms also include a contribution of  $\pm 80$  years to allow for possible isotopic fractionation effects. The practice adopted in previous date lists of widening the error term to include possible errors due to fluctuations in the C<sup>14</sup> content of the carbon exchange reservoir in the past (de Vries effects) has been discontinued, thus leaving the user of the dates free to apply corrections for such deviations as they become available (e.g., Stuiver and Suess, 1966).

#### ACKNOWLEDGMENT

Thanks are due to Miss G. I. Hassall of the National Physical Laboratory, for isotopic fractionation measurements made in connection with the investigation of age discrepancies in Egyptian materials.

#### SAMPLE DESCRIPTIONS

##### ARCHAEOLOGIC SAMPLES

##### *A. Crete*

##### **Knossos series**

Five samples from Neolithic settlement of Knossos, Crete (35° 31' N Lat, 25° 20' E Long), from sounding below central court of Minoan Palace (Evans, 1964a,b). Coll. 1960 and subm. by J. D. Evans, Inst. of Archaeol., Univ. of London, for comparison with unexpectedly early dates previously obtained for Knossos Neolithic, BM-124, 8050  $\pm$  180 and BM-126, 7000  $\pm$  180 (Radiocarbon, 1963, v. 5, p. 104).

**7570  $\pm$  150**

##### **BM-272. Knossos 2**

**5620 B.C.**

Sample 2, ref. Area AC, Level 24. Charcoal from Occupation layer assoc. with 1st brick houses and immediately overlying earliest camp occupation above bedrock (Stratum IX, Evans, 1964b). Expected age early 6th millennium B.C. based on BM-124 and BM-126. (P)

**6210  $\pm$  150**

##### **BM-273. Knossos 3**

**4260 B.C.**

Sample 3, ref. Area AC, Level 17. Charcoal from habitation deposit in Stratum VI (Evans, 1964b). Expected age late 6th millennium B.C. based on BM-124 and BM-126. (P)

**6140  $\pm$  150**

##### **BM-274. Knossos 4**

**4190 B.C.**

Sample 4, ref. Area A, Level 15. Charcoal from habitation level in Stratum V (Evans, 1964b). Expected age end of 6th millennium B.C. based on BM-124 and BM-126. (P)

**BM-279. Knossos 6** **5680 ± 150**  
**3730 B.C.**

Charcoal sample from Upper Neolithic level, Stratum IV (Evans, 1964b). (P)

*General Comment* (J.D.E.): new series of dates in conjunction with Stratum X date (BM-124), but without BM-126, gives consistent and acceptable picture of development of Knossos Neolithic through 3 millennia.

**Knossos, the cereal problem**

Carbonized grain containing high proportion of naked hexaploid wheat (bread wheat, id. by H. Helbaek) found in Stratum X assoc. with carbonized wooden stake previously dated at  $8050 \pm 180$  (BM-124). Date was unexpectedly early by comparison with other evidence for westward spread of domesticated cereals from earliest centers of cultivation. However, date for BM-124 was confirmed by remeasurement, using liquid scintillation technique (BM-278) and measurement on carbonized grain provided direct confirmation of early occurrence of grain of this type at Knossos (ref. Evans, Athens, Ann. of British School, in press).

**BM-278. Knossos 1** **7910 ± 140**  
**5960 B.C.**

Charcoal, remains of carbonized wooden stake found in Pit F, Area AC, Level 27, in central court of Minoan Palace (ref. BM-124).

**BM-436. Knossos 7** **7740 ± 140**  
**5790 B.C.**

Carbonized grain, assoc. with carbonized stake described above (ref. BM-124).

*B. Egypt*

**Tarkhan II**

Linen from Mastaba 2050 at Tarkhan near Cairo, Egypt ( $29^{\circ} 40'$  N Lat,  $31^{\circ} 13'$  E Long). Coll. 1912 by W. M. Flinders Petrie and considered by him to date to First Dynasty (Petrie, 1914). Subm. by I. E. S. Edwards, British Mus. Also dated by UCLA and Arizona labs; UCLA-739,  $4265 \pm 80$ ; A569,  $4295 \pm 90$ . Expected age 5000 B.P. (ca. 3050 B.C.).

**BM-203. Tarkhan II** **4150 ± 110**  
**2200 B.C.**  
Pretreated with dilute acid only. (P)

**BM-248. Tarkhan II** **4160 ± 110**  
**2210 B.C.**

Pretreated with dilute acid followed by boiling in 10% aqueous solution of 0.880 ammonia until fabric was almost pure white, followed by thorough washing in distilled water. *Comment*: 2nd measurement after more rigorous pretreatment was made because of suggestion that dark color of linen might be due to non-contemporaneous contaminant such as bitumen. Evidently this was not so. (P)

**Egyptian chronology series**

Radiocarbon measurements of Egyptian material of known age from late 2nd and 3rd millennia B.C. have already indicated that there are serious discrepancies between radiocarbon and calendar ages in this period (see, e.g., Smith, 1964; Damon *et al.*, 1963; Barker and Mackey, 1959, 1961; Berger *et al.*, 1965). More recently, Suess produced detailed plot of discrepancies from ca. 4000 to 1500 B.C. based on radiocarbon measurements of bristlecone pine wood from E central California (Suess, 1967). Following series of freshly coll. samples obtained specifically to investigate this problem are securely dated archaeologically and of exactly known provenance (see Emery, 1938, 1939, 1954, 1958, 1961, 1965). Where possible material such as reed or fabric, representing one or only a few seasons' growth was obtained.

Samples have also been measured by Arizona and UCLA labs (Berger and Libby, 1967). Samples 1-4, 6, 7, 10-13 are from Egypt Exploration Society's excavations at Sakkara Archaic Cemetery (29° 51' N Lat, 31° 14' E Long). Sample 15 is from El Lahun (Fayûm) (29° 13' N Lat, 30° 59' E Long). Coll. 1966 by G. T. Martin; subm. by I. E. S. Edwards, British Mus., who initiated and arranged project. More detailed analysis of results will be publ. elsewhere. Samples were pretreated with dilute acid.

**4300 ± 65**  
**2350 B.C.**

**BM-228. Sakkara 10/66**

$\delta C^{13} = -23.2 \pm 1.0\%$

Reed used as bonding between mud-brick courses, W side of superstructure, Tomb 3357 (Hor-Aha). Beginning of 1st Dynasty, reign of Hor-Aha, ca. 3100 B.C. (P) Age based on 5730 yr half-life 4430 ± 65, 2480 B.C.

**4520 ± 65**  
**2570 B.C.**

**BM-229. Sakkara 1/66**

$\delta C^{13} = -21.8 \pm 1.0\%$

Reed used as bonding between mud-brick courses, N side of superstructure, Tomb 3503 (Mer-Neit). Mid 1st Dynasty, reign of Den, ca. 3000 B.C. (P) Age based on 5730 yr half-life 4660 ± 65, 2710 B.C.

**4380 ± 65**  
**2430 B.C.**

**BM-230. Sakkara 11/66**

$\delta C^{13} = -23.7 \pm 1.0\%$

Reed used as bonding between mud-brick courses, S side of superstructure, Tomb 3035 (Hemaka). Mid 1st Dynasty, end of reign of Den, ca. 2950 B.C. (P) Age based on 5730 yr half-life 4510 ± 65, 2560 B.C.

**4270 ± 65**  
**2320 B.C.**

**BM-231. Sakkara 2/66**

$\delta C^{13} = -23.9 \pm 1.0\%$

Reed used as bonding between mud-brick courses of inner enclosure wall, W side, Tomb 3505 (Ka'a). End of 1st Dynasty, reign of Qaa, ca. 2900 B.C. (P) Age based on 5730 yr half-life 4400 ± 65, 2450 B.C.

**BM-232. Sakkara 12/66** **4230 ± 65**  
**2280 B.C.**

$$\delta C^{13} = -23.1 \pm 1.0\%$$

Reed used as bonding between mud-brick courses, W side of superstructure, Tomb 3046. Second Dynasty, ca. 2750 B.C. (P) Age based on 5730 yr half-life 4360 ± 65, 2410 B.C.

**BM-233. Sakkara 13/66** **4000 ± 65**  
**2050 B.C.**

$$\delta C^{13} = -23.0 \pm 1.0\%$$

Reed used as bonding between mud-brick courses, W side of entrance stairway, Tomb 3030. Early 3rd Dynasty, ca. 2675 B.C. (P) Age based on 5730 yr half-life 4120 ± 65, 2170 B.C.

**BM-234. Sakkara 4/66** **3790 ± 65**  
**1840 B.C.**

$$\delta C^{13} = -25.1 \pm 1.0\%$$

Wood (*Acacia* sp. prob *A. nilotica* L.) from floor of S chapel or offering niche on E side of superstructure, Tomb 3510. Third Dynasty, ca. 2650 B.C. (P) Age based on 5730 yr half-life 3900 ± 65, 1950 B.C.

**BM-235. Sakkara 3/66** **4070 ± 65**  
**2120 B.C.**

$$\delta C^{13} = -23.7 \pm 1.0\%$$

Reed used as bonding between mud-brick courses of S side of superstructure, Tomb 3073-5 (Kha'-bau-Sokar). End of 3rd Dynasty to beginning of 4th Dynasty, ca. 2600 B.C. (P) Age based on 5730 yr half-life 4190 ± 65, 2240 B.C.

**BM-236. Sakkara 6/66** **3840 ± 65**  
**1890 B.C.**

$$\delta C^{13} = -24.8 \pm 1.0\%$$

Cloth (linen) from undisturbed burial between 3rd Dynasty Tombs 3508 and 3510 (Emery, 1965) tentatively dated to 4th Dynasty, ca. 2550 B.C. (P) Age based on 5730 yr half-life 3960 ± 65, 2010 B.C.

**BM-237. Sakkara 7/66** **3720 ± 110**  
**1770 B.C.**

Human bone collagen, from undisturbed burial between Tomb 3508 and 3510 adjacent to tomb containing Sample 6 (BM-236, above). Fourth Dynasty (?), ca. 2550 B.C. (P) Age based on 5730 yr half-life 3830 ± 110, 1880 B.C.

**BM-238. El Lahun** **3580 ± 65**  
**1630 B.C.**

$$\delta C^{13} = -12.0 \pm 1.0\%$$

Sample 15/66. Reed used as bonding between mud-brick courses, N boundary wall of pyramid of Senusret II (Sesostris II). Twelfth Dynasty, ca. 1880 B.C. (P) Age based on 5730 yr half-life 3690 ± 65, 1740 B.C.

**BM-280. El Lahun** **3550 ± 65**  
**1600 B.C.**

$$\delta C^{13} = -11.1 \pm 1.0\text{‰}$$

Sample 15/66. Remeasurement using fresh portion of sample (BM-238, above) pretreated with dilute alkali in addition to standard acid pretreatment. (P) Age based on 5730 yr half-life  $3660 \pm 65$ , 1710 B.C.

*C. France*

**Trou des Forges, Bruniquel**

Antler biserial harpoon fragments and antler waste from Trou des Forges, Bruniquel, Tarn-et-Garonne, France (44° 03' N Lat, 1° 40' E Long). Coll. 1864 by Vicomte de Lastic; subm. by G. de G. Sieveking, British Mus., from British Mus. collection. Antler biserial harpoons define industry termed by Breuil Magdalenian VI; by comparison with other publ. dates for recently excavated samples (see Broecker and Kulp, 1957; Vogel and Waterbolk, 1963; Leroi-Gourhan and Brezillon, 1966) it was hoped to form general assessment of whether selected samples from old collections can sometimes be used as reliable source of material for dating Upper Palaeolithic industries. Samples were demineralized before burning.

**BM-302.** **11,750 ± 300**  
**9800 B.C.**

Harpoon fragments (protein fraction).

**BM-303.** **11,110 ± 160**  
**9160 B.C.**

Antler waste (protein fraction). Comparable material has been dated at 2 other sites: Grotte de la Vache, Ariège, France, Level 2. L-336c,  $11,600 \pm 200$ ; GrN-2025,  $12,540 \pm 105$ . Level 4. GrN-2026,  $12,850 \pm 60$ . Pincevent, Montereau, Seine et Marne, France, Lv-291,  $10,920 \pm 540$ ; Lv-292,  $11,610 \pm 400$ ; Lv-293,  $11,310 \pm 330$ , see refs. above. *Comment:* dates are fully within expected age range for Magdalenian VI.

**BM-304. Montastruc, Bruniquel** **12,070 ± 180**  
**10,120 B.C.**

Antler waste (protein fraction) from Montastruc rock shelter, Bruniquel, Tarn-et-Garonne, France (44° 03' N Lat, 1° 40' E Long). Coll. ca. 1868 by Peccadeau de Lisle; subm. by G. de G. Sieveking, British Mus. Sample is from level containing Magdalenian IV-V industry, in which fine ivory animal carvings now in British Mus. collection were found. Date fits well with BM-302 and BM-303, above. Sample was demineralized before burning .

*D. Great Britain*

**BM-267. Minepit Wood** **1610 ± 150**  
**A.D. 340**

Charcoal (ref.D5(9), Sample 1) from early iron-working site at Minepit Wood (Orznash), Withyham, Sussex, England (51° 06' N Lat, 0° 19' E Long). Coll. 1964 and subm. by J. H. Money, Sussex Archaeol. Soc.

Sample from lowest part of early iron-working furnace which was securely sealed by undisturbed soil, and dates last act of smelting in furnace. (P)

### **Brown Edge series**

Three samples of charcoal from Brown Edge, Totley, Derbyshire, England (53° 18' N Lat, 1° 34' W Long), from burial pits 12 to 14 in deep within low earthwork circle with small central cairn of stones. Coll. 1963 by J. Radley; subm. by G. D. Lewis for Sheffield City Mus., Sheffield, Yorkshire (Radley, 1966). (P)

**3000 ± 150**  
**1050 B.C.**

**BM-177. Brown Edge, Burial 1**

Cremation burial contained in "Pennine" urn. *Comment* (G.D.L.): date is late for collared urn of primary series (Longworth, 1961). See NPL-10, 3355 ± 155, NPL-11, 3470 ± 145 (Callow *et al.*, 1963). (P)

**3200 ± 150**  
**1250 B.C.**

**BM-211. Brown Edge, Burial 2**

Un-urned cremation beneath cairn and adjacent to Burial 1 (BM-177). (P)

**3480 ± 150**  
**1530 B.C.**

**BM-212. Brown Edge, Burial 4**

Un-urned cremation found adjacent to Burials 1 and 2 but not sealed by cairn. (P)

### **Harland Edge series**

Two charcoal samples from filling of pits containing food vessels from Harland Edge, Beeley Moor, Derbyshire, England (53° 13' N Lat, 1° 34' W Long). Coll. 1961-62 by D. N. Riley; subm. by G. D. Lewis for Sheffield City Mus., Sheffield, Yorkshire (Riley, 1966).

**3440 ± 150**  
**1490 B.C.**

**BM-178. Harland Edge, Pit 2 (Sample A) (P)**

**3700 ± 150**  
**1750 B.C.**

**BM-210. Harland Edge, Pit 3 (Sample B) (P)**

*Comment* (G.D.L.): 1st available radiocarbon dates with food vessel assoc.

**3450 ± 150**  
**1500 B.C.**

**BM-179. Barbrook II**

Barbrook II earth circle, Ramsley Moor, Holmesfield, Derbyshire, England (53° 16' N Lat, 1° 35' W Long). Coll. 1963 and subm. by G. D. Lewis, Sheffield City Mus. Charcoal (ref. D.6a, Burial 1) from cremation burial contained in collared urn sealed in pit beneath low stone cairn in low earth circle apparently part of adjacent group of cairns and stone circle. *Comment* (G.D.L.): date agrees with other similar radiocarbon dates for assoc. secondary series collared urns. See NPL-17, 3345 ± 160, NPL-18, 3355 ± 160 (Callow *et al.*, 1963); Grn-1686, 3440 ± 60 (Vogel and Waterbolk, 1964). (P)

**3450 ± 150**  
**1500 B.C.**

**BM-213. Chapel Flat Dyke, canoe**

Wood from dug-out canoe from Chapel Flat Dyke, Rotherham, Yorkshire, England (53° 25' N Lat, 1° 23' W Long). Found in river mud in ancient bed of Chapel Flat Dyke, at depth 18 ft below present surface, during tunnelling operations. Coll. 1963 and subm. by H. Raymond Singleton, Dir., Sheffield City Mus. No assoc. finds. (P)

**3470 ± 115**  
**1520 B.C.**

**BM-315. Eriswell**

Eriswell, W Suffolk, England (52° 23' N Lat, 0° 30' E Long). Charcoal from wooden object, perhaps bier, on old ground surface under Middle Bronze age barrow and over primary cremation with collared urn in cylindrical hole. Coll. 1966 and subm. by D. P. Dymond, of Extra-Mural Studies, Univ. of Cambridge.

**5190 ± 150**  
**3240 B.C.**

**BM-180. Windmill Hill Long Barrow**

Antler, ref. B.54, H 419, (326) from primary chalk silt in ditch of Windmill Hill Long Barrow, Avebury, Wiltshire, England (51° 26' N Lat, 1° 52' W Long). Coll. 1961 by P. Ashbee; subm. by G. de G. Sieveking, British Mus. For comparison see dates for Windmill Hill, BM-73, 4910 ± 150 (Barker and Mackey, 1961); Hembury, BM-130, 5100 ± 150 (Barker and Mackey, 1963), BM-136, 5190 ± 150, BM-138, 5280 ± 150; Fussells Lodge, BM-134, 5180 ± 150 (Barker and Mackey, 1968), and Willerby Wold, BM-188, 4900 ± 150, BM-189, 4960 ± 150 (this date list, below). (P)

**Flint mine chronology**

Antler picks measured as part of investigation of chronological sequence and period of use of Neolithic flint mines in S England. Picks were left in mine galleries when these were abandoned and subsequently sealed off by backfilling of shaft as adjacent new shafts were dug. Work will be reported and discussed elsewhere. All samples were demineralized so that dates were obtained on protein fraction. Subm. by G. de G. Sieveking, British Mus.

**Cissbury area flint mines**

**5340 ± 150**  
**3390 B.C.**

**BM-181. Church Hill**

Sample, ref. 61/1584/A from Church Hill, Findon, Sussex, England (50° 51' 42" N Lat, 0° 25' 4" W Long). Coll. ca. 1950 by J. Pull. (P)

**4930 ± 150**  
**2980 B.C.**

**BM-182. Harrow Hill**

Sample, ref. 4464, H.H. 21.58 from Harrow Hill, Sussex, England (50° 52' 45" N Lat, 0° 27' 45" W Long). Coll. 1924-25 by E. and E. C. Curwen. (P)

- BM-183. Cissbury** **4720 ± 150**  
**2770 B.C.**  
Sample, ref. 61/1586/A from Cissbury, Sussex, England (50° 51' 30" N Lat, 0° 23' 06" W Long). Coll. ca. 1952 by J. Pull. (P)
- BM-184. Cissbury, Harrison's pit** **4650 ± 150**  
**2700 B.C.**  
Sample, ref. 61/1586/A from Cissbury, Sussex, England (50° 51' 30" N Lat, 0° 23' 06" W Long). Coll. 1877 by Park Harrison. (P)
- BM-185. Cissbury, Shaft 6** **4730 ± 150**  
**2780 B.C.**  
Sample, ref. 3970 from Cissbury, Sussex, England (50° 51' 30" N Lat, 0° 23' 06" W Long). Coll. 1878 by Park Harrison. (P)
- BM-190. Easton Down flint mine** **4480 ± 150**  
**2530 B.C.**  
From Easton Down, Nr. Salisbury, Wiltshire, England (51° 05' N Lat, 1° 48' W Long). Coll. 1934 by J. F. Stone. (P)
- Grimes Graves flint mines**  
Samples from Grimes Graves, Thetford, Norfolk, England (52° 25' 39" N Lat, 0° 38' 41" E Long).
- BM-276. Grimes Graves, Pit XII, 1933** **3550 ± 150**  
**1600 B.C.**  
Sample from Pit XII. Coll. ca. 1933 by A. L. Armstrong. Intended as check on previous Grimes Graves dates (Barker and Mackey, 1963) for comparison with Cissbury series and expected to give same date as BM-97, 4290 ± 150, original sample from Pit XII. However, it seems probable that this sample which came from layer in shaft and not sealed gallery, dates later infilling of shaft and not active use of this mine. See BM-377 below. (P)
- BM-377. Grimes Graves, Pit XII, 37/38** **4250 ± 130**  
**2300 B.C.**  
Sample from Pit XII. Coll. 1937-1938 by A. L. Armstrong. Repeat by liquid scintillation method of gas proportional counter measurement BM-97, 4290 ± 150 (Barker and Mackey, 1963). See BM-276 above.
- BM-291. Grimes Graves, Greenwell pit** **3810 ± 130**  
**1860 B.C.**  
Sample from Greenwell pit, Gallery III. Coll. 1870 by Canon Greenwell. *Comment:* date is within expected age range 1600 to 2400 B.C. based on previous series of Grimes Graves dates (Barker and Mackey, 1963).
- BM-290. Blackpatch flint mine** **5090 ± 130**  
**3140 B.C.**  
Antler, ref. 61/1585/A, Shaft 4, from Blackpatch, Worthing, Sussex, England (50° 52' N Lat, 0° 27' 15" W Long). Coll. 1923 by J. Pull; subm. by L. M. Bickerton, Worthing Mus.

**Willerby Wold long barrow**

Two samples of charcoal (*Quercus* sp.) from charred timber structure beneath E end of Willerby Wold long barrow, near Bridlington, East Riding, Yorkshire, England (54° 09' N Lat, 0° 06' W Long). Coll. 1960 and subm. by T. G. Manby (Manby, 1963).

**BM-188. Willerby Wold, A**

Sample A, from base of crematorium deposit. (P)

**4900 ± 150**  
**2950 B.C.**

**BM-189. Willerby Wold, B**

Sample B, from center of facade bedding trench. (P) *Comment:* dates show that elaborate crematorium long barrows of Yorkshire developed early in British Neolithic period. Features of mortuary enclosure of barrow resemble those of enclosure at Fussell's Lodge (Ashbee, 1958, 1964) BM-134, 5180 ± 150 (Barker and Mackey, 1968). See also date and Comment above for Windmill Hill long barrow, BM-180, this date list.

**4960 ± 150**  
**3010 B.C.**

**High Peak**

Two charcoal samples from High Peak, Sidmouth, Devon, England (50° 40' N Lat, 3° 06' W Long), Neolithic site sealed beneath Dark Age ramparts. Coll. 1961 and 1964 by Mrs. S. H. Pollard, Devon Archaeol. Explor. Soc; subm. Dept. of Prehist. and Roman Britain, British Mus. Assoc. archaeol. material consisted of pottery and flint artifacts similar to those from Windmill Hill, BM-73, 4910 ± 150 (Barker and Mackey, 1961) and Hembury, BM-130, 5100 ± 150 (Barker and Mackey, 1963).

**BM-214. High Peak, Ref. A.3. (P)**

**4810 ± 150**  
**2860 B.C.**

**BM-215. High Peak, Ref. HB.3. (P)**

**1550 ± 150**  
**A.D. 400**

*Comment* (S.H.P.): in 1964 this level was thought to be part of Neolithic ditch fill. Further excavation in 1965 revealed that it was later tip of ashy material overlying remains of Neolithic ditch and cut into by Dark Age workings (Pollard, 1966). Date agrees with late 5th to early 6th century A.D. Dark Age amphorae sherds found.

**Giants Hills**

Two red deer antlers from Giants Hills long barrow Skendleby, Lincolnshire, England (53° 11' N Lat, 0° 05' E Long). Coll. 1935 by C. W. Phillips; subm. by G. de G. Sieveking, British Mus.

**BM-191. Giants Hills, Sample 1,  
(protein fraction)**

Ref. 1935, 4-12, 42. (P)

**4410 ± 150**  
**2460 B.C.**

**BM-192. Giants Hills, Sample 2,  
(protein fraction)**

Ref. 1935, 4-12, 55. (P)

**4320 ± 150**  
**2370 B.C.**

- 4700 ± 150**  
**2750 B.C.**
- BM-271. Aston I**  
Carbonized grain, ref. A. 058, (probably emmer) from lining inside upper part of small pit in old ground surface sealed by primary beaker barrow at Aston on Trent, Derbyshire, England (52° 52' N Lat, 1° 25' W Long). Coll. 1964 and subm. by D. Reaney, Derbyshire Archaeol. Soc. Expected age ca. 4800 B.P. *Comment*: date agrees well with assoc. Grimston ware. (P)
- 4680 ± 135**  
**2730 B.C.**
- BM-281. Langdale**  
Charcoal, 90 cm below surface of peat assoc. with several stone implements and chippings at site of Neolithic axe factory at Langdale, Westmoreland, England (54° 27' N Lat, 3° 07' W Long). Coll. 1966 by E. P. Johnson, Cumberland and Westmoreland Archaeol. Soc.; subm. by H. Godwin. Date for manufacture of stone axes at Langdale.
- Durrington Walls**  
Two charcoal samples from late Neolithic henge monument at Durrington Walls, Wiltshire, England (51° 12' N Lat, 1° 47' W Long). Coll. 1966 and subm. by G. J. Wainwright, Inspectorate of Ancient Monuments, Ministry of Public Bldg. and Works (Wainwright, 1967, 1968).
- 3560 ± 120**  
**1610 B.C.**
- BM-285. Durrington Walls, Sample 1**  
Ref. D. W. 1966, D.1, Ditch, Hearth 5. Hearth near base of Neolithic ditch. Intended to date henge and Rusticated Beaker. Expected age ca. 1700 B.C.
- 3630 ± 110**  
**1680 B.C.**
- BM-286. Durrington Walls, Sample 2**  
Ref. D.W. 1966, D.1, Ditch, Hearth 3. Hearth in secondary silt of Neolithic ditch. Intended to date plain Ebbsfleet ware. Expected age ca. 1700 B.C.
- Letchworth**  
Charcoal from Blackhorse Rd., Letchworth, Hertfordshire, England (51° 59' N Lat, 0° 12' W Long). Coll. 1960 and 1966 and subm. by J. Moss-Eccardt, Letchworth Mus.
- 3520 ± 150**  
**1470 B.C.**
- BM-186. Letchworth, Sample 1**  
Ref. Pit 7, Layer 3, assoc. with Ebbsfleet ware. (P)
- 3310 ± 150**  
**1360 B.C.**
- BM-187. Letchworth, Sample 2**  
Ref. Pit 7, Layer 4, assoc. with Ebbsfleet ware. (P)
- 3830 ± 140**  
**1880 B.C.**
- BM-283. Letchworth, Sample 3**  
Ref. Pit 7, Layer 4, assoc. with Ebbsfleet ware. Check on BM-187. *Comment*: age of these samples was expected to agree with BM-113,

Ebbsfleet 4660  $\pm$  150 (Barker and Mackey, 1963). Pit from which samples were excavated may have been filled in during Bronze age with refuse which included charcoal samples measured and sherds of older Ebbsfleet ware lying on surface at that time. Mixing of material may also account for poor agreement between BM-187 and BM-283.

**BM-284. Letchworth, Sample 4** **3590  $\pm$  130**  
**1640 B.C.**

Ref. Pit 1, Layer 4, assoc. with pottery assemblage consisting of long-necked beaker, rusticated beaker, and Fengate ware. Date agrees well with expected age of ca. 1700 B.C. and date for similar assemblage at Windmill Hill BM-75, 3500  $\pm$  150 (Barker and Mackey, 1961).

**BM-249. Halling skeleton** **4180  $\pm$  190**  
**2230 B.C.**

Portion of femur of Halling skeleton, ref. BM-48, British Mus. (Nat. Hist.). Coll. 1912 by W. H. Cook from contracted burial in deposits at Halling, Kent, England (51° 21' N Lat, 0° 27' E Long); subm. by K. P. Oakley, British Mus., (Nat. Hist.). Date is of 2nd, carefully pretreated sample (collagen only) from skeleton previously dated 4100  $\pm$  180, BM-168 (Barker and Mackey, 1968). Date was much younger than expected (Oakley, 1963a, b) but is now confirmed by this measurement (Oakley *et al.*, 1967). Re-examination of flint artifacts showed that they could fit into either late Mesolithic or Neolithic context (G. de G. Sieveking, 1967, written commun.). (P)

**BM-374. Paviland skeleton** **18,460  $\pm$  340**  
**16,510 B.C.**

Collagen from portions of left femur and tibiae of skeleton of so-called "Red Lady of Paviland," an ochre burial of young male found in Goat's Hole (Paviland Cave), Gower Peninsula, Glamorganshire, S Wales (51° 33' N Lat, 4° 15' W Long). Coll. 1823 by Dean William Buckland, and now in Geol. Collection, Univ. Mus., Oxford. Subm. by K. P. Oakley, British Mus. (Nat. Hist.). (See Buckland, 1823; Sollas, 1913; Garrod, 1926; North, 1942; Oakley, 1968).

**Pinhole Cave**

Charcoal from Pinhole Cave, Creswell Crags, near Worksop, Nottinghamshire, England (53° 15' 44" N Lat, 1° 12' 01" W Long). Coll. during period 1924-1933 by A. L. Armstrong (1928) and subm. by K. P. Oakley, British Mus. (Nat. Hist.). From series of very small quantities of charcoal from levels containing sequence of Palaeolithic industries claimed to be from Mousterian to "Developed Aurignacian" (now called Creswellian) of expected age from 20,000 to ca. 8000 yr B.P. Although from old excavation it was hoped that samples might prove suitable for dating stone industries in Pinhole Cave.

**BM-437. Pinhole Cave I** **4120  $\pm$  140**  
**2170 B.C.**

Bulked sample (nos. 7-9) representing so-called Mousterian/Upper Aurignacian boundary.

**3910 ± 120****BM-438. Pinhole Cave 2****1960 B.C.**

Bulked sample (nos. 1-4) representing so-called Developed Aurignacian (Creswellian). *Comment:* dates are quite impossible for Mousterian which cannot be less than 20,000 B.P. and are inherently unlikely for Creswellian which is probably not later than 10,000 B.P. and may be much older (McBurney, 1959). Long standing doubts about interpretation of stratigraphy of Pinhole Cave are confirmed by these dates since it is clear that samples measured do not relate to industries represented there.

**Mildenhall**

Two charcoal samples from Phillips II site, Mildenhall, Suffolk, England (52° 25' N Lat, 0° 31' E Long). Coll. 1962 by Col. T. C. Kelly, USAF; subm. by G. de G. Sieveking, British Mus.

**3460 ± 150****BM-225. Phillips II (1)****1510 B.C.**

Sample 1. (P)

**3440 ± 150****BM-226. Phillips II (2)****1490 B.C.**

Sample 2. (P) *Comment* (G. de G.S.): samples were from late glacial open air habitation site having Upper Palaeolithic flint industry. Expected age was ca. 11,000 yr B.P. Dates suggest that Palaeolithic site was disturbed during Bronze age occupation of adjacent site ca. 100 ft away.

*E. Jordan***Jericho series**

Charcoal from pre-pottery Neolithic A and B levels at Tell-es Sultan, Jericho, Jordan (31° 53' N Lat, 35° 27' E Long). Coll. 1960 and subm. by Miss K. M. Kenyon, British School of Archaeol., Jerusalem (Kenyon, 1960; Barker and Mackey, 1963; Stuckenrath, 1963).

**10,300 ± 500****BM-250. Jericho****8350 B.C.**

Ref. J.P.D. 303/34 (CS.1036) DI, Phase DDDi. Phase succeeding construction of pre-pottery Neolithic A (PPNA) defenses. See BM-105, 10,250 ± 200 (Barker and Mackey, 1963), P-378, 9775 ± 110 (Stuckenrath, 1963). (P)

**9390 ± 150****BM-251. Jericho****7440 B.C.**

Ref. J.P.D. 404/14 (CS.1041) DII, Phase Gi. Stage VI (middle stage) of PPNA defenses. See P-379, 9655 ± 84 (Stuckenrath, 1963). (P)

**9320 ± 150****BM-252. Jericho****7370 B.C.**

Ref. J.P.D. 201/38 DI, Phase TTii. Phase succeeding Stage VII (late stage) of PPNA defenses. (P)

**BM-253. Jericho** **8710 ± 150**  
**6760 B.C.**

Ref. J.P.D. 209/1a (CS.116) EI, II, V, Phase J. Mid stage of pre-pottery Neolithic B (PPNB) occupation. See BM-115, 9170 ± 200 (Barker and Mackey, 1963), P-382, 8956 ± 103 (Stuckenrath, 1963). (P)

*F. Malta***Skorba series**

Two charcoal samples from Ghar Dhalam phase at temple site of Li Skorba, Zebbiegh, NW Malta (35° 55' N Lat, 14° 23' 30" E Long). Coll. 1962 and subm. by D. H. Trump, Nat. Mus. Valletta, Malta (Trump, 1966; Barker and Mackey, 1968 and refs.).

**BM-216. Skorba** **5760 ± 200**  
**3810 B.C.**

Level SK. AF5 at depth 50 to 70 cms in stratified deposit beside temple. Ghar Dhalam phase. (P)

**BM-378. Skorba** **6140 ± 160**  
**4190 B.C.**

Trench SB, Layer 4, 48 to 62 cms below surface, sealed below clay floor assoc. with pure Ghar Dhalam phase material. *Comment*: dates provide chronologic basis for Maltese sequence of which Ghar Dhalam phase is earliest. Both dates are consistent with other dates of Skorba series (Barker and Mackey, 1968).

*G. Nigeria***Ife series**

Charcoal from Ita Yemoo and Orun Oba Ado, Ife, W Nigeria (7° 28' N Lat, 4° 32' E Long). Coll. 1962 by Frank Willett, Northwestern Univ., Illinois.

**BM-259. Ita Yemoo, Ife** **790 ± 130**  
**A.D. 1160**

Trench XIII, Layer 19B (IY 2000) from upper part of pit fill beneath potsherd pavement No. 4 and Trench XIII, Layer 6B (IY 866) an occupation deposit on natural subsoil.

**BM-261. Ita Yemoo, Ife** **990 ± 130**  
**A.D. 960**

Trench XIV, Layer II (IY 1427) bottom layer of pit beneath potsherd pavement No. 1. *Comment*: BM-259 and BM-261 agree with estimated date of Classical period of Ife sculpture.

**BM-262. Ita Yemoo, Ife** **890 ± 130**  
**A.D. 1060**

Layer 2 (IY 949, IY 961, IY 963) in which terra cotta sculptures were found and which also represents abandonment of site. *Comment* (F.W.): date confirms estimate that Classical period of Ife art was of 12th to 14th centuries A.D. if not earlier, for sculptures in this deposit were already broken before site was abandoned. There can be no doubt that sculptures were made before 1st Europeans reached Benin.

**BM-264. Orun Oba Ado, Ife** **960 ± 130**  
**A.D. 990**  
Grave, Pit 6.

**BM-265. Orun Oba Ado, Ife** **1390 ± 130**  
**A.D. 560**

Grave, Pit 11. *Comment:* dates are for site to which heads of Kings of Yoruba dynasty in Benin were returned for burial, estimated to be ca. 1000 to 1300 A.D.

#### *H. West Pakistan*

#### **Loebanr I**

Charred human bone fragments from pre-Buddhist graves at Loebanr, Swat, W Pakistan (34° 45' N Lat, 72° 30' E Long). Coll. 1962 by Dr. Ch. Silvi-Antonini; subm. by Prof. G. Genna, Inst. of Anthropol., Univ. of Rome. Expected age: 1200 to 300 B.C. (Antonini and Tucci, 1963).

**BM-195. Loebanr I, Sample 1** **2980 ± 150**  
**1030 B.C.**  
Ref. L, IT, 54. (P)

**BM-196. Loebanr I, Sample 2** **2850 ± 150**  
**900 B.C.**  
Ref. L, IT, 61. (P)

#### *I. Yugoslavia*

**BM-379. Lepenski Vir** **6900 ± 150**  
**4950 B.C.**

Charcoal (*Quercus* sp.) from floor of House 37, 1 of series of trapezoidal houses in pre-Neolithic horizon succeeded by Starcevo Neolithic level at Lepenski Vir on Yugoslav bank of Danube, NW of Donje Milanovac, N Serbia (44° 31' N Lat, 22° 02' E Long). Coll. 1967 by D. Srejović; subm. by J. G. Nandris, Univ. of London, Inst. of Archaeol. *Comment:* date agrees well with expected age and is consistent with other dates for 1st (Starcevo) Neolithic stratified above this level (Nandris, 1968; Srejović, 1968a, b).

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British Museum V	Barker and Mackey, 1968
Groningen IV	Vogel and Waterbolk, 1963
Groningen V	Vogel and Waterbolk, 1964
Lamont IV	Broecker and Kulp, 1957
NPL I	Callow, Baker, and Pritchard, 1963
Pennsylvania VI	Stuckenrath, 1963
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