

BRITISH MUSEUM NATURAL RADIOCARBON MEASUREMENTS XXI

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The following list consists of dates obtained by liquid scintillation counting of benzene for archaeological samples mostly measured between June 1986 and June 1987.

Charcoal and grain samples were pretreated with 1M HCl followed by washing in water and, where considered necessary, with dilute alkali for the removal of humic acids. Wood samples were treated either in the same way, or, where large enough, were reduced to cellulose by the action of chlorine dioxide produced *in situ*. All antler and bone samples were treated with cold dilute acid. The term 'collagen' is used throughout to mean the acid insoluble organic fraction produced by this treatment. Peat samples were treated with dilute acid and alkali to separate the humin and humic acid fractions, which were dated separately.

The dates were obtained by liquid scintillation counting of benzene in low potassium glass vials, specially selected for similar backgrounds (Ambers, Leese & Bowman, 1986) in either a Packard model 3255 scintillation counter or an LKB rackbeta 1217 (with "Kangaroo" package), using PPO in toluene as a scintillator. The maximum sample size used was 5.5ml and smaller samples were made up to this volume with 'dead' benzene. Samples were counted for a minimum total period of 2000 minutes in trains containing at least 2 background and 2 modern samples. Each sample in the train was counted in successive 50-minute periods to achieve quasi-simultaneous counting. This procedure is basically the same as outlined in previous lists (see, eg, BM VIII: R, 1976, v 18, no. 1, p 16).

Dates are expressed as suggested by Stuiver and Polach (1977), *ie*, in radiocarbon years relative to AD 1950, based on the Libby half-life for ^{14}C of 5570 yr, and corrected for isotopic fractionation ($\delta^{13}\text{C}$ values are given relative to PDB). The 1986 Recommendations Adopted by the Twelfth International Radiocarbon Conference on the expression of calibrated and uncalibrated dates (R, 1986, v 28, no. 2A, p 799) have been followed. The modern reference standard is NBS oxalic acid.

Errors quoted are the counting error for the sample combined with an estimate of the errors contributed by the modern and background samples. This estimate includes both counting and non-counting errors, the latter being computed from differences in the overall count rates observed among the individual backgrounds and moderns. The overall error is given as ± 1 standard deviation ($\pm 1\sigma$).

National Grid References are abbreviated to NGR. Descriptions, comments, and references to publications are based on information supplied by submitters.

British Isles

England

Hognaston series

Samples assoc with barrow at Hognaston, Derbyshire (53° 00' N, 1° 40' W, NGR SK 245517). Coll 1983 and subm by J Collis, Univ Sheffield.

BM-2417. Hognaston **3480 ± 110**
 $\delta^{13}C = -24.9\text{‰}$

Charcoal, ref 182 (*Corylus* sp) id. by C Hunt, Univ Sheffield, from stake hole assoc with collared urn.

BM-2418. Hognaston **3480 ± 60**
 $\delta^{13}C = -24.3\text{‰}$

Charcoal, ref 123 (mainly *Tilia* sp with some *Quercus* sp) id. by C Hunt, from one of several dumped deposits in mound, possibly derived from land clearance at time of barrow construction.

BM-2419. Hognaston **3430 ± 40**
 $\delta^{13}C = -24.3\text{‰}$

Charcoal, ref 106 (*Corylus* sp) id. by C Hunt, from context 8, upper silting of barrow ditch.

BM-2420. Hognaston **3430 ± 80**
 $\delta^{13}C = -25.1\text{‰}$

Charcoal, ref 244 (*Tilia* sp, *Quercus* sp, mosses and moss stems) id. by C Hunt, from context 20, in grave assoc with collared urn containing ogival dagger.

BM-2421. Hognaston **4930 ± 60**
 $\delta^{13}C = -23.5\text{‰}$

Charcoal, combined samples ref 227, 231, 234, 201/214/217/213 (*Tilia* sp, rhizomes, stems, and leaves of graminiae, moss stems) id. by C Hunt, from pit, context 11, assoc with Neolithic vessel and sealed by iron pan beneath barrow.

BM-2422. Hognaston **4120 ± 70**
 $\delta^{13}C = -25.2\text{‰}$

Charcoal, ref 176 (mainly *Quercus* sp, some *Tilia* and *Pinus* spp) id. by C Hunt, from context 12, land sealed under barrow. May be from tree root, assoc with land clearance.

General Comment (JC): samples come from large barrow containing single burial, cremation in collared urn, accompanied by ogival dagger. Barrow lies on heavy clay overlying shales, but close to limestone area of White Peak. It yielded important environmental evidence, notably pollen, for one of a few dated contexts in this area of Derbyshire. Dates are all as expected.

Runnymede series

Samples from Neolithic and Bronze Age site at Runnymede Bridge, Berkshire (51° 30' N, 1° 30' W, NGR TQ 018718). Coll 1984 and subm by S Needham, Dept Prehist and Romano-British Antiquities, British Mus.

BM-2435. Runnymede

3770 ± 60
 $\delta^{13}C = -24.8\text{‰}$

Wood, ref ERB84 A14 121 (*Cornus* sp) id. by Rowena Gale, from bundle of rods and branches, some with beaver-gnawed ends and all stripped of bark, from layer of organic mud in long strat sequence with no assoc cultural debris.

BM-2436. Runnymede

3740 ± 80
 $\delta^{13}C = -23.6\text{‰}$

Cellulose extracted from wood from same context as that used for BM-2435, above.

BM-2550. Runnymede

7790 ± 80
 $\delta^{13}C = -27.0\text{‰}$

Wood from outer rings, immediately beneath bark, of section of tree trunk, ref A13 549, from bed of alluvial silt. Measured to date one of earliest levels of alluviation encountered on site.

BM-2551. Runnymede

1190 ± 60
 $\delta^{13}C = -27.4\text{‰}$

Wood from outer rings of heartwood of 1 of 2 worked wooden stakes, ref A11 6, excavated by contractors from 'Southern Loop,' relict branch of R Thames. Measured to compare with dated Late Bronze Age waterfront structures excavated further north.

General Comment (SN): BM-2435 and -2436 should closely date enveloping silt and provide first dated intermediate horizon in long alluvial sequence between Middle Neolithic (5000–4600 BP) and Late Bronze Age (2800–2550 BP) levels (Harwell dates, as yet unpub). Context is strat at base of alluvium 1.5m deep, which must have accumulated during 2nd millennium BC, prior to establishment of Late Bronze Age settlement. BM-2550 dates unworked tree trunk lying horizontally within body of silt which appears to represent early floodplain aggradation. Over 1m of silt layers covered sample before area was occupied in Middle Neolithic. Thus, deposition of silts occurred between ca 8000 and 5000 BP. BM-2551, for eroded worked stake, gives Saxon date and thus, is completely unrelated to Late Bronze Age site bounded by Southern Loop. It may attest waterfront activity assoc with Saxon Egham. Early wharf is implied at spot by place-name "Glanty," or *Glenthuthe*, as recorded in Chertsey Charter, ca 12th–13th centuries AD (Turner, 1926, p 9–10).

BM-2437. Swan Lane **2140 ± 45**
 $\delta^{13}C = -17.9\text{‰}$

Collagen from right radius of whale (*Balaena glacialis*) id. by M Sheldrick, from Swan Lane, City of London (51° 30' N, 0° 05' W, NGR TQ 335815). Coll 1981 and subm by Barbara West, Dept Urban Archaeol, Mus London. *Comment* (BW): true date of bone is probably early to mid-Roman due to “reservoir effect” (Olsson, 1983). “Flipper bone” of Biscay whale bore ancient butchery marks indicating meat removal, and probably represents only example of this sp id. from Roman period in Britain. Only a few whale bones from British archaeologic sites have ever been id. to sp (Clark, 1947).

BM-2439. Sipson Lane **3090 ± 50**
 $\delta^{13}C = -23.9\text{‰}$

Charcoal, ref WGF 84 5, from deposit of domestic debris, including Middle Bronze Age pottery, loom weights and flint work, in upper fill of isolated feature (?elongated pit/ditch) at Sipson Lane, 3rd terrace of R Thames, Greater London (51° 30' N, 0° 30' W, NGR TQ 078783). Coll 1984 and subm by J Cotton, Mus London. *Comment* (JC): single date, which falls within latter part of Middle Bronze Age, would appear to suit assoc finds, as these included sherds of hooked rim jars.

Dorchester series

Samples from Dorchester ritual complex (Kinnes, 1979; Chambers & Bradley, Excavations on the Dorchester on Thames Bypass, ms in prep), Dorchester on Thames, Oxfordshire (51° 40' N, 1° 10' W, NGR SU 582948). Coll 1949 by R J C Atkinson and subm 1984 by R Bradley, Univ Reading.

BM-2440. Dorchester **4320 ± 90**
 $\delta^{13}C = -21.8\text{‰}$

Collagen from antler, ref 33, (red deer, tines) id. by Annie Grant, Univ Reading, from bottom of Ditch 1 of triple-ditched enclosure (Site XI) abutted by Dorchester on Thames cursus (Atkinson, Piggott & Sandars, 1951).

BM-2442. Dorchester **4320 ± 50**
 $\delta^{13}C = -21.4\text{‰}$

Collagen from antler, ref 87, (red deer, brow tine) id. by A Grant from similar context to that dated by BM-2440, above.

BM-2443. Dorchester **4510 ± 100**
 $\delta^{13}C = -24.1\text{‰}$

Collagen from antler, ref 79a, (red deer, beam and tine) id. by A Grant, from lowest silt of cursus ditch, site VIII.

General Comment (RB): BM-2443 confirms chronol context of cursus monuments, already indicated by BM-2438 (R, 1987, v 29, no. 2, p 186) from Dorset cursus. Dorchester on Thames Site XI was thought by excavator to antedate cursus but since BM-2440 and -2442 come from secondary struc-

tural phase, they do not provide unambiguous test of interpretation; suitable samples are not available from other phases. Dates do confirm Neolithic context of ring ditches of this type.

BM-2445. Stonea **2910 ± 90**
 $\delta^{13}C = -25.0\text{‰}$

Charcoal from context 1360, small Late Bronze Age pit, at Stonea, Cambridgeshire (52° 30' N, 0° 10' E, NGR TL 449937). Coll 1983 and subm by T W Potter, Dept Prehist and Romano-British Antiquities, British Mus. *Comment* (TWP): date is early but generally acceptable.

Maiden Castle series

Samples from Neolithic layers in hillfort at Maiden Castle, Dorchester, Dorset (50° 40' N, 2° 30' W, NGR SY 668885). Coll 1985 and subm by N Sharples, Trust for Wessex Archaeol.

BM-2447. Maiden Castle **4800 ± 45**
 $\delta^{13}C = -20.4\text{‰}$

Collagen from bone, ref 14555, (large ungulate) id. by Miranda Armour-Chelu, from organic-rich middle fill of Neolithic causewayed camp ditch in Tr 1, assoc with large quantities of charcoal, flint and pottery refuse.

BM-2448. Maiden Castle **4710 ± 70**
 $\delta^{13}C = -20.3\text{‰}$

Collagen from bone, ref 14558, (ox, left tibia) id. by M Armour-Chelu, from one of lowest fills of Neolithic causewayed camp ditch in Tr 1.

BM-2449. Maiden Castle **5040 ± 60**
 $\delta^{13}C = -25.4\text{‰}$

Charcoal, ref 14565, (*Quercus* sp) id. by N Balaam, English Heritage, from loose chalk rubble layer at base of Neolithic causewayed camp ditch in Tr 1.

BM-2450. Maiden Castle **5020 ± 50**
 $\delta^{13}C = -23.5\text{‰}$

Charcoal from similar position to BM-2449, above.

BM-2450A. Maiden Castle **5050 ± 60**
 $\delta^{13}C = -23.5\text{‰}$

Recount of same sample as BM-2450, above.

BM-2451. Maiden Castle **4860 ± 70**
 $\delta^{13}C = -20.4\text{‰}$

Collagen from human bone, ref 2010, (left femur) id. by J Henderson, from outer ditch of Neolithic causewayed camp, assoc with other disarticulated human bone.

BM-2452. Maiden Castle**4640 ± 50** $\delta^{13}C = -21.5\text{‰}$

Collagen from bone, ref 2012, (ox, right tibia) id. by M Armour-Chelu, from outer ditch of Neolithic causewayed camp, assoc with disarticulated human bone.

BM-2453. Maiden Castle**14,310 ± 100** $\delta^{13}C = -25.2\text{‰}$

Charcoal, ref 14509, (*Quercus* sp) id. by N Balaam, from occupation material lying on old ground surface sealed by bank assoc with inner causewayed camp ditch.

BM-2454. Maiden Castle**4830 ± 60** $\delta^{13}C = -20.8\text{‰}$

Collagen from bone, ref 14562, (ox, right metatarsal and right pelvis) id. by M Armour-Chelu, from middle fill of Neolithic causewayed camp ditch in Tr II, assoc with large quantities of charcoal, flint, and pottery refuse.

BM 2455. Maiden Castle**3470 ± 70** $\delta^{13}C = -21.9\text{‰}$

Coll: gen from bone, ref 14570, (ox, right femur) id. by M Armour-Chelu, from late fill of Bank Barrow ditch, assoc with Beaker pottery.

BM-2456. Maiden Castle**4720 ± 100** $\delta^{13}C = -20.9\text{‰}$

Collagen from bone, ref 14543, (red deer, left tibia) id. by M Armour-Chelu, from stoney layer on N side of bank barrow ditch immediately overlying primary fill.

General Comment (NS): BM-2447 to -2452, -2454 are from causewayed camp ditch. With exception of BM-2452, primary fills are earlier than secondary fills. Apparent 200-yr difference between primary and secondary fills in Tr 1 may be exaggerated due to use of charcoal and bone, respectively, for samples. BM-2456 gives preliminary date of Bank Barrow. BM-2455 gives date for Beaker occupation of hilltop. Only unexpected date, BM-2453, should be contemporary with or slightly earlier than occupation of causewayed camp and is archaeologically unacceptable. Pattern suggests that causewayed camp was constructed in 1st century of 5th millennium BP and was occupied for ca 100–200 yr. Within 100 yr of its abandonment, Bank Barrow was constructed. Hilltop was then abandoned until Early Bronze Age when there was domestic occupation assoc with Beaker pottery.

BM-2465. Fishbourne**2900 ± 45** $\delta^{13}C = -21.9\text{‰}$

Cellulose derived from outer 15 rings of sapwood of rooted tree stump found in presumed Roman dam now submerged under Fishbourne Millpond, 400m SW of Fishbourne Roman Palace, Chichester, W Sussex (50°

50' N, 0° 50' W, NGR SU 483005). Coll 1981 and subm by H Wallace, Sussex Archaeol Soc, as part of investigation into sea-level changes. *Comment* (HW): stump was enclosed in clay dam datable archaeologically to AD 43–74.

Gold Park series

Charcoal samples from 1 of 2 hut platforms at Gold Park, Shapley Common, Dartmoor (50° 40' N, 3° 50' W, NGR SX 701818). Coll 1984 and subm by A Gibson, Dept Archaeol, Univ Leicester, to provide absolute date for site with no datable artifacts in strat contexts. Site was occupied by successive timber and stone huts.

BM-2466. Gold Park

2090 ± 120

$\delta^{13}C = -24.0\text{‰}$

Charcoal, ref C S 9, (gorse, hazel and oak) id. by G Morgan, Univ Leicester, from patch of charcoal on floor of stone hut.

BM-2467. Gold Park

2050 ± 40

$\delta^{13}C = -22.4\text{‰}$

Charcoal, ref C S 6, (gorse, hazel and oak) id. by G Morgan, from patch of charcoal on floor of timber hut, sealed below wall of stone hut.

BM-2468. Gold Park

2080 ± 60

$\delta^{13}C = -23.4\text{‰}$

Charcoal, ref C S 17, (oak, hazel, gorse and poplar) id. by G Morgan, from patch of charcoal in stone hut.

BM-2469. Gold Park

2190 ± 60

$\delta^{13}C = -23.4\text{‰}$

Charcoal, ref C S 28, (gorse and hazel) id. by G Morgan, from central hearth assoc with timber hut.

BM-2470. Gold Park

2200 ± 60

$\delta^{13}C = -24.3\text{‰}$

Charcoal, ref C S 29, (gorse, hazel, oak and poplar) id. by G Morgan, from section 22 of bedding trench of timber hut.

General Comment (AG): absence of datable artifacts from strat contexts made absolute dating of site essential. Dates identify new type of Iron Age settlement in SW and extend date range nationally of this type of unenclosed platform settlement site. Charcoal ids. support Simmons' (1969) reconstruction of Iron Age Dartmoor and show that house lay in open scrubland or moorland with forest surviving in valleys.

BM-2472. Bloodhound Cove

3460 ± 70

$\delta^{13}C = -24.4\text{‰}$

Charcoal (*Quercus* sp) id. by J Ambers, from base of small pit containing small urn, but no burial, at Bloodhound Cove, Harlyn Bay, Cornwall (50° 40' N, 5° 00' W, NGR SW 875755). Coll 1985 and subm by Ann Pres-

ton-Jones, Cornwall Comm for Rescue Archaeol. *Comment* (P Rose, Cornwall Comm for Rescue Archaeol): urn is decorated with twisted cord impressions and belongs to ApSimon's Trevisker style 1 (ApSimon & Greenfield, 1972). Pit, exposed in cliff fall, was covered by capstone and low mound. Similar findspots are known from Harlyn Bay, and there is second barrow group nearby on Cataclews Point (Christie *et al*, 1985; Griffith *et al*, 1984; Harris & Trudgian, 1984). Date is closely consistent with others from Cornish cairns or barrows hinting at concentration of barrow building during relatively limited period.

BM-2480. Abbey Mead

970 ± 50
 $\delta^{13}C = -23.9\text{‰}$

Cellulose from wood (ca 20 rings) from one of line of waterlogged wooden piles exposed by gravel extraction in ancient river channel at Abbey Mead, Chertsey, Surrey (51° 20' N, 0° 30' W, NGR TQ 042679). Coll 1986 and subm by I M Stead, Dept Prehist and Romano-British Antiquities, British Mus. *Comment* (IMS): gravel pit had produced Iron Age shield and Bronze Age sword, and series of piles were possibly in some way related to prehistoric finds. This is evidently not so.

BM-2497. Haddenham

3360 ± 50
 $\delta^{13}C = -21.9\text{‰}$

Charcoal, ref 2172 III, from within collared urn containing cremation and 2 pots in primary grave of secondary expansion of Late Neolithic/Early Bronze Age barrow at Haddenham 3, Cambridge (52° 20' N, 0° 10' E, NGR TL 409748). Coll 1985 and subm by C Evans, Univ Cambridge. *Comment* (CE): date is acceptable and would correlate well with secondary style of collared urn (I Longworth, pers commun) and its status in barrow sequence.

Ireland

Known Age series

Cellulose extracted from dendrochronologically dated wood samples supplied by M Baillie, Queen's Univ, Belfast, measured as check on accuracy of system.

BM-2494. Known age 1090 BC

2880 ± 40
 $\delta^{13}C = -25.7\text{‰}$

Cellulose from wood sample from Ballymacombs, dendrochronologically dated to bi-decade centered on 1090 BC. *Comment* (JA & SB): calibrates to 1210–1030 cal BC at 1 σ (Pearson & Stuiver, 1986), and compares with result of 2886 ± 12 measured by Pearson *et al* (1986) for wood from same rings.

BM-2560. Known age 3010 BC

4360 ± 50
 $\delta^{13}C = -22.9\text{‰}$

Cellulose from wood sample from Balloo Cottage, dendrochronologically dated to bi-decade centered on 3010 BC. *Comment* (JA & SB): com-

pares with result of 4345 ± 14 measured by Pearson *et al* (1986) for wood from same rings.

BM-2562. Known age 1090 BC **2920 ± 50**
 $\delta^{13}C = -24.3\text{‰}$

Cellulose from same sample as BM-2494, above. *Comment* (JA & SB): calibrates to 1255–1030 cal BC at 1σ (Pearson & Stuiver, 1986), and compares with result of 2886 ± 12 measured by Pearson *et al* (1986) for wood from same rings.

Cameroon

Shum Laka series

Samples from excavation at Shum Laka (5° 50' N, 10° 05' E). Coll 1982 and subm by R N Asombang, Inst Archaeol, Univ London.

BM-2495. Shum Laka **40 ± 40**
 $\delta^{13}C = -24.9\text{‰}$

Charcoal, ref sample 1, from topmost layer of site, assoc with end of use of pottery at site.

BM-2496. Shum Laka **6360 ± 100**
 $\delta^{13}C = -25.3\text{‰}$

Charcoal, ref sample 3, from depth of 60cm, assoc with concentration of stone flakes at site.

General Comment (RA): BM-2495 is clearly contaminated with recent charcoal. BM-2496 confirms expectations and is in accord with other dates for site.

Egypt

Thebes series

Samples from Tomb of Sethos I, Valley of Kings, Thebes (25° 40' N, 32° 40' E). Coll ca 1820 and subm 1985 by T G H James, from colln of Dept Egyptian Antiquities, British Mus, to provide date for objects found in tomb. *Comment* supplied by D P Ryan, Pacific Lutheran Univ, Tacoma, Washington.

BM-2351. Thebes **2800 ± 45**
 $\delta^{13}C = -11.2\text{‰}$

Rope of vegetable fibers (from leaves of date palm *Phoenix dactylifera* and leaves and culms of halfa-grass, probably *Desmostachya bipinnata*), ref EA 5403, id. by Paula Rudall, Royal Botanic Gardens, Kew, to provide date for particular style of rope ladder.

BM-2471. Thebes **2020 ± 50**
 $\delta^{13}C = -23.9\text{‰}$

Wood from rung of rope ladder, ref EA 5402, to provide date for later activity in tomb by priests or robbers and to check assoc with rope dated by BM-2351, above.

General Comment (DPR & TGHJ): as anticipated from other data concerning hist of tomb, calibrated date for rope of 900-1000 cal BC is ca 300–400 yr later than tomb itself (ca 1300 BC); result dates rope, forming part of study of Ancient Egyptian ropes. Date for wooden rungs proves conclusively that they do not belong with rope with which they were previously assoc, and must represent rungs of ladder used on different occasion to enter tomb.

India

Early Metallurgy in India

Samples from early mining and metal extraction sites in India dated as part of long-term and wide-ranging project and subm by P T Craddock, Research Lab, British Mus. For other related dates, see BM-2017, -2065, -2148, -2149: R, 1984, v 26, no. 1, p 67–68; BM-2222, -2223, -2243: R, 1985, v 27, no. 3, 518–519; BM-2338, -2356, -2364, -2381: R, 1987, v 29, no. 2, p 188–189.

Zawar series

Samples assoc with early mining and smelting over wide area at Zawar (Craddock *et al*, 1986), Udaipur Dist, Rajasthan (23° 20' N, 75° 50' E). Coll 1985 and subm by P T Craddock, Research Lab, British Mus.

Modern

BM-2381. Zawar $\delta^{13}C = -25.2\text{‰}$

Charcoal, ref ZM/LW/85/13, from small chamber off main galleries in Zawar Mala Mine.

2150 ± 110

BM-2482. Zawar $\delta^{13}C = -26.1\text{‰}$

Wood, ref ZM/LW/85/14, from short ladderway in Zawar Mala Mine.

2180 ± 35

BM-2483. Zawar $\delta^{13}C = -26.2\text{‰}$

Wood, ref ZM/LW/85/8, from burned layer in Zawar Mala Mine.

100 ± 45

BM-2484. Zawar $\delta^{13}C = -23.4\text{‰}$

Charcoal, from Site 5, Layer 3, large slag heap from lead smelting operation, apparently accumulated over short period.

1950 ± 60

BM-2485. Zawar $\delta^{13}C = -23.8\text{‰}$

Charcoal, from Site 14, Layer 3, large slag heap from silver/lead smelting operation, apparently accumulated over short period.

200 ± 35

BM-2486. Zawar $\delta^{13}C = -23.9\text{‰}$

Charcoal, from Site 29, Layer 2, small pit or hearth full of charcoal immediately beneath scattered layer of slag and rock fragments.

BM-2487. Zawar**1930 ± 80**
 $\delta^{13}C = -23.8\text{‰}$

Charcoal, from Site 2, Tr 2, small slag heap in area of slag scatter.

BM-2488. Zawar**1370 ± 80**
 $\delta^{13}C = -24.0\text{‰}$

Charcoal, from Site 7, Tr 2, small slag heap from silver/lead smelting, apparently accumulated over short period.

BM-2489. Agucha**2350 ± 40**
 $\delta^{13}C = -24.8\text{‰}$

Charcoal, from Layers 3 and 4 in section cut by modern well through metallurgic layers at Agucha mine, Rajasthan (25° 50' N, 74° 40' E). Coll 1985 and subm by P T Craddock.

Dariba series

Samples from metal extraction debris at Dariba, Chittor Dist, Rajasthan (24° 25' N, 74° 00' E). Coll 1985 and subm by P T Craddock.

BM-2490. Dariba**2340 ± 60**
 $\delta^{13}C = -23.7\text{‰}$

Charcoal from Site 9, Layer 4, area of extensive remains of silver production close to surface and sealed by washed-in layers.

BM-2491. Dariba**2170 ± 45**
 $\delta^{13}C = -23.2\text{‰}$

Charcoal from Site 10, Layer 23, one of lower layers of massive buildup (>6m deep) of metallurgic debris revealed in section cut by well.

BM-2492. Dariba**1940 ± 70**
 $\delta^{13}C = -23.7\text{‰}$

Charcoal from Site 7, Layer 4, from one of number of slag dumps.

General Comment (PTC): at each of three sites, there are extensive lead/silver/zinc deposits, all with early exploitation. Previous work and dating at Zawar established medieval and later dates for zinc distillation but proved that mines were >2000 yr old. Hypothesis was that early dates related to silver/lead extraction with some zinc ore mined for brass manufacture by cementation process. All dates above are for material from 1985 season which concentrated on silver/lead slag heaps and extended investigation to two other major silver/lead mines in NW India, where there is no evidence of early zinc production. Dates from all three mines show intense activity during latter half of 1st millennium BC. Mines are among most sophisticated and extensive known from antiquity and their very complete state enabled every stage in production of silver and lead to be recorded. At both Dariba and Agucha, there are extensive surface remains of Mauryan occupation, which is especially interesting as they probably produced first coinage in India, and sites are almost certainly source of silver used.

Italy

Italian prehistory series

Samples from SE and Central Italy subm by Ruth Whitehouse, Univ Lancaster to establish ^{14}C chronology for prehist of area, for which few dates are available. For previous dates in series, see BM XIX: R, 1987, v 29, no. 1, p 71–74.

Botromagno series

Samples from Period I of Iron Age site at Botromagno, Gravina-in-Puglia (40° 45' N, 16° 25' E). Coll 1982 to 1983 by R Whitehouse.

BM-2408. Botromagno **2770 ± 50**
 $\delta^{13}\text{C} = -18.5\text{‰}$
Collagen from bone, ref I 761.

BM-2409. Botromagno **2810 ± 60**
 $\delta^{13}\text{C} = -19.4\text{‰}$
Collagen from bone, ref I 764.

BM-2410. Botromagno **2360 ± 50**
 $\delta^{13}\text{C} = -22.8\text{‰}$
Collagen from bone, ref I 496.

BM-2411. Botromagno **2410 ± 50**
 $\delta^{13}\text{C} = -19.0\text{‰}$
Collagen from bone, ref I 431.

General Comment (RW): BM-2408 and -2409 give calibrated dates that fit well with archaeol expectations of range 1000–700 BC. BM-2410 and -2411 should fall in same range (since 5th century BC layers occur strat later and have clearly recognizable archaeol material). Apparent anomaly is possibly due to nature of calibration curve in range 2500–2400 BP.

Coppa Nevigata series

Samples from Neolithic ditched village and Bronze Age settlement at Coppa Nevigata, Com Manfredonia, Foggia Prov (41° 30' N, 15° 45' E). Coll 1983 by A Manfredini, S Cassano, A Cazzella and M Moscoloni, Univ “La Sapienza,” Rome.

BM-2412. Coppa Nevigata **2980 ± 45**
 $\delta^{13}\text{C} = -22.3\text{‰}$
Charcoal, ref E3D 1IIB, from foundations of Floor 1 in late Bronze Age phase.

BM-2557. Coppa Nevigata **7780 ± 320**
 $\delta^{13}\text{C} = -22.0\text{‰}$
Carbonized grain, ref C5/H3 (mainly *Triticum monococcum* and *Triticum dicoccum*) id. by A Sargent, Univ Cambridge, from deposit of plant material in Neolithic ditch.

General Comment (RW): BM-2412, when calibrated, fits archaeol expectations of 13th–12th century BC date. Large margin of error on BM-2557 requires caution in interpretation, but date is notably early, though not as early as date of ca 8200 BP sometimes quoted for sample from excavations conducted on site in 1950s. It is earliest date yet obtained on cereal grains from Italy, thus providing earliest direct evidence for agriculture.

BM-2413. Vivara **2620 ± 50**
 $\delta^{13}C = -24.9\text{‰}$

Charcoal from hearth in upper level of Hut A in early Bronze Age village site on Vivara I., Com Procida, Napoli Prov (40° 50' N, 14° 00' E), assoc with 2 Mycenaean sherds. Coll 1982 by A Cazzella and M Moscoloni. *Comment* (RW): date, even when calibrated, is several centuries later than expected date of 16th–15th centuries BC (assoc with imported Mycenaean IA and I/II sherds). Cause of anomaly is not known.

BM-2414. Santa Tecchia **6520 ± 70**
 $\delta^{13}C = -19.3\text{‰}$

Collagen from human bone, ref ST F4, from Level 4 of compound ditch in Neolithic ditched village site at Santa Tecchia, Com Manfredonia, Foggia Prov (41° 30' N, 15° 40' E). Coll 1980 by S Cassano and A Manfredini, Mus Origini, Univ Rome. *Comment* (RW): date is considerably later than previous date from Layer 6 (two layers below) of 7600 ± 100 BP (Cassano & Manfredini, 1983, p 265). Yet it falls comfortably in range of dates from sites with comparable pottery styles (Whitehouse, 1978, 1986; Sargent, 1985).

BM-2415. Fontana Rosa **6490 ± 150**
 $\delta^{13}C = -25.6\text{‰}$

Charcoal, ref FR 6a, from Level 6a of external ditch of Neolithic ditched village at Fontana Rosa, Com Manfredonia, Tavoliere (41° 30' N, 16° 00' E). Coll 1980 by S Cassano and A Manfredini. *Comment* (RW): date fits comfortably into range of dates from sites with comparable pottery styles (Whitehouse, 1978, 1986; Sargent, 1985).

Ponte Napesino series

Samples from Phase I of occupation site at Ponte Napesino, near Rome (42° 20' N, 12° 20' E). Coll 1982 and subm by T Potter, Dept Prehist and Romano-British Antiquities, British Mus.

BM-2473. Ponte Napesino **1110 ± 60**
 $\delta^{13}C = -24.1\text{‰}$

Charcoal, ref 79 (*Quercus* sp) id. by J Ambers, from spread of charcoal probably relating to initial occupation of site, sealed below unit 40, dated by BM-2474, below.

BM-2474. Ponte Napesino**1090 ± 40** $\delta^{13}C = -24.2\text{‰}$

Charcoal, ref 40 (*Quercus* sp) id. by J Ambers, from layer of charcoal averaging 5cm thick, derived from burning down of wooden buildings of earliest phase of site occupation.

General Comment (TP): calibrated date ranges of cal AD 885–995 (BM-2473) and cal AD 895–995 (BM-2474) (Stuiver & Pearson, 1986) support view that so-called ‘Forum ware’ was introduced ca AD 800, rather than ca AD 600, as had been suggested.

*Jordan***BM-2434. Tell Irbid****3040 ± 40** $\delta^{13}C = -20.0\text{‰}$

Carbonized grain, ref 001.53.8.6 (*Hordeum* ? *distichon* and *Triticum dicoccum*) id. by Julie Bond, Univ Bradford, from cache of grain on floor of collapsed and burned mudbrick and stone house in Bronze Age destruction layer in Tell Irbid, N Jordan (32° 45' N, 35° 50' E). Coll 1984 and subm by Alison McQuitty, North Jordan Project. *Comment* (AMcQ): sample was taken from structure assigned to Phase IIb, Late Bronze Age period (Lenzen, Gordon & McQuitty, 1985), dated by ceramic parallels to 1300 to 1150 BC. Result calibrates (Pearson & Stuiver, 1986) to 1395–1260 cal BC, which places result firmly within traditional Late Bronze Age period rather than Late Bronze Age/Iron Age I transition. Sample was taken from grain cache which probably dates to within 1 yr of destruction.

*Pakistan***Aligrāma series**

Charcoal samples from protohistoric settlement site (Stacul & Tusa, 1975, 1977; Tusa, 1982, 1985a,b) at Aligrāma, Swāt (34° 45' N, 72° 15' E). Coll 1972 and 1980–1983 and subm by S Tusa, Italian Archaeol Mission in Pakistan.

BM-2457. Aligrāma**2950 ± 60** $\delta^{13}C = -22.0\text{‰}$

Sample, ref 34, from Sq 1ML 4, Room 3, Layer 3, from inside jar used as fireplace.

BM-2458. Aligrāma**2640 ± 70** $\delta^{13}C = -22.8\text{‰}$

Sample, ref 35, from Sq 1ML 4, Room 3, Layer 3, floor.

BM-2459. Aligrāma**3030 ± 50** $\delta^{13}C = -24.0\text{‰}$

Sample, ref 407, from Tr U', Layer 6.

BM-2460. Aligrāma

3060 ± 70
 $\delta^{13}C = -23.6\text{‰}$

Sample from Tr U', Layer 7.

BM-2461. Aligrāma

3090 ± 120
 $\delta^{13}C = -20.0\text{‰}$

Sample from Tr U', Layer 8, Area 5, *terminus post quem* for plowed field.

General Comment (ST): for other dates from site, see P-2150 to -2152: R, 1977, v 19, no. 2, p 214; PRL-186: R, 1977, v 19, no. 2, p 229; PRL-243: -244, -246: R, 1978, v 20, no. 2, p 234. BM-2457 and -2458 clarify chronology of middle phase (IV-V periods) of Aligrāma sequence and agree well with other evidence. Difference between dates from same context is not surprising, as BM-2457 is from wood used for fuel, whereas BM-2458 comes from actual destruction debris. BM-2459 to -2461 confirm date of period III and support theory that plowed field traces found in Tr U' should be dated to ca 3000 BP, making this one of earliest examples in the world.

BM-2463. Shahi Mahl

2190 ± 80
 $\delta^{13}C = -21.5\text{‰}$

Charcoal sample from natural section in hill at Shahi Mahl, Darel, Indus Karakorum (35° 45' N, 73° 45' E). Coll 1980 during first field survey of area and subm by S Tusa. *Comment* (ST): BM-2463, together with BM-2464, below, cannot be interpreted in real historic perspective because area was previously totally unexplored archaeologically. Dates form beginning of chronology for Darel area. Sample is from probable origin of bronze hoard attributed to first millennium BC.

BM-2464. Urali

320 ± 60
 $\delta^{13}C = -7.9\text{‰}$

Carbonized seeds (*Panicum miliaceum*) id. by J Bond, Univ Bradford, from stone platform on river bank at Urali, Darel, Indus Karakorum (35° 45' N, 73° 45' E). Coll 1980 during first field survey of area and subm by S Tusa. *Comment* (ST): sample is one of first for area and helps establish first chronology.

*Spain***Moncīn series**

Samples from Bronze-Age levels in multi-period settlement site at Moncīn, Borja, Zaragoza Prov (41° 50' N, 1° 30' W). Coll 1985, 1986 and subm by R J Harrison, Dept Classics and Archaeol, Univ Bristol.

BM-2475. Moncīn

3570 ± 50
 $\delta^{13}C = -22.6\text{‰}$

Charcoal, ref sample 1, from Sq 1, Level 11.

BM-2476. Monc̄in **3620 ± 40**
 $\delta^{13}C = -22.5\text{‰}$
Charcoal, ref sample 4, from Sq 1, Level 11.

BM-2477. Monc̄in **3900 ± 40**
 $\delta^{13}C = -22.4\text{‰}$
Charcoal, ref sample 5, from Sq 1, Level 15.

BM-2478. Monc̄in **3380 ± 40**
 $\delta^{13}C = -22.8\text{‰}$
Carbonized acorns, ref sample 7, from Sq IX, Level 4, assoc with late Bell Beaker pottery and large bone button.

BM-2479. Monc̄in **3730 ± 40**
 $\delta^{13}C = -22.9\text{‰}$
Charcoal, ref sample 8, from Sq VIII, Level 9a.

General Comment (RJH): dates are for samples selected from Early Bronze Age and Eneolithic contexts in long strat sequence. Latest date, BM-2478, belongs to level with many burned acorns and some decorated pottery of style derived from Ciempozuelos Bell Beakers. BM-2475 and -2476 come from ash lens (level 11) below this in main sequence, rich in burned wheat and plain Early Bronze Age pottery. Immediately below level 11 is series of layers with incised Bell Beakers decorated in Ciempozuelos style; BM-2479 dates richest group of pottery in this series. BM-2477 is for material from base of deepest sondage made on site, assoc with small amounts of decorated Bell Beaker pottery of incised Ciempozuelos style. Dates show that developed styles of Ciempozuelos Bell Beakers were still in use in 38th century BP, and that there is strong likelihood that decorative traditions lasted some time after this. Dates, together with previous results for site (BM-1924 to -1928: R, 1983, v 25, no. 1, p 54, and BM-2193, -2194: R, 1985, v 27, no. 3, p 522) cover whole of 2nd millennium BC and allow accurate evaluation to be made of speed of cultural change recognized as “secondary products revolution” (Harrison, 1985).

Syria

Tell Brak series

Samples from occupation site at Tell Brak (D Oates, 1977, 1982a,b, 1985, 1987; J Oates, 1985), near El Haseke, NE Syria (36° 40' N, 41° 00' E). Coll and subm by D Oates, Inst Archaeol, Univ London.

BM-2511. Tell Brak **3960 ± 90**
 $\delta^{13}C = -20.5\text{‰}$

Humic acids separated from grain sample, ref CH 450, from destruction level preceding construction of Agade “palace” by Naram-Sin. Coll 1981.

BM-2531. Tell Brak **3840 ± 50**
 $\delta^{13}\text{C} = -19.6\text{‰}$

Humic fraction from same sample as BM-2511, above.

BM-2554. Tell Brak **3990 ± 50**
 $\delta^{13}\text{C} = -23.4\text{‰}$

Charcoal sample, ref FS 504, from floor of large public building believed to date to period of Naram-Sin. Coll 1986.

BM-2555. Tell Brak **3730 ± 50**
 $\delta^{13}\text{C} = -25.6\text{‰}$

Charcoal sample, ref FS 1093, from floor of latest phase (2A) of "grey libn building" which also produced post-Akkadian seal. Coll 1984.

BM-2556. Tell Brak **3960 ± 50**
 $\delta^{13}\text{C} = -25.3\text{‰}$

Charcoal, ref FS 1383, from same floor as BM-2554, above. Coll 1985.

General Comment (JO): on calibration, BM-2511 and -2531 fall very satisfactorily within expected 2460–2285 BC range and suggest that buildings were destroyed either by Sargon of Agade or by some late Early Dynastic king, sometime before 2234 BC. BM-2554 and -2556 come from floor of building believed to date to either time of Naram-Sin of Agade or some earlier Akkadian king. Contents of building should postdate those found in building dated by BM-2511 and -2531. Dates are, in fact, indistinguishable from BM-2511 and -2531. There are two possible explanations for discrepancy: charcoal may derive from older re-used roof beams or building may itself have been re-used by Akkadians. BM-2555 is, from context, believed to date to some time between Akkadian (ca 2360 to ca 2220 BC) and third Dynasty of Ur (ca 2140 to ca 2030 BC). Result calibrates to 2200 to 2120 cal BC or 2080 to 2040 cal BC (Pearson & Stuiver, 1986); earliest of ranges fits historic context well.

General Comment (SB & JA): grain sample dated by BM-2511 and -2531 is from same context as BM-1971 to -1973 (R, 1983, v 25, no. 1, p 57). These dates are now known to be in error (Tite *et al*, 1988) and, by comparison with mean of BM-2511 and -2531, are on average ca 280 yr too young. Similarly, BM-2555 is for same context as BM-1970 (R, 1983, v 25, no. 1, p 57) and is ca 290 yr older.

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