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RADIOCARBON

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INSTRUCTIONS TO CONTRIBUTORS

Manuscripts of radiocarbon papers should follow the recommendations in *Suggestions to Authors*, 5th ed.* All copy (including the bibliography) must be typewritten in *double space*. Manuscripts for vol 17, no. 2 must be submitted in *duplicate* before October 1, 1974; for vol 17, no. 3 before February 1, 1975.

Descriptions of samples, in date lists, should follow as closely as possible the style shown in this volume. Each separate entry (date or series) in a date list should be considered an *abstract*, prepared in such a way that descriptive material is distinguished from geologic or archaeologic interpretation, but description and interpretation must be both brief and informative, emphasis placed on significant comments. Date lists should therefore not be preceded by abstracts, but abstracts of the more usual form should accompany all papers (eg, geochemical contributions) that are directed to specific problems.

Each description should include the following data, if possible in the order given:

1. Laboratory number, descriptive name (ordinarily that of the locality of collection), and the date expressed in years BP (before present, ie, before AD 1950) and, for finite dates, in years AD/BC. The standard error following the date should express, within limits of $\pm$ 1σ, the laboratory's estimate of the accuracy of the radiocarbon measurement, *as judged on physicochemical (not geologic or archaeologic) grounds.*

2. Substance of which the sample is composed; if a plant or animal fossil, the scientific name if possible; otherwise the popular name; but not both. Also, where pertinent, the name of the person identifying the specimen.

3. Precise geographic location, *including latitude-longitude coordinates.*

4. Occurrence and stratigraphic position in precise terms; use of metric system exclusively. Stratigraphic sequences should *not* be included. However, references that contain them can be cited.

5. Reference to relevant publications. Citations within a description should be to author and year, with specific pages wherever appropriate. References to published date lists should cite the sample no., journal (R for Radiocarbon), years, vol, and specific page (eg, M-1832, R, 1968, v 10, p 97). Full bibliographic references are listed alphabetically at the end of the manuscript, in the form recommended in *Suggestions to Authors.*

6. Date of collection and name of collector.

7. Name of person submitting the sample to the laboratory, and name and address of institution or organization with which submitter is affiliated.

8. Comment, usually comparing the date with other relevant dates, for each of which sample numbers and references must be quoted, as prescribed above. Interpretive material, summarizing the significance and implicity showing that the radiocarbon measurement was worth making, belongs here, as do technical matters, *eg*, chemical pretreatment, special laboratory difficulties, etc.

Illustrations should not be included unless absolutely essential. They should be original drawings, although photographic reproductions of line drawings are sometimes acceptable, and should accompany the manuscript in any case, if the two dimensions exceed 30cm and 23cm.

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* Suggestions to authors of the reports of the United States Geological Survey, 5th ed, Washington, DC, 1958 (Government Printing Office, $1.75).

NOTICE TO READERS

Half life of ^{14}C. In accordance with the decision of the Fifth Radiocarbon Dating Conference, Cambridge, 1962, **all dates published in this volume (as in previous volumes) are based on the Libby value, 5570 ± 30 yr,** for the half life. This decision was reaffirmed at the 8th International Conference on Radiocarbon Dating, Wellington, New Zealand, 1972. Because of various uncertainties, when ^{14}C measurements are expressed as dates in years BP the accuracy of the dates is limited, and refinements that take some but not all uncertainties into account may be misleading. The mean of three recent determinations of the half life, 5730 ± 40 yr, (**Nature,** v 195, no. 4845, p 984, 1962), is regarded as the best value presently available. Published dates in years BP, can be converted to this basis by multiplying them by 1.03.

AD/BC dates. As agreed at the Cambridge Conference in 1962, AD 1950 is accepted as the standard year of reference for all dates, whether BP or in the AD/BC system.

Meaning of $\delta^{14}C$. In Volume 3, 1961, we indorsed the notation Δ (Lamont VIII, 1961) for geochemical measurements of ^{14}C activity, corrected for isotopic fractionation in samples and in the NBS oxalic-acid standard. The value of $\delta^{14}C$ that entered the calculation of Δ was defined by reference to Lamont VI, 1959, and **was corrected for age.** This fact has been lost sight of, by the editors as well as by authors, and recent papers have used $\delta^{14}C$ as the **observed** deviation from the standard. At the New Zealand Radiocarbon Dating Conference it was recommended to use $\delta^{14}C$ only for age-corrected samples. Without an age correction, the value should then be reported as percent of modern relative to 0.95 NBS oxalic acid. (Proceedings 8th Conference on Radiocarbon Dating, Wellington, New Zealand, 1972.)

In several fields, however, age corrections are not possible. $\delta^{14}C$ and Δ, uncorrected for age, have been used extensively in oceanography, and are an integral part of models and theories. For the present therefore we continue the editorial policy of using Δ notations for samples not corrected for age.

Radiocarbon Measurements: Comprehensive Index, 1950-1965. This index, covering all published ^{14}C measurements through Volume 7 of RADIOCARBON, and incorporating revisions made by all laboratories, has been published. It is available to all subscribers to RADIOCARBON at ten dollars US per copy.

Publication schedule. Beginning with Volume 15, RADIOCARBON is published in three numbers: Winter, Spring, and Summer. The next deadline is October 1, 1974. Contributors who meet our deadlines will be given priority but not guaranteed publication in the following issue.

List of laboratories. The comprehensive list of laboratories at the end of each volume now appears in the third number of each volume.

Index. All dates appear in index form at the end of the third number of each volume.

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Radiocarbon

1974

BIRMINGHAM UNIVERSITY RADIOCARBON DATES VIII

F W SHOTTON, R E G WILLIAMS and A S JOHNSON

Geology Department, University of Birmingham,
Birmingham, England

The following list of dates contains all measurements made during 1973, *ie*, since our last list (R, 1973, v 15, p 451-468). We have installed this year a Nuclear Enterprises NIM system to be used with our 2.5L Oeschger-type proportional counter (Philips), in addition to our 6L and 1L proportional counters which have worked consistently with Beckman Lowbeta electronics. The Philips counter has been calibrated relative to the Beckman electronics and we are now calibrating it relative to the NIM system.

Age calculations are based on 95% activity of the NBS oxalic acid standard computed from the Libby half-life of 5570 ± 30 yr. Background samples are synthesized from Welsh anthracite. Errors quoted refer only to the standard deviation (1σ) calculated from a statistical analysis of sample, background, and standard count rates.

$^{13}C/^{12}C$ ratios are measured directly on all methane gas samples as previously described (R, 1973, v 15, p 451) and ages are corrected for $\delta^{13}C$ deviations.

Sample preparation and pretreatment continue as before (R, 1969, v 11, p 263). Where sample size was insufficient for full pretreatment, details of procedure accompany the result. For bone samples, we use the extraction method based on the solubility of collagen in slightly acidic hot water of Longin (1971).

ACKNOWLEDGMENTS

We particularly wish to thank Lina Salvini for routine sample preparation and pretreatment. Sample descriptions are based on information provided by submitters and collectors.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. British Isles

Ellerby series, Holderness, Yorkshire

Samples from 2 of 3 thin organic beds within gray clay filling kettle hole in till SW of New Ellerby, Holderness, Yorkshire (53° 50′ 00″ N, 0° 13′ 52″ W, Grid Ref TA 16403894). Coll Oct 1970 and subm by G D Gaunt, Inst Geol Sci, Leeds.

Birm-351. **3800 ± 150**
1850 BC
$\delta^{13}C = -25.0‰$

Highest organic bed from ca 0.6m deep.

Birm-390. **6240 ± 150**
4290 BC
$\delta^{13}C = -26.7‰$

Middle organic bed from ca 1.0m deep.

General Comment (GDG): lowest organic bed from ca 1.2m deep dated at 10,040 ± 210 (Birm-304; R, 1973, v 15, p 5). Date of lowest horizon and kettle hole structure suggest hollow originated as subsidence feature due to melting, at start of Flandrian climatic amelioration, of ice buried deep enough to have survived transient late Devensian amelioration(s).

Birm-381. Sugworth Farm, Abingdon Bypass, Berkshire **>47,700**

Wood, unid, from tree trunk ca 4.0m deep and ca 3.0m below plateau drift gravel in road cut for bridge foundation at Sugworth Farm, Abingdon Bypass, Berkshire (51° 42′ N, 1° 15′ W, Grid Ref SP 512018). Coll Nov 1972 by P J Osborne; subm by F W Shotton. *Comment*: date consistent with interglacial interpretation.

Aston Mill series, Worcestershire

Wood and moss washed from current bedded sand and fine gravel with lenses of gray silty clay overlying Lower Lias at Aston Mill, SW of Bredon Hill, Worcestershire (52° 01′ 00″ N, 2° 04′ 45″ W, Grid Ref SO 944355). Coll Dec 1971 and subm by P F Whitehead, Dept Geol, Univ Birmingham.

Birm-410. Field 3, Site 25 **3840 ± 130**
1890 BC
$\delta^{13}C = -24.4‰$

Wood from ca 0.5m deep.

Birm-411. Field 3, Site 14 **4380 ± 100**
2430 BC
$\delta^{13}C = -26.5‰$

Wood (*Alnus glutinosa*) id by D F Cutler, Plant Pathol Dept, Kew Gdns, London, from ca 2.43m deep in gray blue silty marl.

Birm-382. **26,000 ± 300**
24,050 BC
$\delta^{13}C = -26.8‰$

Moss washed from organic deposit with *coleoptera* and plant seeds at ca 6.20m deep at base of gravel immediately overlying Lower Lias. *Comment*: Birm-382 indicates date at end of middle Devensian, agreeing with contained fauna and flora and also with date of 27,650 ± 250 (R, 1973, v 15, p 5) from similar terrace gravel at Beckford, 4km E. Birm-410 and Birm-411 indicate Neolithic date and there may be a substantial break between upper and lower parts of gravel sequence.

Cletwr Pingo series, Cardiganshire

Gray clay interbedded with peat overlying 14cm gray clay at Cletwr pingo 10km SSE of New Quay, Cardiganshire (52° 07′ 25″ N, 4° 19′ 30″ W, Grid Ref SN 412499). Coll July 1972 and subm by Edward Watson, Dept Geog, Univ College Wales, Aberystwyth.

Birm-389. Pingo K, Sample W4 **8260 ± 300**
6310 BC
$\delta^{13}C = -24.9‰$

"Russian" auger peat from 3.55 to 3.59m below bog surface, 10m S of foot of N rampart on profile line (Watson, 1972, written commun).

Birm-388. Pingo K, Sample W3 **10,170 ± 220**
8220 BC
$\delta^{13}C = -26.5‰$

"Russian" auger peat from 3.50 to 3.56m below bog surface, 9m S of N rampart, offset 1m W of profile line. *Comment*: sample size excluded alkali pretreatment.

General Comment (EW): Birm-389 younger than expected. Probably due to contamination by younger material when auger drawn up. Birm-388 earlier than basal organic material in Cledlyn pingo (Birm-368: 9380 ± 340, R, 1973, v 15, p 461) and compatible with much shallower form of Cletwr basin in which ice lens expected to melt out more quickly and undisturbed organic sedimentation to begin earlier.

Tattershall Castle pit series, Lincolnshire

Vegetable matter washed from peat and silt lenses at large gravel pit near Tattershall Castle, Lincolnshire (53° 05′ N, 0° 12′ W, Grid Ref TF 210570) where Devensian gravel which overlies Ipswichian peat (Birm-260: >42,000, R, 1973, v 15, p 4) includes numerous bones of bison, reindeer and other mammals and a number of horizons of organic silt containing abundant insect assemblages. Two of these horizons referred to provisionally as the Lower Silt (Birm-398 and -408) and the (newer) *Anodonta* Bed (Birm-341 and -409) are stratigraphically assoc above Ipswichian peat. Devensian gravel is overlain by clay, peat, and gravel of Flandrian age. Coll 1973 and subm by FWS, G R Coope, R B Angus, and Maureen Girling, Dept Geol, Univ Birmingham.

Birm-409. **42,200 ± 1000**
40,250 BC
$\delta^{13}C = -26.2‰$

Plant debris washed from *Anodonta* Bed (*cf* Birm-341: $43,000^{+1300}_{-1100}$, R, 1973, v 15, p 453).

Birm-398. **42,100 +1400 −1100**
40,150 BC
$\delta^{13}C = -25.4‰$

Finely divided organic material from Lower Silt, ca 5.0m deep, and 0.5m above Ipswichian peat.

Birm-408. **44,300 +1600 −1300**
42,350 BC
$\delta^{13}C = -27.8‰$

Plant debris washed from Lower Silt, ca 4.0m horizontal distance from Birm-398.
General Comment: ages of these 2 beds very similar, with Lower Silt only slightly earlier than *Anodonta* Bed, despite marked alteration of climate indicated by insect assemblages.

Birm-448.
(a) 30,800 ± 360
28,850 BC
$\delta^{13}C = -23.2‰$
(b) 28,000 ± 800
26,050 BC
$\delta^{13}C = -27.7‰$

Comminuted plant debris washed from 1.90 to 2.10m deep, from organic silt bed with *Anodonta*, extending with decreasing organic content to 1.20m below surface. Overlain by gravel and underlain by at least 1.40m sand and gravel. A marked paleosol at top of silt bed, truncated by Upper gravel (see Birm-451, below). (a) after alkali pretreatment, (b) humate extract.

Birm-451.
(a) 4120 ± 200
2170 BC
$\delta^{13}C = -23.9‰$
(b) 4290 ± 130
2340 BC
$\delta^{13}C = -24.9‰$

Rootlets washed from large volume of silty clay, 1.20 to 1.40m deep, highest part of palaeosol referred to above. (a) and (b) are independent determinations on separate samples.
General Comment: visual evidence indicates that some rootlets at least penetrate from overlying gravel, and that date may underestimate age of palaeosol. Young date for Birm-448 (expected on faunistic grounds to be closer to 40,000, *cf* Birm-409) suggests penetration of these roots into Birm-448.

Birm-450. **39,400 ± 800**
37,450 BC
$\delta^{13}C = -25.4‰$

Plant debris from small lens of organic silt, with *Anodonta* and rich insect assemblage, 4.55m deep in gravel underlying chalky till (no intervening Ipswichian peat here).

Birm-447. **4570 ± 150**
2620 BC
$\delta^{13}C = -23.9‰$

Piece of *Pinus* wood from base of peat in Flandrian succession of 1.25m alluvial silt and clay, on ca 1m black peat with large pieces of wood, on ca 0.5m angular flinty gravel with roots, resting on Devensian gravels.

Birm-393. Newport Pond, Newport, Essex

(a) 3270 ± 120
1320 BC
$\delta^{13}C = -28.7‰$
(b) 3500 ± 130
1550 BC
$\delta^{13}C = -27.9‰$

Humified and structureless fen peat from 4.50 to 4.90m deep in Borehole C19 at Newport Pond, Newport, Essex (51° 58′ 30″ N, 0° 13′ 00″ E, Grid Ref TL 52403327). Coll Nov 1972 and subm by C A Baker, Dept Geog, Kings College, Univ London. *Comment*: sample (a) after alkali pretreatment, (b) humate extract. Date confirms pollen analysis as Zone VIIb.

Birm-400. Trawling Ground, Pembrokeshire **8740 ± 110**
6790 BC
$\delta^{13}C = -25.1‰$

Peat from 2.55 to 2.60m below ocean bed, −21.55 to −26.60m alt, from hydrocore Site ZZ27 at Trawling Ground 4.8km NE of Newquay, Pembrokeshire (52° 14′ 12″ N, 4° 18′ 24″ W). Coll Aug 1972 during Whitethorn project, Inst Geol Sci; subm by R A Garrad, Dept Geol, Univ College Wales, Aberystwyth. *Comment*: date is maximum for Flandrian transgression at site.

Birm-404. Brimfield, Herefordshire

(a) 10,550 ± 340
8600 BC
$\delta^{13}C = -25.0‰$
(b) 10,700 ± 210
8750 BC
$\delta^{13}C = -27.2‰$

Plant material washed from stratified sand and silt at 2.50 to 2.80m deep from low terrace of R Teme ca 1km E of village of Brimfield, Herefordshire (52° 18′ 32″ N, 2° 40′ 35″ W, Grid Ref SO 53886814). Coll July 1972 and subm by Peter Cross. *Comment*: terrace postdates

R Teme's E diversion to the R Severn by Wye Glacier ice (Cross, 1971). Acid pretreatment only on (a), 1% NaOH for "humate" extraction on (b).

Roos Bog series, Yorkshire

Fine detritus coll by multiple shots with "Russian" peat sampler at the Bog, Roos, E Riding, Yorkshire (53° 44′ N, 0° 05′ W, Grid Ref TA 274288). Coll Jan 1973 and subm by S C Beckett, Dept Geog, Univ Hull.

Birm-405. R-192 to R-197 — **10,120 ± 180** / **8170 BC** / $\delta^{13}C = -31.3‰$

From 9.20 to 9.25m deep.

Birm-406. R-25 to R-29 — **11,220 ± 220** / **9270 BC** / $\delta^{13}C = -28.2‰$

From 10.91 to 10.95m deep.

Birm-407. R-12 to R-15 — **11,450 ± 230** / **9500 BC** / $\delta^{13}C = -27.6‰$

From 11.02 to 11.05m deep.

General Comment: insufficient sample for alkali pretreatment. Previous dates from this site; Birm-318: 11,500 ± 170 (11.10 to 11.15m deep) and Birm-317: 13,050 ± 270 (11.33 to 11.40m deep); R, 1973, v 15, p 454.

Birm-412. Docking Common, NW Norfolk — **24,000 ± 550** / **22,050 BC** / $\delta^{13}C = -27.2‰$

Upper humic layer of a paleosol profile ca 1 to 2m thick overlain by ca 3m cryoturbated flint gravel and underlain by involuted gravels on shallow dry valley floor at Docking Common, NW Norfolk (52° 53′ 30″ N, 0° 40′ 00″ E, Grid Ref TF 790357). Coll Jan 1973 and subm by Allan Straw, Dept Geog, Univ Exeter. Alkali pretreatment for contamination impossible as sample completely soluble in 1% NaOH and had to be reprecipitated. *Comment* (AS): older than previous determination on similar soil Birm-350: 19,300 ± 300 (R, 1973, v 15, p 459), suggests minimum age and soil formed well before Late Devensian advance to Holderness.

Birm-414. Caisteal-nan-Gillean, Oronsay, Scotland

(a) 3990 ± 130 / **2040 BC** / $\delta^{13}C = +0.7‰$

(b) 4080 ± 120 / **2130 BC** / $\delta^{13}C = +0.5‰$

(c) 4110 ± 130 / **2160 BC** / $\delta^{13}C = +0.4‰$

Inner (a), middle (b), and outer (c) fraction of limpet shells from emerged beach on SE coast of I of Oronsay in Inner Hebrides, Argyllshire, Scotland (56° 00′ N, 6° 14′ W, Grid Ref NR 359880). Coll July 1972 and subm by W G Jardine, Dept Geol, Univ Glasgow. *Comment* (WGJ): dates are considerably younger than those for *Arctica islandica* from same horizon of emerged beach (7020 ± 140: Birm-363, R, 1973, v 15, p 457). Hard-water effect may be greater for *Arctica islandica* than for *Patella* because of different habitat. Dates for *Patella* are younger than date for *Patella* in lower layers of adjacent Mesolithic shell midden (5850 ± 310: Birm-348, R, 1973, v 15, p 456). This supports suggestion of excavators in 1914 that sea had not retreated far before midden areas were occupied.

Birm-415. Palnure Borehole, Scotland **6540 ± 120**
4590 BC
$\delta^{13}C = -25.7‰$

Sample at +6.38m alt from base of thick peat ca 4.73m deep, overlying gray clay (carse deposit) in Palnure Borehole, Newton Stewart, Kirkcudbrightshire, Scotland (54° 56′ N, 4° 25′ W, Grid Ref NX 4500-6367). Coll Aug 1969 and subm by WGJ. *Comment*: Birm-189: 6240 ± 240 (R, 1971, v 13, p 144) wood assoc with peat from same junction of carse deposit.

Birm-418. Grimstock Hill, Warwickshire **>33,000**
$\delta^{13}C = -26.9‰$

Peat between +89.9 and +91.4m alt, overlain by 0.9m silty peat and 2.7m gravelly solifluction and underlain by at least 13m gravel, sand and silty clay, in sequence predating valley of R Tame and its terraces at Grimstock Hill, Coleshill, Warwickshire (52° 30′ 30″ N, 1° 43′ 00″ W, Grid Ref SP 19259033). Coll 1973 and subm by P J Markham, Dept Geol, Univ Birmingham. *Comment*: palynology indicates an interglacial, possibly Hoxnian.

Birm-443. Craigeazle Bog, Galloway, Scotland **910 ± 150**
AD 1040
$\delta^{13}C = -24.6‰$

Sphagnum peat from 0.70 to 0.75m deep in auger hole at Craigeazle Bog, Silver Flowe Nature Reserve, Galloway, Scotland (55° 05′ N, 4° 24′ W, Grid Ref NX 476812). Coll April 1973 and subm by P D Hulme, Dept Botany, Univ Hull. *Comment*: dates start of major phase of pool system development.

Birm-444. Hornsea Old Mere, Yorkshire **10,720 ± 480**
8770 BC
$\delta^{13}C = -20.4‰$

Plant fragments from detritus mud with shells 12.52 to 12.73m deep at Hornsea Old Mere, E Riding, Yorkshire (53° 54′ N, 0° 10′ W, Grid Ref TA 210476). Coll May 1973 and subm by S C Beckett, Dept Geog, Univ Hull. *Comment*: sample dated as control on pollen zonation of late Glacial period. Large error as sample was small.

Birm-449. Stubbers Green, Staffordshire **>28,700**
$\delta^{13}C = -25.6‰$

Wood (? *Pinus*) from borehole at ca 7m deep in peat, beneath 2.5m made ground and 4m coarse, medium sand and gravel, in drift filled channel at Stubbers Green, Staffordshire (52° 35′ N, 2° 00′ W, Grid Ref SK 045010). Coll April 1973 and subm by PJM. *Comment* (PJM): base of peat contains early interglacial type pollen (*Betula, Pinus*), 40cm higher in peat sequence more temperate pollen types found (*Alnus, Corylus, Picea, Pinus*). Date consistent with interglacial interpretation.

10,040 ± 160
Birm-452. Wicken Water, Newport, Essex **8090 BC**
$\delta^{13}C = -27.0‰$

Macroflora remains (*Betula* twigs, reeds, and seeds) washed from clayey fen peat 7.20 to 7.50m deep in Hiller auger Borehole C23 at Wicken Water, Newport, Essex (51° 59′ N, 0° 12′ E, Grid Ref TL 51573418). Coll Aug 1973 and subm by CAB. *Comment*: dates start of sedimentation in postglacial infills in area.

12,040 ± 100
Birm-458. Howth Demesne, Co Dublin, Ireland **10,090 BC**
$\delta^{13}C = -26.8‰$

Peat at 1.50 to 1.60m deep from bed at 1.30 to 1.80m deep, between 2 calcareous tills at Howth Demesne, Co Dublin, Ireland (53° 23′ N, 6° 04′ W, Grid Ref O 283384). Coll Aug 1973 and subm by G F Mitchell, Trinity College, Dublin. *Comment*: date younger than expected but verified by date on separate sample from same horizon by Teledyne Isotopes (I-7433: 12,020 ± 175, unpub).

3290 ± 110
Birm-461. Lochar Water, Scotland **1340 BC**
$\delta^{13}C = -26.2‰$

Wood fragments at +9.20m alt from top of peat 1.97m thick underlying 1.99m silty clay (? lake deposit) and overlying 6.65m marine sand (+0.58 to +7.23m alt), directly above fluvioglacial gravels at Sandyknowe Bridge, Lochar Water, Dumfriesshire, Scotland (55° 05′ N, 3° 32′ W, Grid Ref NY 017776). Coll Sept 1973 and subm by WGJ. *Comment*: dates change from peat formation to overlying inorganic sediment. GU-65: 7426 ± 136; R, 1969, v 11, p 51, dates wood from base (+0.58m alt) of underlying marine sand.

34,500 ± 800
Birm-466. Little Rissington, Gloucestershire **32,550 BC**
$\delta^{13}C = -21.2‰$

Collagen from elephant tusk (? *Mammuthus primigenius*) from 3.66m deep in ochreous oolite terrace gravel of R Dikler at Little Rissington near Bourton-on-the-Water, Gloucestershire (51° 53′ N, 1° 44′ W, Grid Ref SP 182203). Coll 1973 by H E O'Neil; subm by FWS. *Comment*: previously recorded fauna (Richardson and Sandford, 1961) suggests possible correlation with No 2 Terrace of R Avon, confirmed by Middle Devensian date.

Birm-467. Cosford Pumping Station, Shropshire **500 ± 120**
AD 1450
$\delta^{13}C = -26.5‰$

Twigs (*Betula*) washed from gray-brown clay, 0.60m thick, 3.96m deep from borehole NW of Wolverhampton at Cosford Pumping Sta, Shropshire (52° 38′ 15″ N, 2° 19′ 20″ W, Grid Ref SJ 781045). Coll 1973 and subm by P D Triccas, Westhill College Educ, Birmingham. *Comment*: recent deposition of river alluvium.

B. Miscellaneous Geologic Samples

Atlantic volcanic island series

Carbonized wood samples from volcanic rocks on Terceira I, Azores; and Tenerife, Canary Is. Coll Sept 1970 and subm by Stephen Self, Dept Geol, Imperial College, London.

Birm-394. Locality 1, S56 **2040 ± 120**
90 BC
$\delta^{13}C = -22.3‰$

Carbonized tree branches from discrete carbon layer between 2 basaltic ashes at road cut near center of Terceira I, Azores (38° 44′ N, 27° 16′ W).

Birm-395. Locality 91, S228 **19,680 ± 330**
17,730 BC
$\delta^{13}C = -20.4‰$

Carbonized tree trunk or large branch at base of nonwelded basal zone of Saõ Mateus ignimbrite on cliffs at old church of Saõ Mateus, Terceira I, Azores (38° 41′ N, 27° 17′ W).

Birm-396. Locality 29, S43 **18,600 ± 650**
16,650 BC
$\delta^{13}C = -19.5‰$

Carbonized twigs from fine grained, non-welded, basal layer of Lajes ignimbrite (Self, 1971) at Caldera das Lajes, Terceira I, Azores (30° 47′ N, 27° 08′ W). *Comment*: Birm-306: 23,100 ± 350 (R, 1973, v 15, p 462) from 3m above base of Lajes ignimbrite significantly older.

Birm-417. S7 **$28{,}500^{+1580}_{-1320}$**
26,550 BC
$\delta^{13}C = -21.2‰$

Carbonized wood from near base of thin ignimbrite in Orotaua Valley, ca 2km W of Puerto de la Cruz, Tenerife I, Canary Is (28° 26′ N, 16° 30′ W). *Comment*: Birm-180 (a): >25,200 (R, 1971, v 13, p 150) sample assoc with latest explosive eruption of Tenerife volcano.

General Comment: dates form part of tephrochronologic study of volcanic sites of N Atlantic Ocean by G P L Walker, Imperial College, London.

Birm-399. Jebel Idwa, W Sudan

3520 ± 100
1570 BC
$\delta^{13}C = -21.5‰$

Carbonized wood buried in massive air-fall pumice deposit exposed within gulley ca 1.6km N of N rim of Deriba Caldera, Jebel Marra, ca 2.0km E of Jebel Idwa, Darfur Province, W Sudan (12° 59′ 30″ N, 24° 16′ 00″ E). Coll March 1972 and subm by R S Thorpe, Dept Earth Sci, Open Univ. *Comment*: dates probable last major volcanic activity from Jebel Marra caldera (Vial, 1973).

Aavatsmokbreen series, Vestspitsbergen

Shell and whale bone from emerged beach sequence N of Aavatsmokbreen, Vestspitsbergen (78° 45′ N, 11° 15′ E). Coll 1973 and subm by G S Boulton, Dept Environmental Studies, Univ East Anglia.

Birm-421. S114, +3.3m alt

(a) 10,500 ± 280
8550 BC
$\delta^{13}C = +0.5‰$
(b) 11,030 ± 310
9080 BC
$\delta^{13}C = +0.0‰$

Inner (a) and middle (b) fraction of shells (*Hia galicena*).

Birm-422. S112, +8.8m alt

(a) 12,670 ± 250
10,720 BC
$\delta^{13}C = -0.3‰$
(b) 11,730 ± 230
9780 BC
$\delta^{13}C = +0.6‰$

Inner (a) and middle (b) fraction of shells (*Hia galicena*).

Birm-423. S110, +12.2m alt

11,160 ± 140
9210 BC
$\delta^{13}C = +1.5‰$

Middle fraction of mixed shells (*Hia galicena* and *Mya truncata*).

Birm-424. S63, +15.8m alt

(a) 10,520 ± 180
8570 BC
$\delta^{13}C = +1.0‰$
(b) 10,350 ± 170
8400 BC
$\delta^{13}C = +1.4‰$

Inner (a) and middle (b) fraction of mixed shells (*Hia galicena* and *Mya truncata*).

Birm-425. S108, +18.4m alt

(a) 13,420 ± 460
11,470 BC
$\delta^{13}C = +2.4‰$

(b) 14,600 ± 240
12,650 BC
$\delta^{13}C = +1.1‰$

Inner (a) and outer (b) fraction of shell fragments (unid).

Birm-426. S65, +24.8m alt

(a) 14,900 ± 300
12,950 BC
$\delta^{13}C = +1.7‰$

(b) 13,730 ± 290
11,780 BC
$\delta^{13}C = +1.4‰$

Inner (a) and outer (b) fraction of mixed shells (*Hia galicena, Mya truncata and Macomacarea*).

Birm-427. S64, +41.7 to +43.2m alt

1440 ± 100
AD 510
$\delta^{13}C = -15.0‰$

Collagen extracted from whale bone. *Comment*: where sufficient sample was available 3 fractions were evolved, the outer discarded, determinations were done on the inner and middle fractions. For the smaller samples only 2 fractions were evolved and dated as Inner and Outer. Inner fraction of Birm-423 was lost.

General Comment: dating is part of crustal uplift study of Spitsbergen area. Discorrelation between date and beach height may be due to hard water-effect or some isotopic replacement. Whale bone on highest beach obviously intrusive, and, in view of hard-water error, could be recent.

Qaleragdlit imâ series, S Greenland

Shells and cemented calcite concretions washed out from small outcrop of marine silty sand (+3.5m alt) 2km from glacier calving into head of fjord at entrance to Marrait tributary valley on SW side of Qaleragdlit imâ fjord, S Greenland (60° 58′ 24″ N, 46° 39′ 06″ W). Coll July 1973 and subm by M R Kelly, Dept Environmental Sci, Univ Lancaster.

Birm-455.

(a) 7980 ± 150
6030 BC
$\delta^{13}C = -0.3‰$

(b) 7640 ± 150
5690 BC
$\delta^{13}C = -0.5‰$

(c) 7790 ± 150
5840 BC
$\delta^{13}C = +0.8‰$

Inner (a), middle (b), and outer (c) of lamellibranchs (*Mya truncata*).

Birm-454. **4690 ± 130**
2740 BC
$\delta^{13}C = -15.6‰$

Calcite cemented concretions of silt containing fragments of lamellibranchs (*Mytilus edulis*). Cementation probably by solution of shells (similar to Birm-455).

General Comment (MRK): evidence from Qaleragdlit imâ and adjacent areas shows parts of margin of S Greenland ice sheet in mid postglacial times was well behind present or "little ice age" maximum positions. Shell dates agree well with indirect age of 8000 to 6000 from shoreline evidence. Calcite cement date indicates formation from different carbonate system and $\delta^{13}C$ measurements show isotopic fractionation occurred in recrystallization process.

Emuruangogolak volcano series, Kenya

Wood (? *Acacia*) from tree molds in lava of 2nd youngest basalt flow of Emuruangogolak volcano, Kenya (1° 27′ N, 36° 20′ E). Coll May 1973 and subm by S D Weaver, Dept Geol, Univ Birmingham.

Birm-456. S49 **270 ± 100**
AD 1680
$\delta^{13}C = -24.0‰$

Birm-457. L15 **230 ± 100**
AD 1720
$\delta^{13}C = -23.8‰$

General Comment (SDW): older lavas of Emuruangogolak (Chapman *et al*, 1974) intercalate with Suguta valley sediments which were probably deposited in a "greater Lake Rudolf".

II. ARCHAEOLOGIC SAMPLES

A. British Isles

Birm-377. Bidford-on-Avon, Warwickshire **1560 ± 110**
AD 390
$\delta^{13}C = -25.4‰$

Wood, unid, from pile with iron tip, in bed of R Avon at Roman ford, Bidford-on-Avon, Warwickshire (52° 09′ N, 1° 51′ W, Grid Ref SP 101508). Coll 1970 and subm by W J Ford, Co Mus, Warwick. *Comment* (WJF): later date than expected. Site some distance downstream from previously assumed river crossing and may represent alternative or replacement ford. Dates site within Theodosian re-organization of late 4th century AD.

Stretton-on-Fosse series, Warwickshire

Collagen of human bones from Romano-British and ? Saxon cemeteries at Stretton-on-Fosse, Warwickshire (52° 25′ N, 1° 41′ W, Grid Ref SP 221383). Coll between 1949 and 1971, and subm by WJF.

Birm-383. Cemetery 1, ST 1949

1700 ± 180
AD 250
$\delta^{13}C = -17.7‰$

Birm-384. Cemetery 3, F16, SF71

1800 ± 190
AD 150
$\delta^{13}C = -18.6‰$

Tibia.

Birm-385. Cemetery 3, F11, SF71

1570 ± 150
AD 380
$\delta^{13}C = -18.8‰$

Tibia. Comment: this date and Birm-384 represent 2 phases of same cemetery.

Birm-386. Cemetery 2, Grave 4, F88

1480 ± 170
AD 470
$\delta^{13}C = -19.6‰$

Tibia from ca 1m deep in believed Anglo-Saxon cemetery (Grid Ref SP 220383).

Birm-439. Cemetery 2, F61, ST68

1530 ± 100
AD 420
$\delta^{13}C = -20.2‰$

Tibia.

Birm-440. Cemetery 2, F101, ST68

1550 ± 110
AD 400
$\delta^{13}C = -20.0‰$

Tibia.

Birm-441. Cemetery 2, F1, ST68

1630 ± 110
AD 320
$\delta^{13}C = -19.8‰$

Rib bones from sand pit.

Birm-442. Cemetery 2, F6, ST68

1660 ± 130
AD 290
$\delta^{13}C = -18.7‰$

Femur.

General Comment (WJF): dates from Cemetery 2 too early for Anglo-Saxon period but further archaeologic study indicates assoc shield is of late Roman army type found on the continent (particularly in the Danube frontier area) and not of normal Anglo-Saxon type. Dates useful in suggesting sequence of use of burial ground over 3 centuries.

Skaill series, Orkney Islands, off NE Scotland

Hearth charcoal under sequence of humus 0.31m, Iron age cobbling 0.15m, and mixed earth and stones with Lower Bronze age pottery 0.20m, and overlying paving of Lower Bronze age at Skaill, Deerness, on the Orkney Is, off NE Scotland (58° 56′ 45″ N, 2° 42′ 50″ W, Grid Ref HY 588064). Coll July 1972 and subm by P S Gelling, Dept Ancient Hist and Archaeol, Univ Birmingham.

Birm-397. **2100 ± 100**
150 BC
$\delta^{13}C = -20.5‰$

Bulk sample given acid pretreatment only. CH_4 not as pure as normal due to ruthenium catalyst being poisoned.

Birm-413. **2120 ± 120**
170 BC
$\delta^{13}C = -26.2‰$

Small pieces of charcoal washed from bulk sample. Pretreatment included mild NaOH (1%).

General Comment: sample redated due to incomplete conversion to CH_4 in Birm-397 and differences in $\delta^{13}C$ values reflect differing degrees of isotopic fractionation. Dates confirm Iron age, and overlying earth and stones must be disturbed ground.

York series

Samples from archaeologic excavations of middle Saxon to early Norman ? succession undertaken by York Archaeologic Trust on site of Lloyds Bank extension, York (53° 58′ 00″ N, 1° 04′ 25″ W, Grid Ref SE 606523). Coll Jan 1973 by P C Buckland and J R A Greig; subm by P V Addyman, York Archaeol Trust.

Birm-401. LB IV/2b top **1030 ± 100**
AD 920
$\delta^{13}C = -26.0‰$

Small wooden stakes from beneath cellar floor of bank. Highest surviving wood material in 5m succession of floors and rough timber walls.

Birm-402. LB IV/F10 middle **990 ± 100**
AD 960
$\delta^{13}C = -24.6‰$

Leather from 1.5m below Birm-401. *Comment*: no NaOH pretreatment.

Birm-403. LB IV/24 bottom **1070 ± 100**
AD 880
$\delta^{13}C = -27.2‰$

Plant debris, mostly reeds, from 3m below Birm-401.

General Comment: dates fit chronology of Anglo-Danish cultures which precede Norman invasion of York.

Lonan series, Isle of Man

Charcoal (*Quercus*) from cooking sites at Clay Head Cairns, Lonan, I of Man (54° 12′ N, 4° 23′ W, Grid Ref SC 440807). Coll 1961 and subm by A M Cubbon, Manx Mus, I of Man.

Birm-416. Clay Head I, S1

2800 ± 120
850 BC
$\delta^{13}C = -24.2‰$

Sample from within stone-lined trough of cooking site.

Birm-476. Clay Head I, S4

3330 ± 120
1380 BC
$\delta^{13}C = -25.1‰$

Birm-429. Clay Head III, S3

3800 ± 150
1850 BC
$\delta^{13}C = -23.9‰$

Mixed sample from cairn of burned stones and ash forming cooking site.

Birm-475. Clay Head III

3480 ± 100
1530 BC
$\delta^{13}C = -24.7‰$

General Comment: "Clay Head III finds 3 and 4 might suggest a late Neolithic or early Bronze age date. The fragment of corroded bronze from the lower layer of burnt material at Clay Head I indicates that the primary period of that site cannot be older than the Bronze age" (Cubbon, 1963, p 589). Dates, though they differ by 1000 yr, are not incompatible with evidence from elsewhere.

Birm-419. Broxbourne gravel pit, Hertfordshire

8120 ± 160
6170 BC
$\delta^{13}C = -26.4‰$

Wood from below Mesolithic site at Broxbourne gravel pit, Hertfordshire (51° 45′ 25″ N, 0° 00′ 30″ E, Grid Ref TL 379082). Coll 1972 and subm by Raymond Bonnet, Dept Chem, Queen Mary College, London. *Comment*: sample, together with previous determinations from this site; Birm-342: 7830 ± 520 and Birm-343; 8700 ± 170 (R, 1973, v 15, p 465), predate Mesolithic industry. Dates involved in Bonnet's study of chemical changes in wood constituents with age.

Birm-420. Shepperton, Middlesex

1520 ± 120
AD 430
$\delta^{13}C = -27.4‰$

Wood from group of stakes pointed at top and bound with wicker work, crossing bed of old stream at gravel pit ca 6.8km SE of Staines, at Shepperton on the Thames, Middlesex (51° 23′ 30″ N, 0° 26′ 30″ W, Grid Ref TQ 097166). Coll Feb 1973 and subm by D G Bird, Surrey Archaeol Soc. *Comment*: predates gravel as stakes below several layers of clean water-laid gravel underlying 2 soil layers.

Birm-428. Moreton-in-Marsh, Gloucestershire

1110 ± 110
AD 840
$\delta^{13}C = -18.1‰$

Collagen from human *femur* from skeleton ca 23cm beneath floor of public bar at Bell Inn, Blockley, near Moreton-in-Marsh, Gloucestershire (52° 00′ 40″ N, 2° 45′ 35″ W, Grid Ref SP 164349). Coll Feb 1973 and subm by N M Marshall, Blockley Antiquarian Soc. *Comment*: date confirms Bell Inn built on part of Saxon burial ground previously undiscovered.

Quernmore Coffin Ship series, Lancaster

Wood (*Quercus*) from hull of coffin ship buried in peat bed 28cm thick and overlying gray clay with decayed gritstone at Quernmore, Lancaster (54° 00′ 36″ N, 2° 41′ 56″ W, Grid Ref SD 543574). Coll March 1973 and subm by Brian Barnes, Bolton Inst Technol.

Birm-430. Cl-B$_2$ — **1340 ± 110**
AD 610
$\delta^{13}C = -24.3‰$

Birm-474. Cl-A$_2$ — **1300 ± 100**
AD 650
$\delta^{13}C = -26.1‰$

General Comment: archaeologically, indicates Bronze age, but 2 determinations disprove this.

Beckford series, Worcestershire

Charcoal from very large earthwork that stratigraphically predates extensive habitation site of early Pre-Roman Iron age at Beckford, Worcestershire (52° 01′ 30″ N, 2° 01′ 30″ W, Grid Ref SO 983363). Coll March 1973 and subm by W J Britnell, Rescue Archaeol Group.

Birm-431. — **3360 ± 200**
1410 BC
$\delta^{13}C = -21.6‰$

Bulked sample from lower layers of large linear ditch (ca 6.0m wide and 2.5m deep). *Comment* (WJB): sherds from single vessel within same layer of fill are without precise parallel; formerly attributed to late Bronze age-early Iron age transition but date is middle Bronze age. Dates for similar type of ditch and pottery, Birm-202: 3130 ± 132; Birm-192: 3080 ± 115 (R, 1971, v 13, p 154). A *terminus ante quem* for ditch is Birm-432 (below) from succeeding Iron age settlement which partly cuts into upper layers of fill of this ditch.

Birm-432. — **2110 ± 120**
160 BC
$\delta^{13}C = -24.2‰$

Bulked sample from primary fill of L-shaped rubbish pit in ditched enclosure and containing pottery of "Duck-Stamped" type described by Peacock (1968). *Comment* (WJB): pit contemporary with enclosure which produced hoard of 10 "currency bars".

Skara Brae series, Orkney Islands, NE Scotland

Bone samples (*Bos*) from tenacious midden material composed of large numbers of animal bone, marine shells and stone, bone and pottery artifacts of Neolithic occupation site on S edge of Bay of Skaill at Skara Brae, Orkney Is, off NE Scotland (59° 02′ 50″ N, 3° 20′ 40″ W, Grid Ref HY 231187). Coll July 1972 and subm by D V Clarke, Natl Mus Antiquities, Edinburgh, Scotland.

Birm-433. Trench 1, Sec B, S 2A — **3830 ± 110** / **1880 BC** / $\delta^{13}C = -21.1‰$

Birm-434. Trench 1, Sec B, S 2B — **4020 ± 110** / **2070 BC** / $\delta^{13}C = -21.2‰$

Birm-435. Trench 1, Sec B, S 10A — **3870 ± 100** / **1920 BC** / $\delta^{13}C = -21.1‰$

Birm-436. Trench 1, Sec B, S 10B — **4040 ± 110** / **2090 BC** / $\delta^{13}C = -22.2‰$

Birm-437. Trench 2, Sec C, S 12A — **3780 ± 110** / **1830 BC** / $\delta^{13}C = -21.4‰$

Birm-438. Trench 2, Sec C, S 12B — **4140 ± 120** / **2190 BC** / $\delta^{13}C = -20.6‰$

General Comment (DVC): dates midden, constituting final observable Neolithic occupation of site; for detailed description see Childe, 1931. Dates disprove Watson's hypothesis "that it is more probable that the Skara Brae cattle are post-Roman than that they are of earlier date . . ." (Childe, 1931, p 202).

Birm-445. Coombe Hay, Somerset — **2650 ± 120** / **700 BC** / $\delta^{13}C = -23.9‰$

Charcoal from ca 1m deep at Bronze age site in Coombe Hay, ca 3.22km S of Bath, Somerset (51° 21′ N, 2° 23′ W, Grid Ref ST 739613). Coll April 1973 and subm by P A Rahtz, Hist School, Univ Birmingham. *Comment*: sample assoc with extensive range of younger Bronze age pottery and saddle-quern.

Birm-453. Blackstone Excavation, Worcestershire — **2180 ± 100** / **230 BC** / $\delta^{13}C = -24.4‰$

Wood charcoal (*Quercus*) id by C A Keepax, Dept Environment Lab, London from post-hole beneath topsoil in sand and gravel of river terrace at Blackstone Edge, 200m W of Brant Farm, Bewdley, Worcestershire (52° 21′ 30″ N, 2° 18′ 20″ W, Grid Ref SO 7904273533). Coll Aug

1973 by S Hillson; subm by A M Hunt, Co Mus, Hartlebury Castle, Worcestershire. *Comment*: occupation site dated as pre-Roman Iron age, not Romano-British.

B. Miscellaneous Archaeologic Samples

Isoya series, W Nigeria

Vegetable matter from levels of midden at Isoya in Ife Div W State of Nigeria (7° 22′ N, 4° 33′ E). Coll 1972 and subm by Omotoso Eluyemi, Centre W African Studies, Univ Birmingham.

Birm-373. Level 5 — **$\delta^{14}C = -9.2 \pm 8.2‰$** **Modern** *$\delta^{13}C = -24.7‰$*

Charcoal from 0.92m deep.

Birm-375. Level 7 — **$\delta^{14}C = +8.4 \pm 8.2‰$** **Modern** *$\delta^{13}C = -22.4‰$*

Carbonized banana from 1.62m deep.

Birm-372. Level 9 — **$\delta^{14}C = +4.4 \pm 17.1‰$** **Modern** *$\delta^{13}C = -22.2‰$*

Carbonized yam from 1.70m deep.

Birm-374. Level 10 — **570 ± 240** **AD 1380** *$\delta^{13}C = -21.4‰$*

Wood from 2.06m deep.

Birm-376. Level 12A — **$\delta^{14}C = +16.3 \pm 17.5‰$** **Modern** *$\delta^{13}C = -23.3‰$*

Wood from 2.18m deep.

General Comment: hoped that samples would date assoc archaeologic artifacts. Clearly modern except Birm-374. Evidence of recent animal disturbance observed at Level 7.

Birm-391. Lake Chad, Nigeria — **110 ± 80** **AD 1840** *$\delta^{13}C = -24.8‰$*

Wood (*Acacia nilotica*) from submerged stumps near W shore of Lake Chad almost adjacent to Niger/Nigeria border (ca 13° 00′ N, 14° 15′ E). Coll 1972 and subm by P R Reid, Ministry of Nat Resources, Maiduguri, W Africa. *Comment*: tree grew during last recession period when lake was at very low level, was submerged ever since only to reappear in ca last 7 yr. Diam of stump ca 8cm, outer ca 0.5cm sampled for dating.

Birm-392. Lebena, Crete

(a) $\delta^{14}C = +1.9 \pm 11.0‰$
Modern
$\delta^{13}C = -23.2‰$
(b) $\delta^{14}C = +18.5 \pm 12.0‰$
Modern
$\delta^{13}C = -25.9‰$

Wood charcoal from ca 0.75m deep near center of circular stone-built tomb (diam ca 3.20m) at Yerokampos, Lenda on SE coast of Crete (34° 56′ N, 24° 55′ E). Coll June 1969 by S Alexiou; subm by P M Warren, Dept Ancient Hist Archaeol, Univ Birmingham. *Comment*: imported XI-XIIth Dynasty Egyptian scarab contained in upper burial level (Daux, 1960, p 845). Sample was thought to be from an early Minoan II level but 2 preparations from separate parts of sample ([a] and [b]) prove it is clearly intrusive.

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[RADIOCARBON, VOL. 16, No. 3, 1974, P. 304-306]

INSTITUT FONDAMENTAL D'AFRIQUE NOIRE RADIOCARBON DATES I

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We follow the same method of radiocarbon dating used in the Gif-Sur-Yvette dating laboratory. Samples are inspected and foreign material removed. Wood and charcoal samples are treated with 0.1N ammonium hydroxide and 0.1N hydrochloric acid. Shells are treated with 10% hydrochloric acid to eliminate surface contamination. Bone samples are treated with 0.1N ammonium hydroxide to remove humic acids and 10% HCl to remove inorganic carbonate and retain collagen for radiocarbon measurements. Sample CO_2 is produced by combustion in oxygen. The stream of gases passes over CuO at 600°C to insure complete oxidation of C to CO_2 and through traps containing, respectively, silver nitrate and sulfuric chromic acid solution for purification; barium carbonate is precipited from barium hydroxide bubblers. After filtering and drying, CO_2 is liberated from barium carbonate by sulfuric acid. The CO_2 is used to fill a 1.2L steel proportional counter at 740mm Hg. Age calculations are based on a ^{14}C half-life of 5568 ± yr and 0.95 of activity of the NBS oxalic acid standard; ages are quoted in yr before 1950. Finite ages are quoted with 1σ criterion corresponding to the standard deviation based only on counting errors; the maximum age is quoted with 4σ criterion above background.

We sent our results for all samples listed here before receiving data about them. This list includes only cross-check samples from different laboratories; the table summarizes our results. Agreement of dates is generally good; John C Sheppard states that "the disagreements on WSU-1281 and -1302 can be attributed to the high barometric pressure dependence of the WSU system's background."

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Lab. no.	Locality	Sample	Age BP	Reference
L-607 B	Mensha	Wood	11,800 ± 100	Broecker, W S and Farrand, W R, The radiocarbon age of the Two Creek forest bed: Lamont Geol observatory, Columbia Univ (in press).
DaK-122	"	"	11,700 ± 170	
L-730	Little Valley	Wood	20,800 ± 400	Broecker, W S and Kaufman, Aaron, 1965, Radiocarbon chronology of Lake Lahontan and Lake Bonneville, pt 2, Great Basin: Geol Soc America Bull, v 76, p 537-566.
DaK-123	"	"	20,600 ± 500	
P-497, P-SW-SEq-2		Wood (tree rings)	60 to 28 BC 1990 ± 120	Ralph, E K and Michael, N H, 1970, MASCA radiocarbon dates for sequoia and bristlecone-pine samples, *in*: Olsson, I U (ed), Radiocarbon variations and absolute chronology, Stockholm, Almqvist & Wiksell.
DaK-124		"	39 BC	
P-495, P-SW-SEq- 2		Wood (tree rings)	148 BC to 109 BC 2070 ± 120	
DaK-125		"	120 BC	
P-1518	Franchthi cave	Charcoal	8938 ± 100	Lawn, Barbara, 1971, University of Pennsylvania radiocarbon dates XIV: Radiocarbon, v 13, p 366.
DaK-126	"	"	9000 ± 150	
O-1738 (EPR1)	Galveston Co, Texas	Marine shells	1975 ± 105	Unpub
DaK-127	"	"	2070 ± 110	
O-1432	"	"	2750 ± 115	
DaK-128	"	"	2650 ± 120	
O-1781 (EPR3)	St Martin Parish, Louisiana	Peat	3825 ± 120	Unpub
DaK-129			3460 ± 120	

Lab. no.	Locality	Sample	Age BP	Reference
I-4987		Wood	5710 ± 120	Unpub
DaK-130			5630 ± 125	
ISGS-73	P-7258	Wood	9270 ± 120	Coleman, D D, 1973, Illinois State Geological Survey radiocarbon dates V: Radiocarbon, v 15, p 75-85.
DaK-131	"	"	9410 ± 120	
ISGS-74	Miller Creek	Wood	2850 ± 80	
DaK-132	"	"	2960 ± 100	
ISGS-679	Mohomet SW	Wood	21,670 ± 130	" "
DaK-133			21,800 ± 400	
WSU-1303		Charcoal	1310 ± 140	
DaK-137			1110 ± 110	
WSU-1281		Collagen	12,850 ± 150	Unpub
DaK-138			11,500 ± 210	
WSU-1268		Charcoal	Modern	"
DaK-139			Modern	
WSU-1302		Charcoal	640 ± 140	"
DaK-140			1180 ± 120	
SI-662		Shells	1625 ± 125	
DaK-149			1580 ± 120	
SI-820	Cariri Brazil	Charcoal	305 ± 65	Stuckenrath, Robert and Mielke, J E, 1973, Smithsonian Institution radiocarbon measurements VIII: Radiocarbon, v 15, p 421.
DaK-150			670 ± 120	
SI-968	Islelo	Peat	3105 ± 55	*Ibid*, p 407.
DaK-151			3770 ± 130	
UW-96		Charcoal	8423 ± 78	
DaK			8350 ± 180	Unpub

[RADIOCARBON, VOL. 16, NO. 3, 1974, P. 307-330]

UNIVERSITY OF LUND RADIOCARBON DATES VII

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INTRODUCTION

Most of the ^{14}C measurements reported here were made between October 1972 and October 1973. Equipment, measurement, and treatment of samples are the same as reported previously (R, 1968, v 10, p 36-37; 1970, v 12, p 534).

Age calculations are based on a contemporary value equal to 0.950 of the activity of NBS oxalic acid standard and on the "conventional" half-life for ^{14}C of 5568 yr. Results are reported in years before 1950 (years BP), and in the AD/BC system. Errors quoted ($\pm 1\sigma$) include standard deviations of count rates for the unknown sample, contemporary standard, and background. Corrections for deviations from the "normal" $^{13}C/^{12}C$ ratio for terrestrial plants ($\delta^{13}C = -25.0‰$ in the PDB scale) are applied for all samples; also for marine shells, because apparent age of recent marine shells is not always just counterbalanced by the effect of isotopic fractionation (*cf*, Recent marine shells series, R, 1973, v 15, p 506-507). $\delta^{13}C$ values quoted are relative to the PDB standard.

The remark, "undersized; diluted", in *Comments* means the sample did not produce enough CO_2 to fill the counter to normal pressure and "dead" CO_2 from anthracite was introduced to make up the pressure. "% sample" indicates amount of CO_2 derived from the sample present in the diluted counting gas; the rest is "dead" CO_2. Organic carbon content reported for bone sample is calculated from yield of CO_2 by combustion of pretreated collagen. Organic carbon lost during treatment is not included in calculated percentage.

The description of each sample is based on information provided by the submitter.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Sweden

Malghult Pool series

Sediment (Livingstone core sampler, diam 60mm) from deepest part of Malghult Pool, Kristdala parish, S Sweden (57° 22′ N, 16° 15′ E). Coll 1970 and subm by M Aronsson, Dept Quaternary Geol, Univ Lund.

Dating is part of study on development of vegetation and cultural history in Kristdala area. Depths in sample titles refer to pool water level. Water depth 160cm at sampling point. Pollen analyses by submitter. Only weak pretreatment with HCl due to small samples.

1490 ± 50
Lu-508. Malghult Pool 8, 299 to 306cm **AD 460**
$\delta^{13}C = -30.6‰$

Detritus gyttja. Low *Picea* value (ca 0.5%).

1430 ± 50
Lu-509. Malghult Pool 7, 284 to 291cm **AD 520**
$\delta^{13}C = -28.4‰$

Detritus gyttja. Beginning of pronounced *Picea* increase.

1180 ± 50
Lu-510. Malghult Pool 6, 264 to 271cm **AD 770**
$\delta^{13}C = -29.1‰$

Detritus gyttja. Continued *Picea* increase.

920 ± 55
Lu-511. Malghult Pool 5, 244 to 251cm **AD 1030**
$\delta^{13}C = -28.9‰$

Detritus gyttja. Just below *Picea* maximum (ca 12%) combined with increase of cereal and weed pollen. *Comment*: undersized; diluted; 91% sample.

730 ± 55
Lu-512. Malghult Pool 4, 224 to 231cm **AD 1220**
$\delta^{13}C = -29.2‰$

Detritus gyttja. *Comment*: undersized; diluted; 88% sample.

720 ± 50
Lu-513. Malghult Pool 3, 223 to 230cm **AD 1230**
$\delta^{13}C = -29.4‰$

Detritus gyttja. *Comment*: samples 3 and 4 are from adjacent cores.

1290 ± 80
Lu-514. Malghult Pool 2, 198 to 209cm **AD 660**
$\delta^{13}C = -28.9‰$

Detritus gyttja with lumps of another soil type containing littoral brown-mosses. *Comment* (MA): deviating age may be explained by presence of littoral plants, indicating temporary outflow of older littoral material and redeposition at sampling point. Undersized; diluted; 46% sample.

610 ± 65
Lu-515. Malghult Pool 1, 184 to 191cm **AD 1340**
$\delta^{13}C = -30.6‰$

Detritus gyttja. *Comment*: undersized; diluted; 56% sample.

Gothenburg Botanical Garden series

Sediment from 2 cores from Gothenburg Botanical Garden (57° 41′ 06″ N, 11° 57′ 18″ E) were dated in conjunction with establishing a Pleistocene/Holocene boundary stratotype (Mörner, 1973). The Late glacial regression brought sea level down to ca +15.5m, the Regression Max or ALV-1 shoreline of Mörner (1969), followed by Postglacial transgressions bringing sea level up to +25.5m. Dates from Cores B 873 and B 870 relate to the ALV-1 stage and beginning of subsequent transgression. Numerous different analyses have been applied to Core B 873 (Mörner, 1973). Pretreated with HCl.

Core B 873

Foil piston core (diam 68mm) taken down to bedrock at 14.5m depth. Surface at +17.4m. Core was proposed as Pleistocene/Holocene boundary stratotype (Mörner, 1973). Coll 1970 and subm by N-A Mörner, Dept Geol, Univ Stockholm.

9030 ± 100
Lu-552. Core B 873, 188.5 to 191.5cm **7080 BC**
$\delta^{13}C = -17.6‰$

Gyttja. Early part of PTM-2 transgression. *Comment*: undersized; diluted; 86% sample.

9240 ± 115
Lu-553. Core B 873, 205 to 207cm **7290 BC**
$\delta^{13}C = -19.1‰$

Clayey gyttja. Early part of PTM-2 transgression. *Comment*: undersized; diluted; 72% sample.

9050 ± 100
Lu-554. Core B 873, 229 to 231cm **7100 BC**
$\delta^{13}C = -18.5‰$

Gyttja. Earliest part of PTM-2 transgression. *Comment*: undersized; diluted; 90% sample.

9740 ± 110
Lu-555. Core B 873, 251 to 255cm **7790 BC**
$\delta^{13}C = -22.6‰$

Clay with gyttja. Beginning of ALV-1 stage. Pollen Zone Boundary IV/V. *Comment*: undersized; diluted; 61% sample.

Core B 870

Surface at +17.8m, 40m from Core B 873. Samples from 15x15cm monolith cut from wall in dug out sec. Coll 1970 and subm by N-A Mörner.

8860 ± 70
Lu-588. Core B 870, I, 176 to 177cm **6910 BC**
$\delta^{13}C = -18.7‰$

Gyttja. Early part of PTM-2 transgression. *Comment*: undersized; diluted; 76% sample. (4 1-day counts.)

Lu-589. Core B 870, III, 183.5 to 187.5cm **9190 ± 100**
7240 BC
$\delta^{13}C = -22.4‰$

Gyttja. End of ALV-1 stage. *Comment*: undersized; diluted: 87% sample.

Näckrosdammen series

Limnic sediment from ancient lake Näckrosdammen, Änggården, Göteborg (57° 40′ N, 11° 57′ E). Pollen-analytic investigation is part of study of Pleistocene/Holocene boundary (Berglund, 1973). Coll 1972 and subm by B E Berglund, Dept Quaternary Geol, Univ Lund. Depths given are below surface. Pretreated with HCl. All samples undersized; diluted.

Lu-738. Näckrosdammen 1 **10,120 ± 100**
8170 BC
$\delta^{13}C = -22.4‰$

Fine detritus gyttja, 259 to 262cm. Pollen-analytically dated to transition zone Younger Dryas—Pre-Boreal. *Comment*: 77% sample. (3 1-day counts.)

Lu-740. Näckrosdammen 3 **10,250 ± 120**
8300 BC
$\delta^{13}C = -20.6‰$

Muddy clay, 267 to 272cm. Pollen-analytically dated to the very end of Younger Dryas. *Comment*: 62% sample. (3 1-day counts.)

Lu-741. Näckrosdammen 4 **11,510 ± 105**
9560 BC
$\delta^{13}C = -23.9‰$

Clay gyttja, 310 to 315cm. Pollen-analytically dated to end of Alleröd. *Comment*: 86% sample. (3 1-day counts.)

General Comment (BEB): dates of Samples 1 and 3 agree quite well with earlier dating of Pollen Zone Boundary Younger Dryas/Pre-Boreal. Sample 4 seems to be slightly older than expected.

Southern Baltic, pine stump series

Wood from pine stumps dredged by fishermen from bottom of S Baltic Sea at water depth 48 and 57m. Coll by H Berntsson; subm by B E Berglund. Pretreated with HCl and NaOH.

Lu-702. Southern Baltic 2 **9480 ± 95**
7530 BC
$\delta^{13}C = -25.6‰$

Wood from pine stump coll 1972 ENE of Stenshuvud (55° 42′ N, 14° 34′ E) at 48m depth.

Lu-807. Southern Baltic 3 **9750 ± 95**
7800 BC
$\delta^{13}C = -25.3‰$

Wood from pine stump coll 1973 SE of Hanö (55° 49′ N, 15° 14′ E) at 57m depth.

General Comment (BEB): similar ages were obtained earlier for submerged pine stumps from bottom of Baltic (*cf* R, 1972, v 14, p 386).

Kullaberg series

Polar bear femur from depression E of Kullagård, Kullaberg, NW Scania (56° 18′ N, 12° 29′ E). Coll 1852 (Lindström, 1880, p. 4-5; Holst, 1902, p 11-12) and subm by B E Berglund. Bone from marl layer (Swedish *märgel*) underlain by gyttja. Bone dense and very well preserved. All samples undersized; diluted.

Lu-660. Kullaberg, inner part **12,710 ± 125**
10,760 BC
$\delta^{13}C = -14.1‰$

Collagen from middle part of bone wall. *Comment*: organic carbon content: 4.5%; 80% sample. (3 1-day counts.)

Lu-661. Kullaberg, outer part **12,740 ± 170**
10,790 BC
$\delta^{13}C = -14.4‰$

Collagen from spongy and superficial material inside bone cavity. *Comment*: organic carbon content: 6.3%; 56% sample. (3 1-day counts.)

Lu-602. Kullaberg, intermediate part **12,580 ± 100**
10,630 BC
$\delta^{13}C = -13.1‰$

Collagen from bone material taken between inner and outer part. *Comment*: organic carbon content: 5.4%; 86% sample. (2 2-day counts.) *General Comment*: agreement between dates indicates contamination is absent or insignificant. No corrections made for apparent age of bones of living polar bears (see Recent polar bears series, below).

Recent polar bears series

Radiocarbon activity of bone collagen from 2 recent pre-bomb polar bears was measured to find their apparent ages.

Lu-715. Kapp Wijk **Apparent age: 480 ± 70**
$\delta^{13}C = -14.6‰$

Collagen from cranium of young polar bear coll 1959 at Kapp Wijk, Dickson Fiord, Spitsbergen (78° 30′ N, 15° 00′ E) by Natascha Heintz, Paleontol Mus, Oslo, Norway; subm by S Håkansson. Time elapsed since death of bear estimated from state of preservation of cranium at 50 ± 50 yr (BP). Activity measurement corrected for this time interval.

Lu-779. Kap Stephensen **Apparent age: 495 ± 45**
$\delta^{13}C = -16.2‰$

Collagen from humerus of ca 2-yr-old polar bear shot in 1932 outside Kap Stephensen, East Greenland (ca 68° 25′ N, 28° 31′ W) by U Møhl; subm by I Sørensen, Zool Mus, Univ Copenhagen, Denmark. Activity measurement age-corrected for time between 1932 and 1950.

Växjösjön series

Sediment from Lake Växjösjön at the town of Växjö, Central Småland (56° 52′ N, 14° 49′ E). Coll 1972-73 and subm by G Digerfeldt, Dept Quaternary Geol, Univ Lund. Dates were part of study of development of lake and surrounding landscape during latest ca 1500 yr. Dates to determine rate of sediment deposition. Depths refer to sediment surface. All samples consist of detritus gyttja.

760 ± 50
Lu-734. Växjösjön, 15 to 20cm **AD 1190**
$\delta^{13}C = -26.0‰$

Comment: pretreated with HCl.

1120 ± 55
Lu-735. Växjösjön, 40 to 45cm **AD 830**
$\delta^{13}C = -26.0‰$

Comment: mild pretreatment with HCl and NaOH. Undersized; diluted; 91% sample.

920 ± 50
Lu-736. Växjösjön, 65 to 70cm **AD 1030**
$\delta^{13}C = -26.3‰$

Comment: same pretreatment as Lu-735.

790 ± 55
Lu-674. Växjösjön, 85 to 90cm **AD 1160**
$\delta^{13}C = -26.2‰$

Comment: pretreated with HCl. 77% sample.

630 ± 55
Lu-737. Växjösjön, 90 to 95cm **AD 1320**
$\delta^{13}C = -27.1‰$

Comment: mild pretreatment with HCl and NaOH. 89% sample.

640 ± 55
Lu-675. Växjösjön, 105 to 110cm **AD 1310**
$\delta^{13}C = -26.7‰$

Comment: pretreated with HCl. 77% sample.

500 ± 55
Lu-676. Växjösjön, 125 to 130cm **AD 1450**
$\delta^{13}C = -26.8‰$

Comment: pretreated with HCl. 67% sample.

Lu-677. Växjösjön, 145 to 150cm **450 ± 55**
AD 1500
$\delta^{13}C = -26.5‰$

Comment: pretreated with HCl. 75% sample.

Lu-678. Växjösjön, 165 to 170cm **480 ± 55**
AD 1470
$\delta^{13}C = -26.7‰$

Comment: pretreated with HCl. 72% sample.

Lu-679. Växjösjön, 185 to 190cm **440 ± 55**
AD 1510
$\delta^{13}C = -26.7‰$

Just above strong increase of *Juniperus*. *Comment*: pretreated with HCl. 80% sample.

Lu-680. Växjösjön, 205 to 210cm **610 ± 55**
AD 1340
$\delta^{13}C = -27.6‰$

Comment: pretreated with HCl. 91% sample.

Lu-681. Växjösjön, 225 to 230cm **770 ± 50**
AD 1180
$\delta^{13}C = -28.2‰$

Comment: pretreated with HCl.

Lu-682. Växjösjön, 245 to 250cm **970 ± 50**
AD 980
$\delta^{13}C = -28.0‰$

Comment: pretreated with HCl.

Lu-683. Växjösjön, 265 to 270cm **980 ± 55**
AD 970
$\delta^{13}C = -28.5‰$

Comment: pretreated with HCl. 93% sample.

Lu-856. Växjösjön, 285 to 290cm **1220 ± 60**
AD 730
$\delta^{13}C = -28.3‰$

Comment: mild pretreatment with HCl and NaOH. 75% sample.

Lu-857. Växjösjön, 305 to 310cm **1340 ± 60**
AD 610
$\delta^{13}C = -28.0‰$

Slight increase of *Juniperus*. *Comment*: same pretreatment as Lu-856. 82% sample.

Lu-858. Växjösjön, 325 to 330cm **1400 ± 60**
AD 550
$\delta^{13}C = -28.3‰$

Just above rational *Picea* limit. *Comment*: same pretreatment as Lu-856. 77% sample.

Lu-859. Växjösjön, 345 to 350cm **1370 ± 75**
AD 580
$\delta^{13}C = -28.6‰$

Comment: same pretreatment as Lu-856. 50% sample.

General Comment (GD): upper samples (from ca 1.5m and upwards) are disturbed and corresponding dates are erroneous due to redeposition of older sediment related to sediment dredging in lake during end of 19th century and beginning of this century.

Solingsmyran series

Marine sediment from beneath peat bog Solingsmyran, Västmanland, Central Sweden (59° 50′ N, 16° 30′ E). Coll 1971 and subm by S Welinder, Dept Quaternary Geol, Univ Lund. Depths given are below surface. Pretreated with HCl.

Lu-718. Solingsmyran 1, 2.44 to 2.49m **6270 ± 70**
4320 BC
$\delta^{13}C = -18.5‰$

Clayey mud.

Lu-719. Solingsmyran 2, 2.93 to 2.98m **6450 ± 75**
4500 BC
$\delta^{13}C = -15.9‰$

Clayey mud.

Rövallsmossen series

Peat from the emerged bog Rövallsmossen, Västmanland, Central Sweden (59° 45′ N, 16° 17′ E). Coll 1971 and subm by S Welinder. Depths are below surface. Pretreated with HCl and NaOH.

Lu-720. Rövallsmossen 1, 0.45 to 0.50m **200 ± 50**
AD 1750
$\delta^{13}C = -22.0‰$

Sphagnum peat.

Lu-721. Rövallsmossen 2, 0.50 to 0.55m **780 ± 50**
AD 1170
$\delta^{13}C = -24.5‰$

Sphagnum peat.

Hasslöv series

Samples from ca 15cm peat underlain by gravel and overlain by sand at Hasslöv, S Halland (56° 25′ N, 13° 00′ E). Coll 1972 and subm by H Svensson, Swedish Nat Sci Res Council, Stockholm.

Lu-805. Hasslöv C, peat **9550 ± 95**
7600 BC
$\delta^{13}C = -27.0‰$

Upper part (ca 1cm) of peat. Depth 60cm below surface. *Comment*: pretreated with HCl and NaOH.

Lu-805A. Hasslöv C, humic acid **8600 ± 90**
6650 BC
$\delta^{13}C = -27.0‰$

Acid-precipitated part of NaOH-soluble fraction from Lu-805.

Lu-805:2. Hasslöv C, new preparation **10,010 ± 100**
8060 BC
$\delta^{13}C = -24.9‰$

Remaining material from preparation for Lu-805 was given stronger pretreatment with NaOH for removal of more humic acid.

Lu-806. Hasslöv D, peat **2850 ± 55**
900 BC
$\delta^{13}C = -27.0‰$

Bottom part (ca 1cm) of peat. Depth 75cm below surface. *Comment*: pretreated with HCl and NaOH.

Lu-806A. Hasslöv D, humic acid **2400 ± 55**
450 BC
$\delta^{13}C = -26.5‰$

Acid-precipitated part of a NaOH-soluble fraction from Lu-806.

Lu-788. Lake Striern, *Pinus* stump **3680 ± 60**
1730 BC
$\delta^{13}C = -24.8‰$

Wood from stump (*Pinus silvestris* L), coll 1972 on land near W shore of Lake Striern, Östergötland (58° 05′ N, 15° 47′ E) and subm by H Göransson, Dept Quaternary Geol, Univ Lund. For other dates from Lake Striern, see R, 1970, v 12, p 541-543. Pretreated with HCl and NaOH. *Comment* (HG): stump was preserved by a lacustrine transgression, indicating climatic change. Shore with stumps became land by lowering of lake water level ca 100 yr ago. Date as expected.

Lake Vån series

Sediment from Lake Vån, 6.3km SE of Brokind RR Sta, Östergötland (58° 11′ N, 15° 47′ E). Alt of lake: +92.4m; size: ca 400x400m. Coll 1969 and subm by H Göransson. Samples taken with 36mm Livingstone core sampler, except Lu-814, which was aggregated from repeated samplings with Hiller sampler. All samples consist of fine detritus gyttja, somewhat clayey in lowest sample. Depths are below sediment-water interface. Water depth at sampling point, 3.8m. Dated as complement to Lake Striern series (R, 1970, v 12, p 541-543). No pretreatment of Lu-822 and -823; all other samples pretreated with HCl.

Lu-814. Vån, 420 to 430cm **9390 ± 95**
7440 BC
$\delta^{13}C = -30.0‰$

Samples 85+86. Rational *Alnus* limit.

Lu-815. Vån, 370 to 380cm **7800 ± 80**
5850 BC
$\delta^{13}C = -30.9‰$

Samples 75+76. Empiric *Tilia* limit.

Lu-816. Vån, 350 to 360cm **7170 ± 80**
5220 BC
$\delta^{13}C = -29.4‰$

Samples 71+ 72. Rational *Tilia* limit.

Lu-817. Vån, 265 to 275cm **5960 ± 70**
4010 BC
$\delta^{13}C = -29.4‰$

Samples 54+55. Classical *Ulmus* decline; rise of *Alnus*; 1st find of *Triticum*.

Lu-818. Vån, 235 to 245cm **5640 ± 70**
3690 BC
$\delta^{13}C = -28.9‰$

Samples 48+49. Rise of *Ulmus* after decline; start of continuous *Juniperus* curve.

Lu-819. Vån, 165 to 175cm **4800 ± 65**
2850 BC
$\delta^{13}C = -28.2‰$

Samples 34+35. Slightly decreasing *Tilia* in Pollen Zone SB 1.

Lu-820. Vån, 140 to 150cm **4460 ± 60**
2510 BC
$\delta^{13}C = -30.8‰$

Samples 29+30. Significant decline of *Ulmus* in SB 1.

Lu-821. Vån, 60 to 70cm **3020 ± 60**
1070 BC
$\delta^{13}C = -28.8‰$

Samples 13+14. Below empiric *Picea* limit; fairly high values of *Plantago lanceolata* and *Rumex acetocella coll*; below *Secale* limit. *Comment*: undersized; diluted; 89% sample.

Lu-822. Vån, 30 to 40cm **1410 ± 60**
AD 540
$\delta^{13}C = -29.9‰$

Samples 7+8. Final decline of *Quercetum Mixtum* components. *Comment*: undersized; diluted; 75% sample.

Lu-823. Vån, 10 to 20cm **710 ± 60**
AD 1240
$\delta^{13}C = -30.5‰$

Samples 3+4. Temporary decline of *Picea* indicating clearing; strong rise of *Juniperus, Rumex acetocella coll,* and *Cerealea*. *Comment*: undersized; diluted; 67% sample.

General Comment (HG): as Lake Vån is very small, it possibly dried out during part of Boreal time and perhaps also during other short periods. Sedimentation rate is very low between 430 and 350cm, and between 70cm and surface layer, indicating possible hiata. Some characteristic levels (eg, rational *Alnus* limit; empiric *Tilia* limit) are distinctly older than in nearby lake Striern. Classical *Ulmus* decline seems older here than in other parts of Scandinavia.

Lu-824. Hindbyhornet **11,330 ± 110**
9380 BC
$\delta^{13}C = -20.3‰$

Collagen from antler (*Megaceros giganteus*) from Late glacial sediment in small ancient lake at Hindby, Malmö (55° 35′ N, 13° 02′ E). Coll 1972 by B Salomonsson; subm by R Liljegren, Dept Quaternary Geol, Univ Lund. Pollen investigation by submitter. *Comment* (RL): pollen study not yet completed, but preliminary results do not contradict date. Organic carbon content: 5.1%.

B. Norway

Lu-716. Domsängen, inner fraction **11,260 ± 110**
9310 BC
$\delta^{13}C = -1.0‰$

Shells (*Macoma calcarea*) from sediment overlain by glaciofluvial material at Domsängen, ca 5km NW of Tönsberg, SE Norway (59° 18′ N, 10° 21′ E). Coll 1972 by S Håkansson. Date is important for chronology of Ra end moraine. Other dates connected with this moraine are summarized by Mangerud (1970, p 135). Many shell pairs were articulated when coll. *Comment*: inner fraction (46% of shells) was used.

Lu-717. Domsängen, outer fraction **11,350 ± 110**
9400 BC
$\delta^{13}C = -1.3‰$

Outer fraction of shells used for Lu-716. *Comment*: outer fraction was 43% of shells; outermost 11% removed by acid leaching.

General Comment: corrections for deviations from "normal" $^{13}C/^{12}C$ ratio for terrestrial plants ($\delta^{13}C = -25.0‰$ in PDB scale) are applied also for shell samples. No corrections are made for apparent age of shells of living marine mollusks. Apparent age in area is studied by Mangerud (1972).

Varanger Peninsula series

Peat from different parts of old moraine line on Varanger Peninsula, N Norway. Studies in area by Svensson (1971a) and Svensson *et al* (1972). Coll 1972 by B Malmström and O Palmér, Dept Phys Geog, Univ Lund; subm by H Svensson.

Lu-782. Torvvand, peat **5540 ± 70**
3590 BC
$\delta^{13}C = -27.8‰$

Sample I(1:1) from base of peat, overlying glacial clay at Torvvand

(70° 28′ 20″ N, 18° 19′ 15″ E). *Comment*: pretreated with HCl and NaOH.

Lu-782A. Torvvand, humic acid **5590 ± 70**
3640 BC
$\delta^{13}C = -27.8‰$

Acid-precipitated part of NaOH-soluble fraction from Lu-782.

Lu-709. Holmfjeldet, 3A+3B **7230 ± 195**
5280 BC
$\delta^{13}C = -25.6‰$

Samples 3A+3B from base of peat, overlying glacial clay at Holmfjeldet (70° 15′ N, 19° 40′ E). *Comment*: no pretreatment; small sample; diluted; 31% sample.

Lu-783. Holmfjeldet, II(1:2) **8050 ± 85**
6100 BC
$\delta^{13}C = -26.6‰$

Sample II(1:2) from base of peat, overlying glacial clay at Holmfjeldet (70° 13′ 20″ N, 19° 37′ 50″ E). *Comment*: mild pretreatment with HCl and NaOH.

Lu-784. Holmfjeldet, II(2:2) **6800 ± 75**
4850 BC
$\delta^{13}C = -26.3‰$

Sample II(2:2) from upper part of base peat, underlying sand. *Comment*: mild pretreatment with HCl and NaOH.

Lu-785. Holmfjeldet, III(1:1) **7190 ± 80**
5240 BC
$\delta^{13}C = -24.5‰$

Sample III(1:1) from base of peat, overlying till at Holmfjeldet (70° 13′ 40″ N, 19° 33′ 38″ E). *Comment*: mild pretreatment with HCl and NaOH.

Lu-786. Kobberhovedet, IV(1:1) **5870 ± 70**
3920 BC
$\delta^{13}C = -27.5‰$

Sample IV(1:1) from base of peat, overlying glacial clay. *Comment*: mild pretreatment with HCl and NaOH.

C. Spitsbergen

Lu-743. Advent Fiord **240 ± 50**
AD 1710
$\delta^{13}C = -23.8‰$

Wood from tree from top surface of "Lagoon-pingo", in Moskus lagoon, inner part of Advent Fiord, Westspitsbergen (78° 14′ N, 15° 45′ E). Coll 1972 by R Åhman; subm by H Svensson. Report of study in Advent Fiord area by submitter (Svensson, 1971b). For other date from same area, see R, 1970, v 12, p 546. Pretreated with HCl and NaOH.

D. Greenland

East Greenland series (III)

Marine shells from emerged marine sediments in Kong Oscars Fjord - Vega Sund dist, Central East Greenland. Coll 1970 to 1972 and subm by C Hjort, Dept Quaternary Geol, Univ Lund; part of 3-yr study of ice oscillations and shoreline displacement. For other dates from area, see R, 1972, v 14, p 388-390; 1973, v 15, p 504-507. For apparent age of recent shells in area, see R, 1973, v 15, p 506-507 and Hjort (1973).

9820 ± 95
Lu-710. Kap Biot **7870 BC**
$\delta^{13}C = +0.7‰$

Shells (*Mya truncata, Hiatella arctica*) from silt covering end moraine at Kong Oscars Fjord, side mouth of Edderfugledal (72° 56′ N, 22° 40′ W). Coll at +40m.

8920 ± 85
Lu-711. Lyells Land E **6970 BC**
$\delta^{13}C = +0.1‰$

Shells (*Mya truncata*) from silt at +72 to +85m on E Lyells Land (72° 36′ N, 24° 44′ W). Highest shell-bearing locality in this part of dist.

9980 ± 95
Lu-712. Gudenelv **8030 BC**
$\delta^{13}C = -0.2‰$

Shells (*Hiatella arctica*) from delta sediment at ca +90m (alt from map; only approx) at middle reaches of Gudenelv (72° 30′ N, 23° 05′ W), interior of Traill Ö. Highest shell-bearing deposit in this part of Traill Ö.

7310 ± 85
Lu-713. Rhedins Fjord **5360 BC**
$\delta^{13}C = +0.7‰$

Shells (*Mya truncata, Hiatella arctica, Macoma calcarea*) from silt on inner side of end moraine in fjord valley. Coll at +20 to +26m, and probably closely postdates ice retreat (72° 36′ N, 26° 23′ W).

9070 ± 90
Lu-714. Månedal, Sample 1 **7120 BC**
$\delta^{13}C = +0.7‰$

Shells (*Mya truncata*) from delta sediment at mouth of Månedal, N Traill Ö (72° 42′ N, 22° 58′ W). Coll at +20 to +25m, but delta surface at +50m.

9880 ± 95
Lu-764. Henrik Möller Dal **7930 BC**
$\delta^{13}C = +0.2‰$

Shells (*Mya truncata, Hiatella arctica*) from clay, covered by delta sediments, Henrik Möller Dal, Fleming Fjord (71° 53′ N, 22° 55′ W).

Coll at +35m but probably assoc with strandline +60m, and closely dates ice retreat from outer Fleming Fjord.

Lu-765. Murgangsdalen **7320 ± 75**
5370 BC
$\delta^{13}C = -0.3‰$

Shells (*Mya truncata, Hiatella arctica, Macoma calcarea, Clinocardium ciliatum,* and *Mytilus edulis*) from stony glaciomarine silt at +10m in outer part of Murgangsdalen, Kempe Fjord, Suess Land side (72° 55′ N, 25° 45′ W). Probably a close date for deglaciation of outer part of valley.

Lu-766. Kap Palander **8420 ± 80**
6470 BC
$\delta^{13}C = +1.5‰$

Shells (*Hiatella arctica, Mya truncata, Nicania* [*Astarte*] *montagui*) from silt at +10m W of Kap Palander, N Traill Ö (72° 38′ N, 22° 41′ W).

Lu-767. Kap Hedlund **7860 ± 80**
5910 BC
$\delta^{13}C = +0.6‰$

Shells (*Mya truncata, Hiatella arctica*) from stony glaciomarine silty clay at +40m, Kap Hedlund, Kempe Fjord (72° 44′ N, 26° 10′ W). Highest shell-bearing sediment at locality, and probably deposited soon after ice retreat. *Cf* Noe-Nygaard (1932).

Lu-768. Östernaesdeltat, Sample 1 **9030 ± 85**
7080 BC
$\delta^{13}C = +1.5‰$

Shells (*Mya truncata, Hiatella arctica, Tridonta* [*Astarte*] *borealis, Nicania* [*Astarte*] *montagui, Bathyarca* [*Arca*] *glacialis*) from clay, overlain and underlain by sand and silt. Coll at +22m but deposited when sea level was higher than +30m. Probably closely dates retreat of ice from terminal zone a few km inland. Delta W of Östernaes on N Traill Ö (72° 49′ N, 23° 17′ W).

Lu-789. Antarctic Dal **9510 ± 100**
7560 BC
$\delta^{13}C = -0.2‰$

Shells (*Mya truncata*) from delta built up to ca +50m. Coll at +40m at mouth of Majdal in Arctic Dal (Kolledal), Scoresby Land (72° 00′ N, 23° 20′ W). *Comment*: undersized; diluted; 85% sample.

Lu-790. Kap Petersens **9130 ± 90**
7180 BC
$\delta^{13}C = -0.5‰$

Shells (*Mya truncata, Hiatella arctica, Macoma calcarea*) from sandy sediment underlain by clay and overlain by gravelly subaerial sediment. Coll at +50 to +55m; dates sea level around or somewhat above +60m. Highest shell-bearing sediment at Kap Petersens, Kong Oscars Fjord (72° 25′ N, 24° 35′ W).

Lu-791. Polhems Dal N, Sample 1

7970 ± 80
6020 BC
$\delta^{13}C = -0.8‰$

Shells (*Mya truncata, Hiatella arctica, Macoma calcarea*) from sandy, silty bed underlain by varved clay (*cf* Lu-825, below) and clay; overlain by gravelly/sandy sediment. Coll at +32m but deposited when sea level was ca +70m. N mouth of Polhemsdal, Lyells Land (72° 44′ N, 25° 05′ W).

Lu-792. Skipperdal

8550 ± 85
6600 BC
$\delta^{13}C = -1.1‰$

Shells (*Mya truncata, Hiatella arctica, Macoma calcarea*) from clay underlying delta built up to +60m at mouth of Skipperdal, Segelsällskapets Fjord (72° 24′ N, 24° 55′ W). Clay lies directly on striated and glacially sculptured rocks, and sample probably approximates deglaciation of this fjord. Coll at +38m.

Lu-793. Kap Laura

8830 ± 85
6880 BC
$\delta^{13}C = +0.3‰$

Shells (*Mya truncata*) from delta built up to +40m. Coll at +20m. Kap Laura (name on Norwegian map 1:50.000), S Geog Soc Ö (72° 53′ N, 23° 25′ W). *Cf* Lu-646, R, 1973, v 15, p 505.

Lu-825. Polhems Dal N, Sample 2

8270 ± 80
6320 BC
$\delta^{13}C = +0.3‰$

Shells (*Mya truncata, Hiatella arctica, Macoma calcarea*) from varved clay at bottom of sequence described under Lu-791 above. Coll at +24m. N mouth of Polhemsdal, Lyells Land (72° 44′ N, 25° 05′ W).

Lu-826. Holms Bugt, Sample 1

8910 ± 85
6960 BC
$\delta^{13}C = -0.2‰$

Shells (*Mya truncata, Hiatella arctica, Macoma calcarea*), from delta built up to +50m. Coll at +45m. Holms Bugt, S Traill Ö (72° 31′ N, 23° 58′ W).

Lu-827. Holms Bugt, Sample 2

7190 ± 75
5240 BC
$\delta^{13}C = -0.2‰$

Shells (*Mya truncata, Hiatella arctica, Macoma calcarea, Nicania* [*Astarte*] *montagui*) from delta sediment at +15m. Probably dates shoreline at +20m. Holms Bugt (72° 31′ N, 23° 58′ W).

Lu-828. Holms Bugt, Sample 3

5570 ± 65
3620 BC
$\delta^{13}C = -0.5‰$

Shells (*Mya truncata, Macoma calcarea, Serripes groenlandica, Clinocardium ciliatum*) from sandy, silty sediment at +8m. Probably dates shoreline at +9m. Holms Bugt (72° 31′ N, 23° 58′ W). For other dates from Holms Bugt, see also Lu-489, -490, -529 (R, 1972, v 14, p 388-389).

Lu-829. Månedal, Sample 2 **8250 ± 80**
6300 BC
$\delta^{13}C = +0.1‰$

Shells (*Mya truncata, Hiatella arctica, Tridonta* [*Astarte*] *borealis*) from delta sediment at +12m. Dates sea level at ca +18m. *Mytilus edulis* and *Chlamys* [*Pecten*] *islandicus* occur in sediment but not in dated part of sample. Mouth of Månedal, N Traill Ö (72° 42′ N, 22° 58′ W). *Cf* Lu-714 above.

Lu-830. Östernaesdeltat, Sample 2 **8270 ± 80**
6320 BC
$\delta^{13}C = -0.3‰$

Shells (*Mya truncata, Hiatella arctica, Macoma calcarea, Nicania* [*Astarte*] *montagui, Mytilus edulis*) from sandy, silty sediment at +30m. Delta W of Östernaes on N Traill Ö (72° 49′ N, 23° 17′ W).

Lu-831. Mestersvig **4130 ± 60**
2180 BC
$\delta^{13}C = -0.3‰$

Shells (*Mya truncata, Hiatella arctica, Macoma calcarea, Clinocardium ciliatum*) from delta foreset beds at +4m. Predates sea level at +6m. Mouth of Tunnelelv in Noret, Mestersvig (72° 13′ N, 23° 53′ W). *Cf* Washburn and Stuiver (1962).

General Comment: corrections for deviations from "normal" $^{13}C/^{12}C$ ratio for terrestrial plants ($\delta^{13}C = -25.0‰$ in PDB scale) are applied also for shell samples. No corrections are made for apparent age of shells of living marine mollusks.

E. Ireland

Blanket bog pine stump series

Wood from stumps and root parts (*Pinus silvestris* L) from blanket bog areas in different parts of Ireland. Coll 1972 and subm by N Malmer, Dept Plant Ecol, Univ Lund. Studied for earliest possible beginning of blanket bog peat formation in those areas. Pretreated with HCl and NaOH.

Lu-772. Killarney **4600 ± 65**
2650 BC
$\delta^{13}C = -24.8‰$

Wood from pine stump layer in contact zone between peat and underlying mineral soil, on N slope of Carrantoohill, 1km S of small village Carrantoohill, 14km WSW of Killarney, Co Kerry (52° 01′ N, 9° 43′ W). Alt 250m. Peat ca 1m deep; highly humified.

Lu-773. Wicklow

4200 ± 60
2250 BC
$\delta^{13}C = -23.3‰$

Wood from pine stump layer in contact zone between peat and underlying mineral soil, SE of TV sta ca 4km SSW of Glencree, 20km S of Dublin, Co Wicklow (53° 09′ N, 6° 17′ W). Alt 630m (Wicklow mts). Peat ca 1m deep; highly humified.

Lu-774. Carrowmoore, Sample a

4340 ± 65
2390 BC
$\delta^{13}C = -25.0‰$

Wood from pine stump layer in peat ca 20cm above mineral soil, along rd from Glenamoy to Carrowmoore, 1km W of Bellonaboy Bridge, Co Mayo (54° 14′ N, 9° 44′ W). Alt 30m. Peat ca 1.2m deep; highly humified.

Lu-775. Carrowmoore, Sample b

7110 ± 75
5160 BC
$\delta^{13}C = -25.6‰$

Wood from pine root from mineral soil underlying blanket bog peat, same place as Lu-774. Root may be referred to pine stumps in contact zone between peat and underlying mineral soil. Charcoal found at this level.

F. Poland

Leba series

Charcoal from fossil soil humus layer, Leba Bay Bar, S coast of Baltic Sea, N Poland. Coll 1972 and subm by K Tobolski, Dept Plant Taxonomy and Phytogeog, A Mickiewicz Univ, Poznań, Poland. Fossil soils in area are described by Tobolski (1972a). Pretreated with HCl and NaOH.

Lu-761. Leba Bay Bar, Sample 3

1540 ± 50
AD 410
$\delta^{13}C = -24.8‰$

Pinus charcoal from lowest part of humus horizon in fossil podsol soil bei Czołpino (54° 43′ 44″ N, 17° 15′ 51″ E).

Lu-762. Leba Bay Bar, Sample 17

1940 ± 50
AD 10
$\delta^{13}C = -24.5‰$

Quercus charcoal from charcoal layer 1 to 2cm thick underlain by sandy humus and overlain by raw humus in fossil soil horizon by Łąska-Dune (54° 45′ 09″ N, 17° 25′ 16″ E). High percentages of *Fagus*-pollen above, and *Quercus*-pollen below charcoal layer.

Lu-763. Ustka, Sample 31/71, insoluble

11,800 ± 115
9850 BC
$\delta^{13}C = -24.5‰$

Insoluble part of organic matter from layer with tundra vegetation remnants from coastal cliff near Ustka (54° 35′ 53″ N, 16° 54′ 11″ E).

Coll 1972 and subm by K Tobolski. Cliff stratigraphy and fossil plants described by submitter (Tobolski, 1972b). Pretreated with HCl and NaOH.

Lu-763A. Ustka, Sample 31/71, humic acid **11,850 ± 115**
9900 BC
$\delta^{13}C = -26.3‰$

Acid-precipitated part of NaOH-soluble fraction from Lu-763. *Comment*: agreement between fractions indicates absence of contamination with younger humus.

II. ARCHAEOLOGIC SAMPLES

Sweden

Hagestad series

Charcoal from Hagestad, Löderup parish, Scania. Coll 1964 to 1972 and subm by M Strömberg, Hist Mus, Univ Lund. For other dates from Hagestad, see R, 1972, v 14, p 394-395; 1973, v 15, p 509. Pretreated with HCl and NaOH.

Lu-700. Hagestad 40^1, Sample 9 **2540 ± 55**
590 BC
$\delta^{13}C = -25.6‰$

Charcoal from trench with stone feature containing Bronze age finds, on field S of rd Hagestaborg-Ramshög, Hagestad 40^1 (55° 24′ N, 14° 09′ E). Coll 1964.

Lu-701. Hagestad 50^3, Sample 10 **3270 ± 55**
1320 BC
$\delta^{13}C = -24.3‰$

Charcoal from hearth on field N of brook, Hagestad 50^3 (55° 23′ N, 14° 09′ E). Coll 1971. Assoc with Bronze age finds.

Lu-781. Hagestad 44^6 D, Sample 1 **1830 ± 50**
AD 120
$\delta^{13}C = -24.5‰$

Charcoal from hearth spatially connected with Late Neolithic as well as Roman Iron age features at Hagestad 44^6 D (55° 23′ N, 14° 08′ E). Coll 1972.

General Comment (MS): dates agree well with archaeol results based on artifact assemblage.

Valleberga series

Charcoal, wood, and bone from grave field at Valleberga, Scania (55° 24′ N, 14° 04′ E). Coll Dec 1972 to March 1973 and subm by M Strömberg.

Lu-798. Valleberga 5 **1990 ± 55**
40 BC
$\delta^{13}C = -24.6‰$

Charcoal from burnt post near urn grave at Valleberga 5. *Com-*

ments: pretreated with HCl and NaOH. (MS): somewhat later than expected.

Lu-803. Valleberga 6[7] B, Sample 10 **3190 ± 55**
1240 BC
$\delta^{13}C = -25.3‰$

Wood fragments from remains of oak trunk coffin from Bronze age grave at Valleberga 6[7] B. Assoc with bronze objects from Period II. *Comment*: only weak pretreatment with NaOH due to poor state of preservation.

Lu-804. Valleberga 6[7] B, Sample 11 **3170 ± 55**
1220 BC
$\delta^{13}C = -18.6‰$

Collagen from human bone from coffin dated as Lu-803. *Comments*: bone treated as described previously (R, 1970, v 12, p 534). Organic carbon content: 5.5%. (MS): agrees well with Lu-803 and with time estimate based on assoc archaeol finds.

Löderup series

Charcoal from grave field at Löderup 15, Löderup parish, Scania (55° 23′ N, 14° 07′ E). Coll Dec 1972 to March 1973 and subm by M Strömberg. For other dates from Löderup 15, see R, 1973, v 15, p 509-510. Pretreatment with HCl and NaOH.

Lu-799. Löderup 15, Grave 75 **3360 ± 60**
1410 BC
$\delta^{13}C = -24.1‰$

Charcoal from bottom of Grave 75 (oak trunk grave).

Lu-800. Löderup 15, Grave 60 **2520 ± 55**
570 BC
$\delta^{13}C = -26.2‰$

Charcoal from hearth near Grave 60 (urn grave).

Lu-801. Löderup 15, Grave 91 **4130 ± 60**
2180 BC
$\delta^{13}C = -25.0‰$

Oak charcoal, id by T Bartholin, from Grave 91 (oak trunk grave). Assoc with flint axe.

Lu-808. Löderup 15, Grave 100 **3840 ± 60**
1890 BC
$\delta^{13}C = -25.6‰$

Charcoal from Grave 100 (oak trunk grave).

Lu-809. Löderup 15, Grave 92 **4060 ± 60**
2110 BC
$\delta^{13}C = -24.1‰$

Charcoal from pit near Grave 92. Assoc with arrowhead.

Lu-810. Löderup 15, Sample 8 **2560 ± 55**
610 BC
$\delta^{13}C = -26.5‰$

Charcoal from hearth in cultural layer N of Mound 3 on grave field. Late Bronze age pottery in adjacent cultural layer.

Lu-811. Löderup 15, Grave 106 **1850 ± 50**
AD 100
$\delta^{13}C = -24.7‰$

Charcoal from cremation burial at bottom of complex grave feature. Assoc with bone comb from Roman Iron age.

General Comment (MS): all dates agree well with results based on archaeol investigation.

Gårdlösa series

Charcoal from Gårdlösa, Smedstorp parish, SE Scania (55° 34′ N, 14° 08′ E). Coll 1971 and 1972 by A Nilsson; subm by B Stjernquist, Hist Mus, Univ Lund. Dated for study of continuity of Iron age settlement in Gårdlösa area. For other dates from area and references, see R, 1972, v 14, p 264-266, 392-393; 1973, v 15, p 510-511. Lu-708 only pretreated with HCl (small sample); all other samples pretreated with HCl and NaOH.

Lu-703. Gårdlösa 3, House LVIII **1570 ± 50**
AD 380
$\delta^{13}C = -24.4‰$

Charcoal from pit at bottom of house foundation.

Lu-704. Gårdlösa 71[1], Kiln 5 **2550 ± 55**
600 BC
$\delta^{13}C = -24.7‰$

Charcoal from mixed layer in remnants of kiln.

Lu-705. Gårdlösa 71[1], Grave 97 **1890 ± 55**
AD 60
$\delta^{13}C = -24.7‰$

Charcoal from Grave 97, just below plough-disturbed surface layer.

Lu-706. Gårdlösa 71[1], Hearth 194 **2480 ± 55**
530 BC
$\delta^{13}C = -25.4‰$

Charcoal from hearth.

Lu-707. Gårdlösa 71[1], house foundation **2460 ± 55**
510 BC
$\delta^{13}C = -23.8‰$

Charcoal from hearth in W part of house foundation.

Lu-708. Gårdlösa 10 **340 ± 60**
AD 1610
$\delta^{13}C = -25.4‰$

Charcoal from post-hole below stone pavement. *Comment* (BS):

unexpected young date; charcoal apparently not contemporaneous with stone feature.

General Comment (BS): all dates except Lu-708 agree well with estimates based on archaeol material.

Slädö Ship series

Oak wood from ancient ship on bottom of strait at Slädö I, Listerby, Blekinge (56° 04′ N, 15° 25′ E). Ship was said to be from Viking age. Coll by Blekinge Mus; subm by B E Berglund. Pretreated with HCl and NaOH.

Lu-744. Slädö Ship 1 — **290 ± 50**
AD 1660
$\delta^{13}C = -23.8‰$

Wood, probably from ship frame. Coll 1941. Object K 5070.

Lu-745. Slädö Ship 2 — **590 ± 50**
AD 1360
$\delta^{13}C = -24.8‰$

Small piece of wood, origin unknown. Object Bl. M. 16111:4.

General Comment (BEB): ship seems much younger than expected; probably not > 300 yr old

Östanön-Kvalmsö-Helgeö series

Wood from artificial blocking at 2 to 3m depth in strait named Kålfjärden between is. Östanön, Helgeö, and Kvalmsö, Listerby, Blekinge (56° 10′ N, 15° 25′ E). Coll 1972 by Blekinge Mus; subm by B E Berglund. Other dates from similar blockings reported previously (R, 1968, v 10, p 50; 1969, v 11, p 448-449; 1972, v 14, p 397-398). Pretreated with HCl and NaOH.

Lu-769. Östanön 2 — **940 ± 50**
AD 1010
$\delta^{13}C = -26.6‰$

Wood and bark from huge ash pile standing in mud.

Lu-770. Kvalmsö 5 — **1050 ± 50**
AD 900
$\delta^{13}C = -25.4‰$

Wood from ash pile.

Lu-771. Helgeö — **960 ± 50**
AD 990
$\delta^{13}C = -27.7‰$

Wood from alder pile.

General Comment (BEB): new dates confirm older ones from E part of this archipelago, *ie,* blockings apparently built ca AD 1000.

Norrvidinge series

Charcoal from buildings from Late Neolithic to Early Bronze age at Norrvidinge, Scania (55° 51′ N, 13° 06′ E). Coll 1971 and subm by

J Callmer, Hist Mus, Univ Lund. Preliminary report by submitter (Callmer, 1973).

3620 ± 135
Lu-836. Norrvidinge 3^{22-23}, Feature 338 **1670 BC**
$\delta^{13}C = -25.5‰$

Charcoal from post-hole in pit-dwelling (Feature 338). Assoc with flint and pottery. *Comment*: no pretreatment (small sample).

2960 ± 55
Lu-837. Norrvidinge 3^{22-23}, Feature 339:8 **1010 BC**
$\delta^{13}C = -23.0‰$

Charcoal from Sec 8 of pit-dwelling (Feature 339). Assoc with daub, flint, and pottery.

General Comment (JC): agrees fairly well with archaeol date.

Löddesborg series

Charcoal from settlement area at Löddesborg, Scania (55° 45′ N, 12° 59′ E). For other date from Löddesborg, see R, 1973, v 15, p 508. Site is culturally closely connected to area studied at Norrvidinge (above). Coll 1972 to 1973 and subm by J Callmer. Pretreated with HCl and NaOH.

3440 ± 55
Lu-838. Fårabacken, Löddesborg, House 1 **1490 BC**
$\delta^{13}C = -24.2‰$

Charcoal from bottom layer in House 1. Assoc with flint and pottery (Late Neolithic to Early Bronze age).

3720 ± 60
Lu-839. Fårabacken, Löddesborg, Feature I-73 **1770 BC**
$\delta^{13}C = -23.6‰$

Oak charcoal, id by T Bartholin, from 0.5m below surface in pit with Middle Neolithic pottery and flint (Battle-axe culture).

General Comment (JC): agrees fairly well with archaeol date.

610 ± 70
Lu-742. Näsums Gudahage **AD 1340**
$\delta^{13}C = -21.2‰$

Collagen from part of poorly preserved human skull from grave at Gudahagen, Näsum parish, Scania (56° 09′ 55″ N, 14° 30′ E). Skull from gravel 0.6m below surface. Coll 1972 by N-G Larsson; subm by M P Malmer, Hist Mus, Univ Lund. For other date from this site, see R, 1969, v 11, p 449. *Comment*: expected age 550 to 950 yr. Sample undersized; diluted; 51% sample. Organic carbon content: 1.4%.

III. MODERN PLANT SAMPLES

Rogen series (II)

Samples from thick carpets of lichen (*Cladonia alpestris*) growing in open mt region above tree line, alt 900m, at Lake Rogen, Härjedalen

(62° 30′ N, 12° 30′ E). Coll 1964, 1968, and 1970 by Lidén, Persson, and Mattsson; subm by S Mattsson, Radiation Phys Dept, Univ Lund. First part of Rogen series pub previously (R, 1972, v 14, p 399). See also comprehensive report by submitter (Mattsson, 1972). All samples pretreated with HCl.

Results are given as a difference, Δ, from our radiocarbon standard (95% activity of NBS oxalic acid standard, age corrected to 1950):

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

where $\delta^{14}C$ is observed deviation from radiocarbon standard in per mil and $\delta^{13}C$ deviation from PDB standard in per mil.

Lu-723. Rogen, V 532, 1964 **Δ = 142 ± 6‰**
$\delta^{13}C$ = −22.0‰

Unfractionated sample (*Cladonia alpestris*). Coll Sept 29, 1964.

Lu-724. Rogen, V 786, 1968 **Δ = 184 ± 6‰**
$\delta^{13}C$ = −22.2‰

Unfractionated sample(*Cladonia alpestris*). Coll Oct 1, 1968.

Lu-725. Rogen, V 919 A, 1970 **Δ = 584 ± 7‰**
$\delta^{13}C$ = −21.5‰

Top fraction, 0 to 3cm (*Cladonia alpestris*). Coll Sept 28, 1970.

Lu-726. Rogen, V 919 B, 1970 **Δ = 371 ± 7‰**
$\delta^{13}C$ = −21.2‰

Middle fraction, 3 to 6cm from top (*Cladonia alpestris*).

Lu-727. Rogen, V 919 C, 1970 **Δ = 101 ± 6‰**
$\delta^{13}C$ = −21.8‰

Lower fraction, below 6cm from top (*Cladonia alpesteris*).

Lu-728. Rogen, V 919 D, 1970 **Δ = 27 ± 6‰**
$\delta^{13}C$ = −22.4‰

Bottom fraction (gelatinous layer and decomposed lichen material; *cf* Mattsson, 1972, p 8-9).

Lu-729. Rogen, V 927 A, 1970 **Δ = 613 ± 8‰**
$\delta^{13}C$ = −22.4‰

Top fraction, 0 to 3cm (*Cladonia alpestris*). Coll. Sept 29, 1970.

Lu-730. Rogen, V 927 B, 1970 **Δ = 347 ± 7‰**
$\delta^{13}C$ = −21.8‰

Middle fraction, 3 to 6cm from top (*Cladonia alpestris*).

Lu-731. Rogen, V 927 C, 1970 **Δ = 59 ± 6‰**
$\delta^{13}C$ = −21.7‰

Lower fraction, below 6cm from top (*Cladonia alpestris*).

Lu-732. Rogen, V 927 D, 1970 $\Delta = -1 \pm 6‰$
$\delta^{13}C = -22.1‰$

Bottom fraction (gelatinous layer and decomposed lichen material).

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[RADIOCARBON, VOL. 16, No. 3, 1974, P. 331-357]

RIKEN NATURAL RADIOCARBON MEASUREMENTS VIII

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The ^{14}C dates given below are continued from our previous list (R, 1972, v 14, p 223-238), and results obtained mainly during 1971-2 are described. A 2.7L stainless steel counter and a 3.3L copper counter are used as previously, yielding background counting rates of 6.9 and 6.0 cpm, respectively, when filled with dead CO_2 at ca 1.8 atm. Dates have been calculated on the basis of the ^{14}C half-life of 5568 yr and 95% of NBS oxalic acid is modern standard. No correction has been made for any of the samples in this list.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Japan

Tokyo Bay series

Samples from boring cores. Coll 1970 by K Kojima; subm by K Kojima and K Kuwahara, Public Works Res Inst.

N-1296. Off Kawasaki (28-H-14′) **>37,800**

Shell from coarse sand, elev −91.4m TP, off Kawasaki (35° 27′ N, 139° 54′ E), Borehole 28, water depth 13.7m TP.

26,100 ± 860
N-1297. Ukishima-cho (32-H-11′) **24,150 BC**

Shell from silty fine sand, elev −85.8m TP, at Ukishima-cho, Kawasaki city (35° 32′ N, 139° 47′ E), Borehole 32, surface elev 2.8m TP.

385 ± 85
N-1298. Ukishima-cho (32-H-1) **AD 1565**

Wood from alluvial sandy silt (N-value 2∼4), elev −11.3m TP, at same borehole as N-1297. *Comment* (KK): comparing with some ^{14}C dates and geologic data (Kanto Regional Construction Bureau, 1973), date of N-1926 is reasonable but N-1297 seems rather young. Borehole 32 is on reclaimed land.

N-1231. Shishimuta Dam (R2′-35) **>37,800**

Charcoal from buried talus overlain by Aso lava, from an adit dug for dam foundation survey at river cliff of Kusu R, a branch of Chikugo R, Kuju-cho, Kusu-gun, Oita Pref (33° 11′ N, 131° 12′ E). Coll 1972 by K Hayashi, Chikugogawa Sta, Ministry of Construction; subm by K Kojima and K Kuwahara. *Comment* (KK): Aso lava is correlated to Young Aso lava dated ca 30,000 BP in other place (Ariake Bay Res Group, 1965).

Yahagi River series

Samples from boring core taken from alluvium of Yahagi R, Ugaikecho, Nishio-shi, Aichi Pref (34° 50′ N, 137° 5′ E). Coll 1971 and subm by A Moriyama, Aichi Univ Education.

N-1262. Yahagi River 1 — **8850 ± 145**, **6900 BC**

Peat from muddy sand ca 28m below surface.

N-1263. Yahagi River 2 — **4180 ± 95**, **2230 BC**

Peat from sand ca 7m below surface, near base of upper sand overlying mud.

N-1264. Yahagi River 3 — **3250 ± 95**, **1300 BC**

Black organic soil from sand as above, ca 3m below surface. *Comment* (AM): sedimentary structure of alluvia in drainage basin of Yahagi R at coastal area is well stratified and slaty. Structure at inland area, however, N of New Tokaido Line, is disordered and confused. Evidently, they depend upon expanse of transported bed loads by tidal or off-shore currents in open sea and lens-like deposition of coarse materials in channel belts on alluvial upland or in closed sea. Using measured ^{14}C age of these layers at coastal area, lower sands accumulated from ca 10,000 BP, middle muds ca 7000 BP, and upper sands ca 4500 BP The coast of the maximum "Jomon" transgression may have lain a little N of the New Tokaido Line. By rapid and successive alluviations, the coast at the age of late "Yayoi" may have lain near the line which links Isshiki with Kira (Moriyama and Ozawa, 1972).

B. Great Britain

N-962. Gate Helmsley (SE65/8463) — **6030 ± 140**, **4080 BC**

Wood from 2 to 2.5m beneath eolian sand, inner side of York Moraine near Gate Helmsley, Yorkshire (53° 58′ N, 0° 58′ W). Coll and subm 1970 by B Matthews, Soil Survey England & Wales. *Comment* (BM): date indicates area was wooded during Atlantic Period; later, wind blown sand accumulated in lee of moraine, probably after Neolithic forest clearance.

East Moor series

Samples from various depths at East Moor, Sutton-on-the-Forest, Yorkshire (54° 4′ N, 1° 4′ W). Coll and subm 1970 by B Matthews.

N-963. East Moor 1 (SE66/1041/1) — **11,000 ± 200**, **9050 BC**

Sandy peat from 118 to 121cm.

N-964. East Moor 2 (SE66/1041/2) — **11,200 ± 160**, **9250 BC**

Sandy peat from 122.5 to 124cm.

General Comment (BM): those and N-488 (10,700 ± 190, R, 1969, v 11, p 455), and N-820 (9950 ± 180, R, 1972, v 14, p 227) limit dates for deposition of eolian sand in Vale of York and for Allerød interstadial in the area (*ie*, 9950 to 11,200 yrs BP). Evidence suggests Allerød started later in Yorkshire than in S England and lasted till a later date (Matthews, 1970; 1971).

N-965. East Moor 3 (SE66/1041/3) **6400 ± 310**
4450 BC

Plant roots embedded in calcareous clayey till from depth 138 to 180cm. *Comment* (BM): sample either contaminated or roots are from vegetation of Atlantic period.

II. PEDOLOGIC SAMPLES

Total organic carbon, unless otherwise stated, of samples from humic horizon in volcanic ash and muck from various localities, coll 1971 to 1972 by Y Yamada, Natl Inst Agric Sci, are dated to determine relationship between soil age and properties of humus in soil.

Kitamoto series

Samples from various depths in volcanic ash soils developed at Kitamoto, Saitama Pref.

N-850. Kitamoto 1-1 **1120 ± 110**
AD 830

From depth 0 to 45cm, A_p horizon, at Yamanaka, Kitamoto-cho, Kitaadachi-gun, Saitama Pref (36° 2′ N, 139° 33′ E). Carbon content: 2.63%.

N-849. Kitamoto 1-2 **1540 ± 110**
AD 410

From depth 45 to 50cm, IIA horizon. Carbon content: 3.24%.

N-957. Kitamoto 11-2 **3410 ± 120**
1460 BC

From depth 28 to 60cm, IIA horizon on Omiya plateau at Miyauchi, Kitamoto-cho (36° 2′ N, 139° 32′ E). Carbon content: 5.20%. *Comment*: (YY): horizon yielding N-957 corresponds to that of N-849. However, N-957 was expected to be older from character of humus.

N-958. Kitamoto 13-3 **18,800 ± 370**
16,850 BC

From depth 160 to 180cm, at Haramamuro, Konosu city (36° 3′ N, 139° 31′ E). Horizon yielding N-958 is considered to overlie Lower Tachikawa Loam bed. Carbon content: 4.41%.

Fukui series

Sample from various depths in organic soils in Fukui city and its environs.

N-1082. Fukui 1-2, soil organic matter **620 ± 100**
AD 1330

M_1 horizon of peaty soil, depth 20 to 40cm, at Mitome, Shimizu-cho, Nyu-gun, Fukui Pref (36° 1′ N, 136° 9′ E). Carbon content: 2.81%.

N-1077. Fukui 1-2, $FeCO_3$ **Modern**

$FeCO_3$ concretion, same horizon as above.

1270 ± 100
N-1083. Fukui 1-4, soil organic matter **AD 680**

M_2 horizon, depth 40 to 50cm. Carbon content: 9.05%.

1330 ± 110
N-1084. Fukui 2-2, soil organic matter **AD 620**

M horizon of muck soil, depth 20 to 40cm, at Ryo-machi, Fukui city (36° 4′ N, 136° 16′ E). Carbon content: 2.89%.

340 ± 100
N-1078. Fukui 2-2, $FeCO_3$ **AD 1610**

$FeCO_3$ concretion, same horizon as above.

895 ± 100
N-1085. Fukui 3-2, soil organic matter **AD 1055**

M horizon of muck soil, depth 16 to 35cm, at Sakai-cho, Sakai-gun, Fukui Pref (36° 9′ N, 136° 13′ E). Carbon content: 4.43%.

N-1079. Fukui 3-2, $FeCO_3$ **Modern**

$FeCO_3$ concretion, same horizon as above.

305 ± 110
N-1206. Fukui 26-2 **AD 1645**

M horizon of muck soil, depth 30 to 50cm, at Hamajima, Kawanishi-cho, Fukui city (36° 9′ N, 136° 7′ E). Carbon content: 4.46%.

1710 ± 90
N-1207. Fukui 27-4 **AD 240**

M horizon of muck soil, depth 33 to 44cm, at Tameyori, Kawanishi-cho, Fukui city (36° 8′ N, 136° 7′ E). Carbon content: 14.24%.

2530 ± 120
N-1208. Fukui 28-4 **580 BC**

M horizon of muck soil, depth 37 to 60cm, at Yawata, Kawanishi-cho, Fukui city (36° 9′ N, 136° 8′ E). Carbon content: 6.13%.

N-1209. Fukui 29-1 **Modern**

A_p horizon of peat soil, depth 0 to 11cm, at Kinoshita, Kawanishi-cho, Fukui city (36° 8′ N, 136° 8′ E). Carbon content: 4.10%.

1480 ± 110
N-953. Fukui 29-2 (1) **AD 470**

Peat from depth 21 to 40cm of P horizon. No pretreatment was made.

1470 ± 110
N-954. Fukui 29-2 (2) **AD 480**

Above sample was washed with 0.5% NaOH, air-dried, and dated.

N-955. Fukui 29-2 (3) **1460 ± 140**
AD 490

Humic acid extracted from N-953.

Imaichi series

Sample from various depths in volcanic ash soils in Imaichi city and its environs.

N-1180. Imaichi 3-1 **1370 ± 100**
AD 580

A_{11} horizon from depth 0 to 20cm, at Myojin, Imaichi city (36° 41′ N, 139° 43′ E). Carbon content: 19.7%.

N-1181. Imaichi 3-2 **3130 ± 110**
1180 BC

A_{12} horizon from depth 20 to 35 cm. Carbon content: 18.7%. *Comment* (YY): considered to correspond to GaK-726 (R, 1967, v 9, p 46) and GaK-1328 (R, 1969, v 11, p 300).

N-1182. Imaichi 3-3 **4140 ± 110**
2190 BC

A_{13} horizon from depth 35 to 50cm. Carbon content: 17.6%.

N-1183. Imaichi 3-4 **5560 ± 125**
3610 BC

A_{14} horizon from depth 50 to 70cm. Carbon content: 12.0%.

N-956. Imaichi 3-5 **5360 ± 120**
3410 BC

A_3 horizon from depth 70 to 84cm underlain by Shichihonzakura pumice layer. Carbon content: 6.78%.

N-1184. Imaichi 4-1 **1690 ± 100**
AD 260

A_p horizon from depth 0 to 28cm, at Osawa, Imaichi city (36° 42′ N, 139° 45′ E). Imaichi 4 soil is used as upland field. Carbon content: 14.9%.

N-1185. Imaichi 4-2 **4290 ± 120**
2340 BC

A_{12} horizon from depth 28 to 46cm. Carbon content: 12.1%.

N-1186. Imaichi 4-3 **5900 ± 125**
3950 BC

A_{13} horizon from depth 46 to 60cm. Carbon content: 9.0%.

N-1418. Imaichi 8-1 **1010 ± 75**
AD 940

From depth 0 to 15cm, A_p horizon, at Yokaichi, Imaichi city (36° 42′ N, 139° 46′ E). Profile characteristics are nearly equal to Imaichi 4 soil. Used as paddy field. Carbon content: 9.21%

N-1187. Imaichi 5-1 — **670 ± 100**
AD 1280

A_p horizon from depth 0 to 15cm, at Yokaichi, Imaichi city (36° 42′ N, 139° 46′ E). Carbon content: 13.9%.

N-1188. Imaichi 5-2 — **1820 ± 100**
AD 130

A_{pg} horizon from depth 15 to 22cm. Carbon content: 11.8%.

N-1189. Imaichi 5-3 — **2060 ± 90**
110 BC

A_{12} horizon from depth 22 to 37cm. Carbon content: 12.3%.

N-1190. Imaichi 5-4 — **2980 ± 110**
1030 BC

A_{13} horizon from depth 37 to 61cm. Carbon content: 12.2%.

N-1360. Imaichi 5-5 — **5970 ± 80**
4020 BC

A_3 horizon from depth 61 to 67cm. Carbon content: 7.60%. *Comment* (YY): considered to roughly correspond to Imaichi 3-4 and 3-5 (N-1183, N-950, above).

N-1191. Imaichi 6-1 — **415 ± 100**
AD 1535

A_p horizon from depth 0 to 18cm of volcanic ash soil derived from secondary deposits of volcanic ash on narrow valley plain on middle terrace, at Yokaichi, Imaichi city (36° 42′ N, 139° 45′ E). Imaichi 6 soil is used as paddy field. Carbon content: 9.7%.

N-1192. Imaichi 6-3 — **1790 ± 100**
AD 160

A_{12} horizon from depth 22 to 35cm. Carbon content: 9.4%.

N-1193. Imaichi 6-4 — **1800 ± 160**
AD 150

A_{13} horizon from depth 35 to 53cm. Carbon content: 5.4%.

N-1194. Imaichi 7-1 — **165 ± 80**
AD 1785

A_p horizon from depth 0 to 14cm, at Shionomuro, Imaichi city (36° 44′ N, 139° 48′ E). Carbon content: 8.4%.

N-1195. Imaichi 7-2 — **1420 ± 100**
AD 530

A_{12} horizon from depth 14 to 26cm. Carbon content: 9.7%.

N-1196. Imaichi 7-3 — **2490 ± 110**
540 BC

A_{13} horizon from depth 26 to 60cm. Carbon content: 11.5%.

N-1361. Imaichi 7-4 **4340 ± 90**
2390 BC

A_{14} horizon from depth 60 to 80cm (Aodo soil). Carbon content: 9.78%.

Tokorozawa series

Sample from various depths in volcanic ash beds in Tokorozawa city and its environs.

N-1382. Tokorazawa 12-1 **1420 ± 90**
AD 530

A_p horizon from depth 0 to 22cm, at Arahata, Tokorozawa city (35° 46′ N, 139° 27′ E). Carbon content: 2.22%.

N-1383. Tokorazawa 12-2 **2830 ± 100**
880 BC

A_{13} horizon from depth 22 to 50cm. Carbon content: 2.32%.

N-1384. Tokorazawa 17-1 **630 ± 70**
AD 1320

A_p horizon from depth 0 to 25cm, at Kamiyamaguchi, Tokorozawa city (35° 46′ N, 139° 25′ E). Carbon content: 1.45%.

Asamizo series

Sample from various depths of humus horizons in volcanic ash soil at Asamizo-dai, Sagamihara city, Kanagawa Pref (35° 46′ N, 139° 25′ E).

N-1419. Asamizo 1 **800 ± 80**
AD 1150

A_p horizon from depth 0 to 21cm. Carbon content: 8.36%.

N-1420. Asamizo 2 **1680 ± 80**
AD 270

II A_{11} horizon from depth 21 to 43 cm. Carbon content: 7.95%.

N-1421. Asamizo 3 **3160 ± 90**
1210 BC

II A_{12} horizon from depth 43 to 50cm. Carbon content: 6.14%.

N-1422. Asamizo 4 **4220 ± 90**
2270 BC

III A horizon from depth 50 to 80 cm. Carbon content: 8.11%.

N-1423. Asamizo 5 **6500 ± 120**
4550 BC

IV A horizon from depth 80cm. Carbon content: 7.30%.

N-1424. Asamizo 6 **7060 ± 130**
5110 BC

VB horizon from depth 130 to 150cm. Carbon content: 2.64%.

III. ARCHAEOLOGIC SAMPLES

A. Japan

Sanrizuka series

Charcoal of coniferous tree from ca 1.2m below ground surface at construction site of New Tokyo International Airport at Kogome, Narita city, Chiba Pref (35° 46′ N, 140° 24′ E). Lens shaped charcoal concentration, 120cm in diam and ca 30cm thick, from lower part of Level 5, considered Tachikawa Loam. Same horizon yielded stone tools such as knife, blade, hand axe, etc (Furuuchi, 1971). Coll 1971 by C Watanabe; subm by G Nishino, Hokuso Kosha, Chiba Pref.

29,300 ± 980
27,350 BC

N-1080. Sanrizuka 1

Charcoal from A55,402,002.

28,700 ± 920
26,750 BC

N-1081. Sanrizuka 2

Charcoal from A55,402,007.

Hamabekkai series

Material from archaeol remains at Hamabekkai, Bekkai-cho, Notsuke-gun, Hokkaido (43° 27′ N, 144° 37′ E). Coll and subm 1971 by T Iwasaki, Tokyo Univ Education.

1130 ± 110
AD 820

N-1111. Hamabekkai 1

Charred timber from probably burned house remnant (H-4) of Post Jomon period.

895 ± 110
AD 1005

N-1112. Hamabekkai 2

Burned wood from floor of house remnant of Okhotsk culture period.

1020 ± 100
AD 930

N-1113. Hamabekkai 3

Charcoal from hearth of dwelling pit (H-10) of Latest Satsumon period. Probably assoc with coin of Ming dynasty. *Comment* (TI): other dates of remains of same period are: GaK-186 and -187 (R, 1963, v 5, p 116) and TK-4, -17, -52, and -53 (R, 1968, v 10, p 147; R, 1969, v 11, p 512) and I-555.

3990 ± 125
2040 BC

N-1114. Hamabekkai 4

Burned wood from floor of house remnant (H-20) of Middle Jomon period.

Suwanohara series

Material from floor of burned houses of Latest Yayoi or Early Kofun period at Suwanohara, Matsudo city, Chiba Pref (35° 47′ N, 139° 54′ E). Coll and subm by T Iwasaki.

N-1115. Suwanohara 1 **1930 ± 100**
AD 20

Charcoal from S-1.

N-1116. Suwanohara 2 **1820 ± 100**
AD 130

Charcoal from S2.

N-1117. Suwanohara 3 **1830 ± 100**
AD 120

Charcoal from S-22.

General Comment (TI): dates older than expected by ca 200 yr.

Kode series

Material from archaeol remain at Kode, Matsudo city, Chiba Pref (35° 47′ N, 139° 54′ E). Coll by I Yawata; subm 1971 by T Iwasaki.

N-1156. Kode 1 **5790 ± 140**
3840 BC

Charcoal from shell mound, assoc with pottery of Hanazumi-Kaso type of Early Jomon period.

N-1157. Kode 2 **5900 ± 115**
3950 BC

Charcoal from floor of Dwelling Pit 202, assoc with pottery of Sekiyama type of Early Jomon period.

Kainohana series

Material from Kainohana shell mound, Hachigasaki, Matsudo city, Chiba Pref (35° 49′ N, 139° 56′ E). Coll by I Yawata; subm 1971 by T Iwasaki.

N-1429. Kainohana 1 **3940 ± 105**
1990 BC

Charcoal from dwelling pit, assoc with pottery of Horinouchi I type of Late Jomon period.

N-1430. Kainohana 2 **3840 ± 190**
1890 BC

Charcoal from shell bed, assoc with pottery of Kasori BI type of Late Jomon period.

N-1431. Kainohana 3 **4170 ± 105**
2220 BC

Charcoal from shell bed, assoc with pottery of Kasori E type of Middle Jomon period.

N-1259. Kotani **3470 ± 85**
1520 BC

Wood fragment from archaeol remains at Kotani, Kasai city, Hyogo Pref (34° 53′ N, 134° 52′ E). Coll 1971 by Y Maeda; subm by K Huzita. *Comment* (KH): assoc artifacts suggest 4th or 5th century occupation.

Tripod Cinerary Urn

Human bone and charcoal contained in a cinerary urn supported with 3 legs of animal-leg shape, owned by Tokuzo-ji monastery, at Higashi-Murayama city, Tokyo (35° 46′ N, 139° 28′ E). Coll by S Asaki; subm 1971 by T Imadate (Asaki, 1957).

N-1212-1. Human bone — **1120 ± 165** / **AD 830**

N-1212-2. Charcoal — **1090 ± 140** / **AD 860**

B. United States

Snyder site series

Charcoal from Snyder site, N of El Dorado, Butler Co, Kansas (37° 52′ N, 96° 49′ W). Coll 1968 to 1971 and subm 1972 by R Grosser, Univ Kansas. Assoc with Archaic materials except N-1280, for which cultural affiliation has not yet been ascertained. *Comment*: other dates of this series are found in R, 1972, v 14, p 229-30.

N-1276. Synder site 1 — **2060 ± 80** / **110 BC**

From depth 45cm, in homogeneous, dark brown, mottled clayey soil. *Comment* (RG): previous date for 40 to 55cm level was 1970 ± 110 (N-769).

N-1277. Snyder site 2 — **3240 ± 85** / **1290 BC**

From depth 84cm, same soil zone as N-1276. *Comment* (RG): a hearth at 100 to 125cm yielded 3650 ± 140 (N-770).

N-1278. Synder site 3 — **3980 ± 100** / **2030 BC**

From depth 128cm, same soil zone as N-1276 and -1277. *Comment* (RG): level 125 to 140cm from another area of site yielded 3910 ± 160 (N-771).

N-1279. Snyder site 4 — **4830 ± 105** / **2880 BC**

From depth 178cm, in transition zone between homogeneous dark brown clayey soil and underlying yellowish brown clay.

N-1280. Snyder site 5 — **4600 ± 125** / **2650 BC**

From depth 250cm in yellowish brown clay, assoc with numerous flakes, grinding stone, and chipped stone. Cultural material absent from preceding 0.5m.

N-1265. Ponshewaing Point site (3182.54) — **3030 ± 95** / **1080 BC**

Charcoal from hearth, Ponshewaing Point site, Emmet Co, Michigan (45° 25′ N, 84° 48′ W). Coll 1970 by W A Lovis; subm 1972 by the Museum, Michigan State Univ.

915 ± 80
N-1266. Pine River Channel site (3683.10) **AD 1035**

Charcoal from hearth, Pine River Channel site, Charlevoix Co, Michigan (45° 19′ N, 85° 16′ W). Coll 1971 by C E Cleland; subm 1972 by the Museum, Michigan State Univ.

2400 ± 80
N-1267. Eagle Island site (3458.7.7) **450 BC**

Charcoal from hearth, Eagle Island site, Charlevoix Co, Michigan (45° 18′ N, 85° 1′ W). Coll 1969 by C E Cleland; subm by the Museum, Michigan State Univ.

905 ± 115
N-1268. O'Neill site (3468.15.14) **AD 1045**

Charcoal from lower occupation zone, O'Neill site, Charlevoix Co, Michigan (45° 36′ N, 85° 21′ W). Coll 1971 by W A Lovis; subm 1972 by the Museum, Michigan State Univ.

Indian Mound Park series

Material from cap area of 2 burial mounds containing 21 persons of both primary and secondary interment at Indian Mound Park (20Ibl), Rolland Township, Isabella Co, Michigan (43° 31′ N, 84° 59′ W). Late Woodland ceramics, quartz projectile point and celt were found, assoc with cap layers. Coll 1971 by K C Carstens; subm by Maria Campbell, Central Michigan Univ.

1070 ± 75
N-1289. Indian Mound Park 1 **AD 880**

Charcoal of occurrence 530R515, Level 2.

1080 ± 75
N-1290. Indian Mound Park 2 **AD 870**

Charcoal of occurrence 545R500, Level 2.

Lilbourn series

Charcoal from burial on Lilbourn archaeol site, 23NM38, fortified Middle Mississippian townsite in New Madrid Co, SE Missouri (36° 34′ N, 89° 36′ W). Coll and subm by A H Chapman, Univ Missouri-Columbia.

830 ± 85
N-1232. Lilbourn 1 **AD 1120**

Cat No. 71-1884.

835 ± 85
N-1233. Lilbourn 2 **AD 1115**

Cat No. 71-1885.

Towosahgy State Archaeological site series

Charcoal from fill of stockade trenches encircling center of Towosahgy State Archaeol site, 23Mi2, fortified ceremonial center for Mississippian tradition of SE Missouri, East Prairie, Missouri (36° 42′ N, 89° 14′ W). Coll by J C Cotter; subm 1972 by M D Southard, Towosahgy State Archaeol site.

815 ± 85
N-1250. Towosaghy 1 (CS2-70) **AD 1135**

From burned post in Stockade Trench A, Grid Unit 857R1353.

1060 ± 85
N-1251. Towosaghy 2 (CS1-71) **AD 890**

From burned post in Stockade Trench A, Grid Unit 703N/130E.

930 ± 95
N-1252. Towosaghy 3 (CS2-71) **AD 1020**

From base of Stockade Trench B, Grid Unit 694.8N.

1200 ± 140
N-1253. Towosaghy 4 (CS3-71) **AD 750**

From burned post in Stockade Trench A.

General Comment (MDS): dates seem too early and do not represent true age of stockade feature assoc with Cairo Lowland phase of Middle Mississippian occupation of Towosahgy. Previous date for post from Stockade A yielded 675 ± 70 (UGA-244).

Pot Shelter series

Material from stratified site of Pot Shelter (23CR149), E-central Missouri (38° 6′ N, 91° 10′ W). First 2 samples come from Woodland occupation; next 3 from Archaic occupation. Coll 1971 by F E Schneider; subm by R Krause, Univ Missouri-Columbia. *Comment* (RK): excavation will be reported in the 3rd Rept to US Natl Park Service on Archaeol Salvage in Proposed Meramec Park Reservoir.

1300 ± 110
N-1169. Pot Shelter 1 **AD 650**

Charcoal from concentrated area of ash and charcoal representing hearth, Feature 7, 46 to 56cm below surface, sealed under a pile of large rocks.

4150 ± 125
N-1170. Pot Shelter 2 **2200 BC**

Charcoal from excavation Level 15, 107 to 114cm below surface, within both a cultural and soil transition zone between upper Woodland and lower Archaic deposits. Pottery first appears stratigraphically in Level 14.

5750 ± 140
N-1171. Pot Shelter 3 **3800 BC**

Charcoal from Level 23, 160 to 175cm below surface. Side-notched dart point was next to Feature 16, burned clay fire hearth.

5600 ± 125
N-1172. Pot Shelter 4 **3650 BC**

Charcoal from Level 26, 188 to 198cm below surface, where burned clay fire hearths, Features 18, 19 and 20, first appear.

6480 ± 145
N-1173. Pot Shelter 5 **4530 BC**

Charcoal combined from Level 30, 221 to 241 cm below surface and from burned clay fire hearth, Feature 24.

805 ± 100
N-1174. Smith Shelter (23CR80) **AD 1145**

Charcoal from Feature 4, Sq 2, excavation Level 4 at Smith Shelter, E-central Missouri (38° 6′ N, 91° 10′ W), in which main occupation is Late Middle Woodland. Feature consisted of circular area of charcoal, max diam 30cm, depth 5cm, as expected for a burned post. A rocker-stamped sherd came from level below. Coll 1971 by F E Schneider; subm by R Krause.

1010 ± 100
N-1175. Patton site (23CR60) **AD 940**

Charcoal from composite sample from Level 3 to 6, 25 to 53cm below surface, in large pit, Feature 3 in Patton site, E-central Missouri (38° 2′ N, 91° 14′ W). The pit, 101 x 99cm, contained cultural debris, charcoal, and burned limestone and was probably roasting or cooking pit. Coll 1971 by F E Schneider; subm by R Krause.

Saba Shelter series

Material from Saba Shelter (23BE149), Benton Co, Missouri (38° 12′ N, 93° 28′ W). Site is stratified and to depth at least 183cm below surface are Woodland materials: ceramics, abundant lithic artifacts and debitage, and floral and faunal material. Coll 1970 by R Vehik; subm by R Krause.

1400 ± 100
N-1176. Saba Shelter 1 **AD 550**

Charcoal from top of small pit, 30cm below surface, containing lithic artifacts, debitage, worked bone, charcoal, seeds, nuts, burned and unburned bone, shell, and snails.

2070 ± 100
N-1177. Saba Shelter 2 **120 BC**

Charcoal from dark brown humus of Stratum 2, 61 to 91cm below surface, assumed assoc with Woodland occupation, because of cord-marked and plain pottery, Scallorn-like points, Rice side-notched points, and other lithic artifacts.

McRoberts Oneota site series

Charcoal from McRoberts site (23SA5), Saline Co, Missouri (39° N, 93° W). Site consists of a group of small horticultural outposts occupied during late spring and late summer-early fall seasons for planting and harvesting crops in Missouri R flood plain. Coll and subm 1972 by R Krause.

N-1269. McRoberts Oneota site 1 (CN 9) **Modern**

300 ± 95
N-1106. McRoberts Oneota site 2 (CN 10) **AD 1650**

N-1270. McRoberts Oneota site 3 (CN 12) **Modern**

N-1271. McRoberts Oneota site 4 (CN 13) **Modern**

110 ± 75
N-1272. McRoberts Oneota site 5 (CN 16) **AD 1840**

300 ± 75
N-1273. McRoberts Oneota site 6 (CN 16) **AD 1650**

390 ± 75
N-1274. McRoberts Oneota site 7 (CN 19) **AD 1560**

General Comment (RK): because recovered trade items, eg, glass beads, brass kettle fragments, and lead rifle ball were found, site was expected to date between AD 1600 to 1800. Dates of N-1106, -1272-1274 fall within or near expected age. N-1269 is equivalent to N-1106 in terms of archaeol context and assoc; both samples were from same prepared hearth. Date of N-1269 is, thus, unacceptable. N-1270 and -1271 were from a prepared hearth assoc with Oneota potsherds; these 2 dates are unacceptable also, but their consistency suggests an error in field interpretation.

C. Mexico

Santa Luisa series

Material from archaeol site 30GZ1 at Santa Luisa, Mexico (20° 28′ N, 97° 4′ W). Coll and subm 1970 by S J K Wilkerson. *Comment* (SJKW): dates help establish reliable chronology for N-central Veracruz area, particularly for Formative periods.

2830 ± 140
N-912. Santa Luisa 1 **880 BC**

Charcoal dispersed in earth from hearth, Trench 5, Level 14, depth 250 to 260cm. Estimated age: 600 to 400 BC.

4740 ± 100
N-913. Santa Luisa 2 **2790 BC**

Dispersed charcoal from Trench 5, Level 25, depth 460 to 480cm. Assoc with obsidian flakes and oyster shells in deepest level. Estimated age: 600 to 1000 BC.

2370 ± 105
N-914. Santa Luisa 3 **420 BC**

Charcoal from Trench 5, Level 11, depth 190 to 210cm. Estimated age: 500 to 200 BC.

N-915. Santa Luisa 4 **2280 ± 120**
330 BC

Total organic carbon in 900g of ash from interior of Structure A-sub 4, earliest ceremonial architecture found at site. Trench 3-B, depth 270 to 272cm. Estimated age: AD 300 to 600.

N-916. Santa Luisa 5 **2730 ± 105**
780 BC

Charcoal from Trench 5, Level 13, depth 230 to 250cm. Estimated age: 600 to 400 BC.

N-917. Santa Luisa 6 **1110 ± 100**
AD 840

Charcoal from firepit, Trench 2, Level 6, depth 110 to 120cm. Estimated age: AD 600 to 900.

N-918. Santa Luisa 7 **2710 ± 105**
760 BC

Charcoal from Trench 5, Level 12, depth 210 to 230cm. Estimated age: 500 to 200 BC.

N-919. Santa Luisa 8 **1600 ± 100**
AD 350

Charcoal from Trench 3-C, depth 415 to 425cm. Estimated age: AD 400 to 700.

N-920. Santa Luisa 9 **4410 ± 130**
2460 BC

Inorganic carbon from carbonaceous ash, Trench 2, Level 9 and 10, depth 178 to 183cm. Estimated age 300 to 0 BC.

Nexpa series

Charcoal from archaeol remains at Nexpa, Morelos, Mexico (18° 31′ N, 99° 9′ W). Coll and subm 1970 by D C Grove, Univ Illinois at Urbana-Champaign.

N-941. Nexpa 1 **3100 ± 120**
1150 BC

From Pit Na-1A, N sidewall, assoc with walls of apparent Early Formative age, 105cm below ground surface.

N-942. Nexpa 2 **3100 ± 120**
1150 BC

From Pit Na-1, assoc with wall and apparent house floor of Early Formative age, 125 to 140cm below ground surface.

N-943. Nexpa 3 **3170 ± 120**
1220 BC

From Pit Na-3, from packed clay house floor of apparent Early Formative age, 65 to 75cm below ground surface.

N-944. Nexpa 4 **3180 ± 125**
1230 BC

From Pit Na-4, from ash layer adjacent to Burial 1 containing Tlatilco-Rio Cuautla style burial offerings. Age: Late Early Formative.

N-945. Nexpa 5 **2930 ± 130**
980 BC

From Pit Nc-2, Layer VI. Age: Early Formative.

N-946. Nexpa 6 **3010 ± 120**
1060 BC

From Pit Nc-2, Level VII. Age: Early Formative.

Chalcatzingo series

Charcoal from archaeol site at Chalcatzingo, Morelos, Mexico (18° 41′ N, 99° 46′ W). Coll and subm 1972 by D C Grove.

N-1402. Chalcatzingo 1 **2620 ± 80**
670 BC

From excavation Unit 112-114S, 0-2E, at depth 57cm. Cemetery area on central plaza. Age: Middle Formative.

N-1403. Chalcatzingo 2 **2480 ± 80**
530 BC

From Unit 112-114S, 2-4E, at depth 20 to 42cm. Cemetery area on central plaza. Age: Middle Formative.

N-1404. Chalcatzingo 3 **2580 ± 65**
630 BC

From Unit 114-116S, 0-2E, at depth 40 to 60cm, near burial offering No. 94 in cemetery area on central plaza. Age: Middle Formative.

N-1405. Chalcatzingo 4 **2700 ± 95**
750 BC

From Unit 114-116S, 2-4E, at depth 40 to 60cm. Cemetery area on plaza. Age: Middle Formative.

N-1406. Chalcatzingo 5 **2890 ± 100**
940 BC

From Unit 118-120S, 0-2E, at depth 90cm. Cemetery area on central plaza. Age: Middle Formative.

N-1407. Chalcatzingo 6 **2960 ± 80**
1010 BC

From Trench 90-87, at depth 360 to 380cm of central plaza. Age: Middle Formative.

N-1408. Chalcatzingo 7 **2800 ± 80**
850 BC

From Trench 84-80, at depth 180 to 220cm, central plaza. Age: Middle Formative.

N-1409. Chalcatzingo 8 **3010 ± 95** **1060 BC**

From Trench 75-71 at depth 370 to 390cm, central plaza. Age: Middle Formative.

N-1410. Chalcatzingo 9 **2620 ± 90** **670 BC**

From Trench 60-63.5 at depth 233cm, central plaza. Assoc with bone and architectural features. Age: Middle Formative.

N-1411. Chalcatzingo 10 **2840 ± 95** **890 BC**

From excavation Area 110-112S 16-18E, at depth 40 to 80cm, central plaza. Assoc with architectural features. Age: Middle Formative.

N-1412. Chalcatzingo 11 **2910 ± 130** **960 BC**

From Area 110-112S, 16-18E, at depth 190 to 210cm, central plaza. Assoc with architectural features. Age: Middle Formative.

N-1413. Chalcatzingo 12 **3320 ± 80** **1370 BC**

From Area 14-17.5S, 39-40E, at depth 180 to 220cm, E edge of long platform mound bounding N side of central plaza. Age: probably Early Formative.

N-1414. Chalcatzingo 13 **1390 ± 75** **AD 560**

From Unit 0-2S, 0-2E, at depth 20 to 40cm, from terrace of Middle Formative and Classic house structures. Age: Classic.

N-1415. Chalcatzingo 14 **1350 ± 75** **AD 600**

From Unit 4-6S, 0-2W, at depth 31 to 40cm, Soil Zone B, from terrace of Middle Formative and Classic house structures. Age: Classic.

N-1416. Chalcatzingo 15 **3030 ± 130** **1080 BC**

From Unit 8-10S, 0-2W, at depth 140 to 160cm, Soil Zone D, from terrace of Middle Formative house structure.

N-1417. Chalcatzingo 16 **2720 ± 80** **770 BC**

From Unit 8-10S, 2-4W, at depth 60 to 80cm, Soil Zone B, from terrace of Middle Formative house structure.

D. Great Britain

Craig Phadrig series

Material from archaeol remains at Craig Phadrig, Inverness, N Scotland (57° 29′ N, 4° 14′ W). Coll and subm 1971 by Alan Small, Univ Dundee.

N-1118. Craig Phadrig 1 (CP25) **2030 ± 100**
80 BC

Charred timber between layers of upper and lower occupations overlying collapse of rampart.

N-1119. Craig Phadrig 2 (CP107) **1540 ± 85**
AD 410

Charcoal from upper occupation layer.

N-1120. Craig Phadrig 3 (CP114) **2250 ± 100**
300 BC

Dispersed charcoal from wooden beam in earthen rampart.

N-1122. Craig Phadrig 4 (CP128) **2280 ± 100**
330 BC

Charcoal from base of wall buried in rubble, 3.5m high.

N-1123. Craig Phadrig 5 (CP130) **2220 ± 100**
270 BC

Charcoal under buried wall.

N-1124. Craig Phadrig 6 (CP133) **2320 ± 105**
370 BC

Charcoal and peat from face of buried wall, 50cm below top of wall.

N-1238. Reswallie Farm **3160 ± 70**
1210 BC

Human bone from Reswallie Farm, Rescobie, Scotland (56° 40′ N, 2° 49′ W). Inhumation in short cist. Grave goods included food vessel and flint flake. Coll 1967 and subm by H Coutts, Dundee Mus. *Comment*: bone collagen dated.

N-1239. Cookston Farm **3550 ± 85**
1600 BC

Human bone from Cookston Farm, Eassie, Scotland (56° 37′ N, 3° 4′ W). Inhumation in short cist. Grave goods included beaker and bone button. Coll 1970 and subm by H Coutts. *Comment*: bone collagen dated.

N-1240. Glamis **3390 ± 90**
1440 BC

Human bone from Glamis, Angus, Scotland (56° 36′ N, 3° W). Inhumation in short cist. Grave goods included food vessel sherd. Coll 1947 by D R Dow; subm by H Coutts. *Comment*: bone collagen dated.

Green Cairn series

Material from archaeol remains at Green Cairn, Fife, Scotland (56° 5′ N, 3° 35′ W). Coll and subm 1972 by L M Wedderburn, Dundee City Mus. Estimated age: 1000 to 3500 BP.

N-1318. Green Cairn 1 (G.C./T1/4/S1) **2130 ± 100**
180 BC

Charcoal from twigs.

N-1375. Green Cairn 2 (G.C./T5/5/S2) **2340 ± 95**
390 BC

Carbon rich material from post hole.

N-1376. Green Cairn 3 (G.C./T1/4/S3) **2490 ± 90**
540 BC

Charcoal from burned timber beam.

General Comment (LMMW): dates represent construction, destruction, and occupation of defended settlement of Scottish Iron age and are supported by stratigraphy of excavated areas.

E. Africa

Chondwe series

Charcoal from Early Iron age site at Chondwe, Copperbelt Prov, W Zambia (13° 12′ S, 28° 47′ E). Coll by N Filmer and E Mills, Ndola, Zambia; subm 1970 by B M Fagan, Univ California, Santa Barbara. *Comment* (BMF): may date beginnings of occupation. Probable date: ca 1100 BP.

N-997. Chondwe 1 **1150 ± 145**
AD 800

From Trench 2, Sq 5, depth 1.98 to 2.06m.

N-998. Chondwe 2 **1440 ± 160**
AD 510

From Trench 2, Sq 5, depth 2.06 to 2.13m.

Kansanshi series

Material from Kansanshi copper mine, Zambia (11° 40′ S, 26° 30′ E). Coll by M S Bisson; subm 1972 by B M Fagan.

N-1281. Kansanshi 1 **360 ± 80**
AD 1590

Charcoal from distinct hearth at contact of orange-gray rubble and sandy orange layer at depth 3.20m in fill, Trench I, 4.2 to 4.65m S of datum.

N-1282. Kansanshi 2 **295 ± 80**
AD 1655

Charcoal from angular rubble and brown sandy matrix at depth 1.73m in fill, Trench I, 5.42m S of datum.

N-1283. Kansanshi 3 **1320 ± 85**
AD 630

Charcoal from daga pit in probably earliest village horizon at Kansanshi, at depth 45 to 75cm, Pit II, Site Ksm. Assoc with copper working.

1190 ± 85
N-1284. Kansanshi 4 **AD 760**

Charcoal from interface between black and yellow layer at depth 37cm, Site Ksm. Assoc with early type pottery.

2360 ± 90
N-1285. Kansanshi 5 **410 BC**

Charcoal from orange clay at base of layer, depth 26cm, containing earlier type of pottery and underlain by (?) Middle Stone age tools, Site Ksm.

1550 ± 90
N-1286. Kansanshi 6 **AD 400**

Charcoal from Pit I fill at depth 47cm. Assoc with Late Iron age pottery and anthill furnace fragments, Site Ksm.

General Comment (MSB): N-1281 and -1282 were from rubble backfill of ancient copper mine at Kansanshi hill. They date final period of great prehistoric activity, obliterating all traces of earlier copper mining. N-1283 to -1286 were all from prehistoric smelting area adjacent to Kansanshi mine. N-1283 dates 1st phase of Early Iron age activity at the mine while N-1284 dates 2nd phase. Both phases are characterized by distinct ceramic assemblages. Dates agree fully with already known Early Iron age dates from NW Zambia. Date of N-1285 was earlier than expected and probably belongs to underlying layer below Iron age pottery. Date of N-1286 was earlier than expected. Subsequent study of pottery from this pit shows that it falls within range of variation of 1st phase of Early Iron age.

Chundu series

Charcoal from Chundu site, Livingstone Dist, S Prov, Zambia (17° 35′ S, 25° 41′ E). Coll 1970 and subm by J O Vogel, Livingstone Mus.

1190 ± 100
N-1137. Chundu 1 (Zlm-32) **AD 760**

Charcoal from depth 1.2m in ashpit, Trench 5.

1290 ± 100
N-1138. Chundu 2 (Zlm-33) **AD 660**

Charcoal from depth 1.2m in ashpit, Trench 2.

1160 ± 160
N-1139. Chundu 3 (Zlm-34) **AD 790**

Charcoal from depth 0.6m within horizon containing village-assoc cultural material, Trench 4. *Comment* (JOV): earlier sample N-668 (220 ± 170: R, 1970, v 12, p 572) was inconsistent with typologic evidence.

Zambesi series

Charcoal from Zambesi site, Livingstone Dist, S Prov, Zambia (17° 49′ S, 25° 37′ E), from provenance believed assoc with Early Iron age horizon. Coll 1971 and subm by J O Vogel.

N-1140. Zambesi 1 (Zlm-35) **1410 ± 130**
AD 540

Charcoal from large pit assoc with hut and filled with Early Iron age pottery, Trench 10.

N-1141. Zambesi 2 (Zlm-36) **895 ± 110**
AD 1055

Charcoal from large pit in Trench 7.

N-1142. Zambesi 3 (Zlm-37) **795 ± 95**
AD 1155

Charcoal from ashpit at 0.8m in Trench 6.

N-1143. Zambesi 4 (Zlm-38) **910 ± 160**
AD 1040

Charcoal assoc with hut daga in Trench 8.

N-1144. Zambesi 5 (Zlm-39) **710 ± 100**
AD 1240

Charcoal assoc with hut in Trench 10.

N-909. Turkwel R Irrigation scheme, Site U **1500 ± 100**
AD 450

Charcoal from possible hearth remnant exposed at surface of wind-deflated site, near Lorogumu, Turkana Dist, Kenya (2° N, 36° E). Late Stone age tools and incised pottery were adjacent to charcoal. Coll and subm 1970 by L H Robbins, Michigan State Univ.

Lothagam Hill series

Material from archaeol sites near Lothagam Hill, S Turkana Dist, Kenya (2° N, 36° E). Subm 1971 by L H Robbins.

N-1100. Lothagam Hill (ZU-4) **8420 ± 170**
6470 BC

Shell from compact grayish sand level, 20 to 30cm below surface, assoc with cultural material including Late Stone age flaking debris and pottery. Coll 1969 by L H Robbins. *Comment* (LHR): shell from Site ZU-6, ca 100m apart from Site ZU-4 yielded 7960 ± 140 (N-813: R, 1972, v 14, p 237).

N-1101. Lothagam Hill 2 (ZU-5) **6010 ± 160**
4060 BC

Shell from exposure of shell beds, 35 to 40cm below surface, Site ZU-5, < 1.6km from ZU-4. Late Stone age flaking debris and pottery found at adjacent surface. Coll 1969 by L H Robbins and J I Ebert.

N-1102. Lothagam Hill 3a (BB-9) **8230 ± 180**
6280 BC

Shell from dark organic lake sediment at Site BB-9, ca 0.4km from S end of Lothagam Hill, yielding human skeletal remains, Late Stone age artifacts, bone points, and fauna. Coll 1969 by L H Robbins.

2260 ± 100
N-1103. Lothagam Hill 3b **310 BC**

Black organic sediment from above site, 2 to 16cm below surface. *Comment* (LHR): material did not serve as independent check against N-1102.

1330 ± 100
N-1076. Lukenya Hill **AD 620**

Charcoal from prehistoric rockshelter, Site GvJm/22, Lukenya Hill, Machakos Dist, Kenya (1° 29′ S, 37° 4′ E), from hearth 50 cm below surface. Coll and subm 1971 by R M Gramly, Univ Nairobi. *Comment* (RMG): should date 2 pottery wares and provide upper limit for Narosura ware.

1240 ± 100
N-1066. Manda **AD 710**

Water-logged wood, probably mangrove, from one of a series of large piles ca 20cm diam, sunk into mud 3.5m thick filling what must have been open creek at Manda, Lamu Dist, Kenya (2° 14′ S, 40° 58′ E). Present shoreline is ca 15m away. Mud surface is at approx present mid-tide level and remains permanently water-logged with salt water. Coll 1970 by H N Chittick; subm by R C Soper, British Inst E Africa. *Comment* (HNC): sample can be assigned to early stage of city of Manda and probably belongs to 9th or 10th century AD, based on pottery imported from Persian Gulf.

New Seronera Game Lodge series

Charcoal from cave site at New Seronera Game Lodge, Serengeti Natl Park, Tanzania (2° 25′ S, 34° 50′ E). Coll 1971 by J R F Bower; subm by R C Soper.

2020 ± 115
N-1067. New Seronera Game Lodge 1 **70 BC**

Charcoal from depth 30 to 40cm from surface, Sq B-2, Site SE-3, underlying stratigraphic break in cave deposits formed by boulder rubble. Assoc with pottery of possible East African "Neolithic" affinity and microlithic industry, mostly obsidian. *Comment* (JRFB): consistent with range of dates for pottery of E African "Neolithic" affinity and provides reliable terminal date for pottery (Gumban A) recovered below rubble.

265 ± 100
N-1068. New Seronera Game Lodge 2 **AD 1685**

Charcoal from depth 10 to 20cm below surface, Sqs B-1 and C-1, Site SE-3, overlying stratigraphic break in cave deposits. Assoc with Iron age pottery (twisted cord rouletting and various forms of incised decoration) and microlithic industry, mostly quartz. *Comment* (JRFB): unexpected younger age due to thorough disturbance of deposits overlying boulder rubble.

280 ± 95
N-1158. New Seronera Game Lodge 3 **AD 1670**

Charcoal recovered at depth 20 to 30cm from surface in Sq C-10, Site SE-4, in colluvium on rock terrace a few meters downslope from cave (SE-3), assoc with thin-walled (av 5mm) pottery with incised, panelled decoration and microlithic industry of mostly quartz. *Comment* (JRFB): date considerably younger than expected. Contamination must have been great, since no natural stratigraphy was observed and immediately overlying layer contained very recent pottery.

Kisii series

Material from various sites in Kisii Dist, W Kenya. Coll 1971 and subm by J R F Bower, Lake Forest College.

2090 ± 170
N-1234. Kisii 1 (Gs Jd 6) **140 BC**

Charcoal from depth ca 55cm in reddish, clayey colluvium (0° 39′ S, 34° 49′ E), assoc with pottery provisionally labelled Kisii Soft Ware.

1190 ± 75
N-1235. Kisii 2 (Gs Jd 21) **AD 760**

Charcoal from depth ca 70cm in brown, loamy colluvium (0° 40′ S, 34° 55′ E), assoc with Kisii Soft Ware on burnt clay floor with hearth stones.

165 ± 90
N-1236. Kisii 3 (Gt Jc 7) **AD 1785**

Charcoal from depth ca 60cm in midden-stained soil (0° 49′ S, 34° 44′ E), assoc with pottery provisionally labelled Button-Necked, lying among hearth stones (?).

1650 ± 90
N-1237. Kisii 4 (Gt Jc 9) **AD 300**

Charcoal from depth ca 60cm in reddish brown colluvium (0° 53′ S, 34° 43′ E), assoc with pottery of Indeterminate type (decoration consisted in short vertical incisions around rim, horizontal bands of punctuations around body, and multiple parallel U-grooved incisions), chipped stone tools, and very friable bone.

General Comment (JRFB): wide gaps in dates are not surprising, since KSW ware (N-1234 and -1235) differs markedly from both BNP ware (N-1236) and Indeterminate ware (N-1237), and the latter 2 are equally divergent in appearance. Of interest, however, is the gap between the 2 KSW dates and the fact that they bracket date for Indeterminate ware.

Ngungani series

Charcoal from archaeol site at Ngungani, Chyulu Hills, Machakos Dist, Kenya (2° 35′ S, 37° 50′ E). Coll and subm 1972 by R C Soper. *Comment* (RCS): expected age is within present millennium and comparable to N-290 (435 ± 105: R, 1968, v 10, p 342).

985 ± 75
N-1316. Ngungani 1 **AD 965**

NG72, Hp14 WI (4). From depth 90cm, assoc with hut floor.

430 ± 75
N-1317. Ngungani 2 **AD 1520**

NG72, HcJp3 (3). From depth 50cm in large ash heap.

General Comment (RCS): N-1317 compares closely with N-290. N-1316 was expected to be contemporary with other 2 on preliminary examination of pottery, but a detailed study has not yet been made; sample came from very localized area and may have been contained in pre-existing animal burrow.

Kwelikwiji series

Material from Kwelikwiji site, Ngulu Hills, Morogoro Area, Tanzania (6° 6′ S, 37° 33′ E), assoc with Early Iron age pottery of Kwale type. Coll and subm 1972 by R C Soper.

3210 ± 85
N-1287. Kwelikwiji 1 **1260 BC**

Charcoal from depth 18 to 22cm in red-brown clay.

3050 ± 85
N-1288. Kwelikwiji 2 **1100 BC**

Charcoal from depth 30 to 40cm, in red-brown clay.

General Comment (RCS): dates are > 1000 yr earlier than comparable sites to N. Kwale ware sherds were from 15 to 45cm below surface, and nondescript quartz industry from 35 to 60cm, with abundant charcoal also from 15 to 45cm. Either the charcoal dates the stone industry and there has been some disturbance, or the charcoal comes from a very old tree (unlikely to be this old), or Kwale ware really is this old and dates back to pre-Iron age.

370 ± 100
N-1145. Nhunguza Ruin **AD 1580**

Piece of structural timber supporting roof of main hut in Zimbabwe-type ruin from Nhunguza ruin (Garlake, 1973a), S Rhodesia (17° 23′ S, 31° 14′ E). Coll and subm 1971 by P S Garlake, Univ of Ife.

Ruanga Ruin series

Charcoal from Ruanga ruin (Garlake, 1973a), S Rhodesia (17° 2′ S, 31° 41′ E). Coll and subm 1971 by P S Garlake.

450 ± 85
N-1146. Ruanga ruin 1 **AD 1500**

Charcoal from depth 45cm in midden in Zimbabwe-type ruin, assoc with "Zimbabwe-type" pottery and walling.

775 ± 100
N-1147. Ruanga ruin 2 **AD 1175**

Charcoal from depth 1.1 to 1.3m in midden, assoc with "Musengezi-type" pottery, underlying "Zimbabwe" deposits.

1070 ± 105
N-1148. Tafuna Hill **AD 880**

Charcoal from Tafuna Hill, S Rhodesia (17° 23′ S, 31° 32′ E), from depth 20 to 30cm in occupation level of Early Iron age Chitope-ware settlement (Garlake, 1971). Coll and subm 1971 by P S Garlake.

Obalara's Land series

Charcoal from site, Obalara's Land, Ife town, W Nigeria (7° 29′ N, 4° 32′ W). Assoc with apparent shrine containing terracotta sculptures of "Classical" period. Estimated age ca 12th to 14th centuries AD. Coll and subm 1972 by P S Garlake (Garlake, 1973b).

480 ± 95
N-1390. Obalara's Land 1 **AD 1470**

Charcoal from gravel surrounding concentration of pottery probably representing shrine offering.

580 ± 60
N-1391. Obalara's Land 2 **AD 1370**

Charcoal from gravel overlying a group of terracotta sculptures.

760 ± 85
N-1392. Obalara's Land 3 **AD 1190**

Charcoal from gravel underlying further concentration of pottery probably representing shrine offering.

625 ± 75
N-1393. Obalara's Land 4 **AD 1325**

Charcoal from gravel amongst concentration of human bones close to group of terracotta sculptures.

Begho series

Charcoal from archaeol remains at Begho, trading town in AD 1400 to 1700, near Hani, Brong Ahafo Region, Ghana (7° 15′ N, 2° 28′ E). Coll and subm 1970 by M Posnansky, Univ Ghana (Posnansky, 1971; Wilks, 1961).

240 ± 100
N-929. Begho 1 **AD 1710**

From Pit I, Layer 6, 3rd occupation layer assoc with many sherds. 1.24m below ground surface.

520 ± 100
N-930. Begho 2 **AD 1430**

From Pit M33, surface of Layer 6, assoc with lowest pottery horizon within very compact orange subsoil. 1.1m below ground surface.

285 ± 100
N-931. Begho 3 **AD 1665**

From Pit K39, Layer 4, midden deposit below floor of 17th century house. Assoc with mass of pottery. 0.8m below ground surface.

500 ± 100
N-932. Begho 4 **AD 1450**

From Pit K39, Layer 7, underlying floor of building dated by assoc small finds to latter half of 17th century. Assoc with well preserved burial in shallow pit. 1.3m below ground surface.

410 ± 75
N-1430. Begho 5 **AD 1540**

From Pit I, Layer 15, assoc with pottery and bones. 3.2m below ground surface.

Coronation Park series

Charcoal from Coronation Park, Salisbury, Rhodesia (17° 50′ S, 31° 6′ E). Coll and subm 1971 by T N Huffman, Natl Mus and Monuments, Rhodesia.

1240 ± 100
N-978. Coronation Park 1 **AD 710**

From sealed pit belonging to Coronation facies of Gokomere tradition (Huffman, 1971a).

970 ± 100
N-979. Coronation Park 2 **AD 980**

From village level belonging to Maxton facies of Gokomere tradition (Garlake, 1967), stratified above N-978. *Comment* (TNH): 1st dates for Coronation and Maxton facies, and they demonstrate a 1000 yr continuum of Gokomere tradition in Mashonaland.

1260 ± 65
N-1275. Makuru **AD 690**

Charcoal from Early Iron age Zhizo site at Makuru (Huffman, 1973), 16km W of Shabani, Rhodesia (20° 19′ S, 29° 58′ E). Coll and subm by T N Huffman. *Comment* (TNH): agrees with dates from Zhizo level at Leopard's Kopje Main Kraal, SR-225 and I-4862 (Huffman, 1971b), and shows that Zhizo and Coronation are contemporary facies of 2nd phase of Gokomere tradition.

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UNIVERSITY OF ROME CARBON-14 DATES XII

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This list includes age measurements carried out from January 1972 to December 1973 with previously described CO_2-proportional counters (Alessio *et al,* 1970). All archaeologic and geologic samples but one come from Italian territory.

Charcoal and wood samples underwent standard pretreatment by boiling with 5 to 10% HCl; α-labeled samples were given additional leaching with 0.2N NaOH.

The activity of our "modern standard", wood grown near Rome between 1949 and 1953, is checked repeatedly with 95% of the counting rate of NBS oxalic acid and measurements are found coincident within 1σ. For each sample of CO_2, the counting rate was corrected according to mass-spectrometrically measured $^{13}C/^{12}C$ ratio as described previously (Alessio *et al,* 1969). Dates are reported in conventional radiocarbon years, using the Libby half-life of 5568 ± 30 yr, with 1950 as the standard year of reference.

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SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC AND HISTORIC SAMPLES

A. Italy

Fimon-Molino Casarotto series

In 1943 G Trevisiol found Neolithic artifacts in peat bog near Molino Casarotto, Valli di Fimon, Berici Mts, 7km S Vicenza, Veneto (45° 28′ 56″ N, 11° 32′ 00″ E) (Trevisiol, 1944-45). Excavations were made 1969-70 and 1972 by B Bagolini, Mus Sci Nat, Trento, L H Barfield, Ancient Hist and Archaeol Dept, Birmingham Univ, and A Broglio, Ist Geol, Paleont and Paleont Umana, Univ Ferrara, on behalf of Sopr Venezie, revealing a Neolithic peri-lacustrine settlement. Three dwelling areas were uncovered, mainly built on large stacked timber platforms or "bonifica" with central superimposed hearths and surrounded by several posts set up in lacustrine lime mud, probably hut structures or platform supports; also found were large shell-middens and settlement debris. Stone industry, bone artifacts, and pottery from the 3 areas are similar and belong to early phase, Finale-Quinzano, of Square-mouthed pottery culture, Middle Neolithic (Fogolari and Broglio, 1969; Broglio and Fogolari, 1970; Barfield and Broglio, 1971; Broglio, 1973; Fogolari, Barfield and Broglio, 1972; Bagolini, Barfield and Broglio, 1973). Pollen and wood analyses (Durante Pasa, 1972; Jones, 1973) sedimentologic studies (Magaldi, 1973) and studies of human finds, flora, and fauna (Capitanio, 1971; Jarman, 1971; Jarman & Jarman, 1971) were made. Charcoal and wood coll and subm 1969-1970 by B Bagolini, L H Barfield, and A Broglio. Other samples from settlement were dated at Birmingham Lab (R, 1970, v 12, p 397; 1973, v 15, p 11).

Site 4, 1st dwelling area, main hearth

R-746. Fimon-Molino Casarotto 1 — **5690 ± 50**
3740 BC
$\delta^{13}C = -24.4‰$

R-746α. Fimon-Molino Casarotto 1 — **5570 ± 50**
3620 BC
$\delta^{13}C = -25.1‰$

Charcoal from Site 4, Sqs 39K and 38-39L, Cut 4, Phase F of main hearth, 1st dwelling area.

R-747α. Fimon-Molino Casarotto 2 — **5510 ± 50**
3560 BC
$\delta^{13}C = -26.0‰$

Charcoal from Site 4, Sq 38K, Cut 5, Phase E of main hearth, 1st dwelling area.

R-748. Fimon-Molino Casarotto 3 — **5440 ± 50**
3490 BC
$\delta^{13}C = -23.5‰$

R-748α. Fimon-Molino Casarotto 3 — **5570 ± 50**
3620 BC
$\delta^{13}C = -23.5‰$

Charcoal from Site 4, Sq 38K, Cut 5, Phase D of main hearth, 1st dwelling area.

R-757α. Fimon-Molino Casarotto 28, 29 — **5800 ± 50**
3850 BC
$\delta^{13}C = -26.2‰$

Charcoal and wood fragments from Site 4, Sq 38K, Cut 8B, Phase A of main hearth, 1st dwelling area. *Comment*: similar sample dated 1973 at 1973 at Birmingham Lab: Birm-263, Fimon-Molino Casarotto 18, 5525 ± 200 BP.

R-756α. Fimon-Molino Casarotto 27 — **5690 ± 50**
3740 BC
$\delta^{13}C = -25.1‰$

Charcoal from Site 4, Sq 38L, Cut 11, Phase A of main hearth, 1st dwelling area. *Comment*: similar sample dated 1973 at Birmingham Lab: Birm-262, Fimon-Molino Casarotto 17, 5820 ± 135 BP.

Site 4, 1st dwelling area, zone surrounding main hearth

R-749. Fimon-Molino Casarotto 4 — **5560 ± 50**, **3610 BC**, $\delta^{13}C = -24.8‰$

R-749α. Fimon-Molino Casarotto 4 — **5490 ± 50**, **3540 BC**, $\delta^{13}C = -24.6‰$

Charcoal from Site 4, Sq 38J, Cut 3, anthropic horizon at bottom of peaty level around main hearth, 1st dwelling area.

R-750. Fimon-Molino Casarotto 5 — **5260 ± 50**, **3310 BC**, $\delta^{13}C = -25.3‰$

R-750α. Fimon-Molino Casarotto 5 — **5140 ± 50**, **3190 BC**, $\delta^{13}C = -25.1‰$

Charcoal from Site 4, Sq 37J, Cut 3, anthropic horizon at bottom of peaty level around main hearth, 1st dwelling area.

R-758α. Fimon-Molino Casarotto 30 — **5730 ± 50**, **3780 BC**, $\delta^{13}C = -25.8‰$

Charcoal from Site 4, Sq 41L, Cut 6, lower part of shell midden S main hearth, 1st dwelling area.

Site 4, 1st dwelling area, peripheric hearth

R-761. Fimon-Molino Casarotto 33 — **5610 ± 50**, **3360 BC**, $\delta^{13}C = -23.8‰$

Charcoal and wood from Site 4, Sqs 35-36O, Cut 3B, shell midden in lower level of peripheric hearth, 1st dwelling area.

R-763α. Fimon-Molino Casarotto 35 — **5570 ± 50**, **3620 BC**, $\delta^{13}C = -27.3‰$

Wood fragments from Site 4, Sq 31O, Cut 3, belonging to "bonifica" of peripheric hearth, 1st dwelling area.

R-762. Fimon-Molino Casarotto 34 — **5640 ± 50**, **3690 BC**, $\delta^{13}C = -25.5‰$

Charcoal from Site 4, Sqs 34-35-36/S-T-U, Cut 3B, belonging to "bonifica" in zone surrounding peripheric hearth, 1st dwelling area.

Site 4, 2nd dwelling area

R-764. Fimon-Molino Casarotto 36 — **5370 ± 50**, **3420 BC**, $\delta^{13}C = -25.7‰$

Wood fragments from Site 4, Sq 33FF, Cut 4, anthropic horizon in zone surrounding hearth, 2nd dwelling area.

R-765α. Fimon-Molino Casarotto 37, 39 **5580 ± 50**
3630 BC
$\delta^{13}C = -25.4‰$

Charcoal from Site 4, Sqs 34/FF-GG, and 38GG, Cut 4, anthropic horizon in zone surrounding hearth, 2nd dwelling area.

R-766α. Fimon-Molino Casarotto 38 **5530 ± 50**
3580 BC
$\delta^{13}C = -25.7‰$

Charcoal from Site 4, Sq 38FF, Cut 3, anthropic horizon in zone surrounding hearth, 2nd dwelling area.

Site 3, 3rd dwelling area

R-753α. Fimon-Molino Casarotto 8 **5680 ± 50**
3730 BC
$\delta^{13}C = -25.6‰$

Partially carbonized wood from Site 3, Trench 2, Cut 2, belonging to "bonifica" of hearth recognized by Trevisiol, 3rd dwelling area.

Site 6, burial

R-754. Fimon-Molino Casarotto 9 **5960 ± 50**
4010 BC
$\delta^{13}C = -24.8‰$

Charcoal from Site 6, burial ca 150m from dwelling areas, with same pottery as found therein.

Site 1

R-752. Fimon-Molino Casarotto 7 **5590 ± 50**
3640 BC
$\delta^{13}C = -25.8‰$

Partially carbonized wood from Site 1, trench without finds, at bottom of peat level overlying lacustrine lime mud.

General Comment: 2 ages of samples pretreated with both 5%HCl only and with additional leaching by 0.2N NaOH (α-labeled samples) are generally coincident within 1σ: humic fraction obtained should not be regarded as contaminating but as belonging to partial humified material.

Rome Lab dates, from ca 6000 to 5100 BP, with a marked accumulation between 5750 and 5500, confirm 1973 Birmingham Lab dates (R, 1973, v 15, p 11). Moreover dates, most of which belong to 1st dwelling area, suggest: a) ca 250 yr between lower and upper levels of main hearth; b) correlation of peripheric hearth with middle and upper levels, F-D phases, of main hearth; c) that the 3 dwelling areas are essentially coeval whereas the burial appears older. Dates are consistent with ages of same phase of Square-mouthed pottery in Italy: Caverna delle Arene Candide, Layers 16 to 19, R-103, 5465 ± 50 BP (R, 1966, v 8, p 402) and Grotta Aisone, R-95, 5825 ± 75 BP (R, 1965, v 7, p 231).

R-952. Girella, Bagnoregio **2180 ± 50** **230 BC**
$\delta^{13}C = -24.3‰$

Charcoal from probable sacrificial level embedded in stone, closing a well, found during excavations by Soprintendenza all' Etruria Meridionale in Etruscan settlement at Girella 9.7km along state rd No. 71 (Umbro-Casentinese), Bagnoregio, prov Viterbo, Latium (42° 07′ 06″ N, 12° 01′ 06″ E). Coll 1972 and subm 1973 by M Cagiano de Azevedo, Ist Archeol, Univ Cattolica, Milan. *Comment*: archaeol deposits, consisting of building material and furnishings, and a "sacred" stone, probably from burnt building, filled well and cistern excavated in tuff and subsequently sealed by stone in 2 stages, as evidenced by embedded charcoal and ashes. Pottery dates settlement between 9th and beginning of 4th century BC (M Cagiano de Azevedo, pers commun). Corrected ^{14}C date (Ralph, Michael, and Ham, 1973) (from 410 to 360-210 BC) agrees well with upper limit of expected age.

R-897α. Catacomba di S Gennaro, Napoli **1470 ± 50** **AD 520**
$\delta^{13}C = -25.7‰$

Badly impaired wood (*Castanea vesca Gaertn*) id by E Corona (pers commun), fragment of head-piece of beam *in situ* in upper part of side wall of M gallery of St Gennaro's lower catacomb, Capodimonte, Naples. Coll 1971 and subm 1972 by Padre U M Fasola, Secr Pontificia Comm Archeol Sacra. *Comment*: M gallery, originally for burials, was reinforced by masonry arches and a beam, almost completely destroyed today, 285cm long and 20×25cm diam, measured by E Corona, since in the upper catacomb a hypogean basilica was erected and partially laid upon M gallery (Fasola, 1972; 1973). Corrected ^{14}C age of beam (AD 450 to 570) (Ralph, Michael, and Ham, 1973), in agreement with archaeol data, is extremely important historically.

B. Turkey

R-956α. Topakli, Level S **2520 ± 50** **570 BC**
$\delta^{13}C = -22.2‰$

Slightly darkened wood (*Juniperus* sp) id by M Follieri, Ist Bot, Univ Rome (pers commun), fragment of wooden pile, 38cm long, 7×3.5cm diam, from inside enclosure wall, Level S, of Phrygian town. Coll 1972 by Italian Archaeol Mission in Hôyûk of Topakli, Central Anatolia, Turkey (39° 01′ 30″ N, 34° 54′ 00″ E); subm by L Polacco, Ist Antropol, Univ Padua. *Comment*: wooden piles reinforced rough-cast enclosure wall, 4.60m thick and preserved up to a height of ca 3m (Polacco, 1972-73). Corrected ^{14}C date (Ralph, Michael, and Ham, 1973), from 800 to 740 BC, agrees with expected age for enclosure wall (700 BC) based on pottery from Level S, 900 to 700 BC.

II. GEOLOGIC SAMPLES

A. Italy

Campi Flegrei, Napoli

This series includes 3rd group of dates of carbonized wood and humified paleosol layers interbedded in pyroclasts recognized as eruptive products of Campi Flegrei volcanic region, 1st Phlegrean period. Preceding date lists (R 1971, v 13, p 403-409; 1973, v 15, p 171-176) reported the more significant outlines of long activity and structure of this volcanic system and essential bibliography.

R-857. Cava Crescenzo I-3 — **39,500 ± 2500**
37,550 BC
$\delta^{13}C = -24.1‰$

R-857$_{\beta/1}$. Cava Crescenzo I-3 — **34,500 ± 1500**
32,550 BC
$\delta^{13}C = -24.5‰$

R-857$_{\beta/2}$. Cava Crescenzo I-3 — **33,700 ± 1300**
31,750 BC
$\delta^{13}C = -24.3‰$

R-857$_{\beta/3}$. Cava Crescenzo I-3 — **33,000 ± 1200**
31,050 BC
$\delta^{13}C = -24.6‰$

R-857$_{\beta/4}$. Cava Crescenzo I-3 — **31,500 ± 1000**
29,550 BC
$\delta^{13}C = -25.0‰$

Carbonized wood embedded in humified layer underlying pumice-lapilli beneath base of Campanian gray tuff (Di Girolamo, Rolandi, and Stanzione, 1973) from Crescenzo tuff quarry near church of St Anna, ca 7km N Nocera Inferiore, prov Salerno, Campania (40° 46′ 42″ N, 14° 38′ 58″ E). Coll and subm 1971 by G Calderoni and C Cortesi, Ist Geochim, Univ Roma and P Di Girolamo and A Scherillo, Ist Min, Univ Napoli. *Comment*: R-857 sample pretreated with only 5%HCl since humic charcoal was nearly completely soluble in 0.2N NaOH. Tentatively however after acid pretreatment, another part of sample underwent subsequent extractions by 0.2N NaOH and humic acid precipitated again by boiling with dilute HCl (R-857$_{\beta/1-4}$).

Owing to age of overlying R-565 charred wood >40,000 (R, 1971, v 13, p 404), for R-857 and other previously dated samples of same humified layer, contamination by younger humic materials can be inferred (see, R-577A, -716, -716A, -717: R, 1971, v 13, p 404-405). Of these dates, R-857, 39,500 ± 2500 BP, is most reliable but, due to assumed contamination, is minimum. At Cava Crescenzo, contamination of underlying old humified layer by young humic material from present soil percolating down through fractures of Campanian gray tuff is very likely.

Tufo grigio campano or "Ignimbrite Campana" series

Two pieces of carbonized wood from Campanian gray tuff from Monte della Taglia tuff quarry ca 2km NW Cicciano, prov Naples, Campania (40° 58′ 10″ N, 14° 33′ 58″ E).

R-821A. Monte della Taglia, Cicciano I-1 — **38,000 ± 2000** **36,050 BC** $\delta^{13}C = -22.9‰$

R-821α. Monte della Taglia, Cicciano I-1 — **42,000 ± 4000** **40,050 BC** $\delta^{13}C = -23.0‰$

Fragments of branch or small trunk, (cfr *Staphylea* sp) id by M Follieri (pers commun), embedded in middle-upper part of Campanian gray tuff, yellow facies. Coll and subm 1971 by G Calderoni, C Cortesi, M Fornaseri, P Di Girolamo, and A Scherillo. *Comment*: R-821A is further sampling of R-821 (R, 1973, v 15, p 171-172).

R-856. Monte della Taglia, Cicciano I-2 — **36,200 ± 1800** **34,250 BC** $\delta^{13}C = -22.6‰$

R-856α. Monte della Taglia, Cicciano I-2 — **35,200 ± 1600** **33,250 BC** $\delta^{13}C = -22.8‰$

Fragment of large trunk (*Pinus* sp *silvestris-montana* group) id by M Follieri (pers commun) embedded in middle-upper part of Campanian gray tuff, yellow facies, near R-821A and approx same level. Coll and subm 1971 by G Calderoni, C Cortesi, P Di Girolamo, and A Scherillo. *General Comment*: R-821A and R-856 dates confirm once more Würm age of Campanian gray tuff (Campanian Ignimbrite) formation, placing it between 30,000 and >42,000 BP (*cf*, R, 1971, v 13, p 404; 1973, v 15, p 171-172).

Monte Somma-Vesuvio series

The following dates (R-935 and R-937 to R-940) include humified layers of paleosols interbedded in pyroclasts of Mt Somma-Vesuvius volcano, taken from Campanian quarry secs where more or less complete series are exposed (Di Girolamo, 1968; Di Girolamo *et al*, 1972). Samples were pretreated with 8N HCl; humic acids were extracted with 0.2N NaOH and precipitated again by boiling with dilute HCl. Coll and subm by C Cortesi, M Fornaseri, P Di Girolamo, and A Scherillo.

R-935. Codola 1 — **25,100 ± 400** **23,150 BC** $\delta^{13}C = -25.6‰$

Sec in pozzolana quarry at Codola, 3.3km along state rd No. 266, about mid-way between Nocera Inferiore and Castel S Giorgio, prov Salerno, Campania (40° 46′ 15″ N, 14° 39′ 33″ E). Exposed series of stratified pumice and ash, products of ancient and more recent activity of

Somma-Vesuvius overlying Campanian gray tuff, yellow facies, with interbedded paleosols. Humic acids from humified layer in lower part of sec embedded between Campanian gray tuff and interbedded layers of leucite-phonolite pumices and presumably phonolitic-trachyte ashes. *Comment*: R-935 date is acceptable: all Somma-Vesuvius products, including oldest ones to which R-935 belongs, being superimposed to Campanian gray tuff dated between 30,000 and >42,000 BP (see R-821A and R-856, *General Comment*, above).

Cava dell'Arciprete series

Sec, ca 4m high, in Arciprete tuff quarry, 77.8km along state rd No. 7bis, prov Avellino, Campania (40° 54′ 13″ N, 14° 45′ 12″ E) exposes stratified upper pumices and ashes of Somma-Vesuvius with 3 interbedded humified layers overlying Campanian gray tuff, yellow facies. Samples are from upper part of thick humified layers.

7870 ± 50
R-937. Cava dell'Arciprete 1 **5920 BC**
$\delta^{13}C = -25.5‰$

Humic acids from humified layer underlying prehistoric pumices overlying Campanian gray tuff, yellow facies.

3870 ± 50
R-938. Cava dell'Arciprete 2 **1920 BC**
$\delta^{13}C = -25.9‰$

Humic acids from humified layer underlying white and gray pumice attributed to AD 79 Plinian eruption of Vesuvius (Booth *et al*, 1971) and overlying prehistoric pumice.

1630 ± 50
R-939. Cava dell'Arciprete 3 **AD 320**
$\delta^{13}C = -24.1‰$

Humic acids from humified layer overlying above mentioned white and gray pumices, underlying scoriae and lapilli belonging to more recent unidentified eruption of Vesuvius.

General Comment: dates confirm stratigraphic position of the whole series overlying Campanian gray tuff. R-937, relatively recent compared to Campanian gray tuff, can be explained by a probable erosion of more ancient products of Mt Somma, present in secs of surrounding areas. R-938 is consistent with R-940, below, both underlying products of probable Plinian age. Recent age of R-939 is also acceptable.

4340 ± 50
R-940. Altavilla Irpina 1 **2390 BC**
$\delta^{13}C = -25.8‰$

Humic acids from humified layer overlying reworked pumice superimposed on Campanian gray tuff, mainly in gray facies, and underlying white and gray pumice attributed to AD 79 Plinian eruption of Vesuvius. Sec in tuff quarry along Pietrastornina stream, ca 1km W Altavilla Irpina, prov Avellino, Campania (41° 00′ 28″ N, 14° 46′ 03″ E). *Comment*: see R-938, *General Comment*, above.

B. Pontine Islands

R-943. Ventotene **>41,000**

$\delta^{13}C = -24.0‰$

Carbonized wood, fragment of branch embedded in lower level of chaotic pumice at Parata Grande, cliff NW coast of Ventotene I, E Pontine Is, Thyrrenian Sea (40° 47′ 50″ N, 13° 25′ 38″ E) at + 4 to 6m. Coll 1972 and subm 1973 by P Di Girolamo. The pyroclastic complex, ca 30m high, NE dip direction, overlies trachy-basalt lava and exposes from top: a) more or less lithified tuffs, ca 10 to 15m thick; b) chaotic pumice stratum, ca 6m thick, with embedded charred branches, 10 to 20cm diam; c) various interbedded levels of paleosols and pumice, ca 7 to 8m thick. *Comment*: 2 K/Ar dates are available for trachy-basalt lava, also outcropping on large areas in SW Is, 1.7m yr and <2m yr (Barberi *et al*, 1967). Nevertheless R-843 date was requested since no data were available for age of overlying pyroclastic complex which, despite age of lava, might also be the product of a much more recent eruption.

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SOUTHERN METHODIST UNIVERSITY RADIOCARBON DATE LIST I

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INTRODUCTION

The SMU Radiocarbon Laboratory is operated by the Department of Geological Sciences within the Institute for the Study of Earth and Man. One laboratory room contains the benzene synthesis system where samples are pretreated and converted to CO_2 in a standard way and gas is purified after the procedures of Broecker (1957) by passage through hot CuO, 10% $AgNO_3$ solution, chromic acid, hot copper, and P_2O_5 via cryogenic pumping with liquid nitrogen. Purified CO_2 is then converted to Li_2C_2 which is hydrolized to C_2H_2 and converted to C_6H_6 catalytically following the procedures of Noakes *et al* (1966). Carbon dioxide and benzene yields are routinely in excess of 90% in both cases.

Liquid scintillation counting is performed in a separate room utilizing a lead-shielded Intertechnique LS-20 counter optimized for handling 3ml of benzene. Principle innovations in optimizing the counter were 1) lining the sample chamber with ca 1cm "quiet" lead to accommodate 2) a pure quartz spectrophotometric cell as counting vial, and 3) adding the scintillator as a precisely weighed powder (0.91% butyl PBD) directly to the sample benzene, thus eliminating the dilution of the sample by a scintillator solution. All samples are transfered via syringe to reduce contact with oxygen.

The count rate for the NBS oxalic acid radiocarbon dating standard is ca 23cpm (specific activity = 8.92cpm/gC) and the background count, using benzene produced from Pennsylvanian anthracite is ca 3cpm yielding a figure of merit (S^2/B) of 143. One to 4 unknown samples are counted between counting runs of background and standard which are statistically averaged for calculating the ages. All samples are counted for at least 1400 min and monitored by printouts every 100 min.

The liquid scintillation counting and benzene conversion systems which will be described in detail elsewhere (Haas & Haynes) have been in operation since the fall of 1972 and routine age analyses were begun in January 1973. Several months of analyzing standards, backgrounds, and samples of known age reveal a high degree of precision and reliability in all systems. Prior to 1973, 130 samples pretreated at SMU were analyzed and dated at the University of Texas radiocarbon laboratory and appear in Valastro *et al* (in press).

The complete methane conversion and counting system of the Mobil Field Research Laboratories was donated to Southern Methodist University and is now a part of our radiocarbon dating facilities at the Institute for the Study of Earth and Man. After installation, testing, and dating of the first eleven samples (SMU-1-11) the CH_4 system was shut down for repairs and modifications, and current plans are to optimize it for the CO_2 counting of very small samples.

ACKNOWLEDGMENTS

The SMU Radiocarbon Laboratory was created through the generosity and forethought of the late William B Heroy, who provided the space and most of the equipment for which we are most grateful. Claude C Albritton, James E Brooks, William B Heroy, Jr, and Fred Wendorf promoted the laboratory within the Institute for the Study of Earth and Man, and without their wholehearted support it could not have been established. Michael J Holdaway provided controlled heating equipment and collaborated in the initial experiments in pyrolyzing bone samples.

E Mott Davis and Sam Valastro, Texas Memorial Museum, arranged analysis and dating of our samples before 1973 at the University of Texas laboratory. Close cooperation has been maintained between the two laboratories and special gratitude is due Sam Valastro and Alejandra G Varela for their help and advice in constructing our benzene synthesis system.

We gratefully acknowledge the gift of the Mobil Field Research Laboratory's methane dating system and thank S M Foulks and J S McNiel, Mobil Research and Development Corp, and Fred Wendorf, SMU for arranging this. John R Cooper, Operator of the Mobil Lab, assisted us in setting up the equipment and dating the first samples.

Indispensible technical assistance in the field and laboratory was provided by Steven Haney, Don Henry, Afifa Hassan, Nancy Neubert, Joe Davis, and Robert Leeper and secretarial work was provided by Marlene Altman, Elise Murphy, and Barbara Doolin. Financial support is provided by the Institute for the Study of Earth and Man, the National Science Foundation (Grants GA-12772 and GA-35625), and the National Geographic Society, which sponsored six years of archaeologic excavations at the Murray Springs Clovis site in Arizona.

Finally, to Paul E Damon and Austin Long, University of Arizona, the senior author is indebted for invaluable experience in the fine points of radiocarbon dating.

SAMPLE DESCRIPTIONS

The samples are classified into (I) Geochemical Samples, (II) Geochronolgic Samples, and (III) Archaeologic Samples. Under the first heading are samples analyzed not for dating *per se* but for calibration, interlaboratory checks, isotopic content, and tests for contamination or geochemical alteration. Where such samples are a part of a series of dated samples they are included with the series under Geochronologic Samples. The latter are all those analyzed primarily for dating purposes and include paleoecologic samples. Archaeological samples are listed separately and all samples are subheaded by geographic area.

I. GEOCHEMICAL SAMPLES

SMU-11. Crude oil FRL-1 **>36,900**

Sample of unknown provenience subm 1972 by Henry F Nelson, Mobil Field Research Lab. Analyzed for possible contamination by organic substances of Modern age. *Comment*: sample is uncontaminated within limits of detectability.

11,850 ± 70
SMU-12. Spruce wood **9900 BC**

11,740 ± 140
SMU-16. Spruce wood **9790 BC**

Sample from Appleton, Wisconsin, 4.2m below plain of glacial Lake Oshkosh (44° 24′ N, 88° 25′ W) run as interlaboratory check with Tx-541, 11,620 ± 80 on same wood specimen. Should be same age as Two Creeks Forest Bed. *Comment*: agrees well with other dates summarized with Tx-541 (R, 1970, v 12, pp 249-250).

130 ± 50
SMU-13. Greenwade House, B **AD 1820**

Wood from foundation post of pioneer log cabin built in middle 1850's in Brazos R valley near Whitney, Texas (31° 54′ N, 97° 23′ W) run as an interlaboratory check with Tx-540, 120 ± 50 on the same wood specimen (R, 1970, v 12, p 249).

II. GEOCHRONOLOGIC SAMPLES

A. Arizona

Murray Springs site (31° 34′ 15″ N, 110° 10′ 38″ W), San Pedro Valley, Cochise Co, Arizona (Ariz: EE:8:25) is a buried Clovis hunting camp and kill site where artifacts assoc with mammoth, bison, and horse occur within a sequence of late Quaternary sediments (Haynes & Hemmings, 1968; Hemmings, 1970). Samples are classified in stratigraphic order by geologic unit. Investigations supported by Natl Geog Soc (Archaeol) and Natl Sci Foundation (Geol). Coll 1966-1973 and subm by C V Haynes.

Murray Springs Unit F_1 series

Unit F_1 (Graveyard sand member, Lehner formation) is a coarse sand and gravel channel deposit of a small stream along which mammoth and bison were killed by Clovis hunters. Remains of extinct forms of horse and camel occur in lower portions of channel fill but not in upper part where Clovis artifacts are concentrated. Charcoal dated from several occurrences to determine time range of deposition. A-805, 11,230 ± 340 (R, 1967, v 9, p 11) is from same unit.

8770 ± 70
SMU-17. Charcoal, Loc 1, Sq C4 **6820 BC**

11,730 ± 180
SMU-18. Charcoal, Loc 2, Sq F2 **9780 BC**

SMU-41. Charcoal, Loc 2, Sq E3 **10,840 ± 70**
8890 BC

SMU-42. Charcoal, Loc 2, Sq E1 **10,840 ± 140**
8890 BC

SMU-43. Humates from SMU-42 **11,160 ± 110**
9210 BC

SMU-19. Humates, Trench 28 **10,740 ± 190**
8790 BC

SMU-29. Humates, Trench 28 **10,790 ± 150**
8840 BC

SMU-27. Charcoal, Trench 20 **10,890 ± 180**
8940 BC

SMU-28. Humates from SMU-27 **11,210 ± 200**
9260 BC

Comment: all except SMU-17 indicate a millennium or less for deposition of Unit F_1. SMU-17 was analyzed after treatment with preservative for wood identification tests at College Agric, Univ Arizona. All Unit F_1 wood identifications are ash (*Fraxinus* sp).

Murray Springs Unit E series

Unit E, Coro marl member, Murray Springs formation, is a pond or emergent water table deposit of calcium carbonate that dried up and was eroded by Unit F_1 channel prior to deposition of Graveyard sand. Previous dates on carbonate CO_2 (Valastro *et al,* in press) overlap with dates on more reliable charcoal from younger units indicating contamination by exchanged CO_2. This series was run on organic carbon residue recovered after pyrolysis followed by acid removal of carbonates. Uppermost sample (#2) occurred 20cm below eroded upper contact and lowermost sample (#11) occurred 20cm above basal contact of a 2m sec of marl exposed in S wall of S branch of Curry Draw 70m E of Loc 1, Stake AO.

SMU-33. Residue #2 **11,880 ± 250**
9930 BC

SMU-34. Residue #4 **13,980 ± 190**
12,030 BC

SMU-35. Residue #6 **18,060 ± 150**
16,110 BC

SMU-36. Residue #8 **16,810 ± 420**
14,860 BC

SMU-37. Residue #10 **27,560 ± 2300**
25,610 BC

19,650 ± 1400
SMU-38. Residue #11 **17,700 BC**

Comment: all ages should be considered minimum due to possible contamination by organic matter from overlying soil.

500 ± 80
SMU-39. Curry Draw, Unit G_3 **AD 1450**

Charcoal from base of 2.4m alluvial terrace exposed in N bank of Curry Draw opposite Murray Springs homestead (31° 34′ 20″ N, 110° 10′ 05″ W) 13km E of Sierra Vista, Cochise Co, Arizona. Coll and subm 1972 by C V Haynes. *Comment*: dates beginning of youngest alluvial fill prior to modern arroyo cutting.

3190 ± 80
SMU-40. Curry Draw, Unit G_{2a} **1240 BC**

Charcoal from hearth 1.2m below surface of 2.4m alluvial terrace and 3m below contact with overlying Unit H exposed in N bank of Curry Draw 1.5km W of Lewis Springs (31° 31′ 50″ N, 110° 09′ 05″ W), Cochise Co, Arizona. Coll 1972 and subm by L Escapule and C V Haynes. *Comment*: dates upper part of Unit G_{2a} (McCool member, Escapule formation).

1100 ± 110
SMU-47. Contention hearth (24-4) **AD 850**

Charcoal from hearth 1.5km below surface of 2.4m alluvial terrace along unnamed arroyo at Contention (31° 40′ N, 110° 12′ W) Cochise Co, Arizona. Coll and subm 1972 by N Johnson and C V Haynes. *Comment*: alluvium is equivalent to Unit G_{2b} at Murray Springs.

3070 ± 60
SMU-45. Contention hearth (24-3) **1120 BC**

Charcoal from rock hearth 1m below surface of 8m alluvial terrace of San Pedro R at Contention (31° 46′ N, 110° 12′ W) Cochise Co, Arizona. Coll and subm 1972 by N Johnson and C V Haynes. *Comment*: dates near end of deposition of intermediate of 3 alluvial fills equivalent to Unit G at Murray Springs.

1150 ± 50
SMU-46. Horsethief Draw hearth (24-9) **AD 800**

Charcoal from hearth with Hohokam potsherds 0.5m below surface of 3.7m terrace exposed by N bank Horsethief Draw (31° 31′ 30″ N, 110° 08′ 53″ W) Cochise Co, Arizona. Coll and subm 1972 by L Escapule and C V Haynes. *Comment*: equivalent to Unit G_{2b} at Murray Springs.

Winkelman Hearth (BB:2:13) series, Arizona

4490 ± 70
SMU-48. Hearth #3 (13-33) **2540 BC**

9.2m below terrace surface, N wall.

SMU-54. Hearth #2 (13-32) **3940 ± 60**
1990 BC

8.3m below terrace surface, S wall.

Charcoal from 13m alluvial terrace exposed in arroyo crossing Hwy 77 ca 14km S of Winkleman (32° 52′ N, 110° 43′ W) Pinal Co, Arizona. Coll and subm 1972 by J E Ayres and C Cronin. *Comment*: equivalent to Unit G_1 at Murray Springs.

SMU-59. Escapule hearth **930 ± 50**
AD 1020

Charcoal exposed in colluvium 0.3m below surface exposed by a rill 2.4km NW of Lewis Springs (31° 36′ N, 110° 10′ W) Cochise Co, Arizona. Coll and subm 1972 by L Escapule and C V Haynes.

SMU-15. Boquillas hearth **390 ± 50**
AD 1560

Charcoal from rock hearth on intermediate terrace 1.4km E of abandoned Boquillas RR sta (31° 47′ N, 110° 13′ W) Cochise Co, Arizona. Coll and subm 1970 by L Escapule and C V Haynes.

B. Colorado

Frazier site series

SMU-32. Humates, 1st extraction **9550 ± 130**
7600 BC

SMU-31. Humates, 2nd extraction **9650 ± 130**
7700 BC

Average 9600 ± 130

Buried dark gray organic soil horizon on gray sandy clay exposed in W wall of ravine cutting through Frazier Agate Basin site (Loc 2) on Kersey terrace 2km NW Kersey (40° 22′ N, 104° 35′ W) Weld Co, Colorado. Coll and subm 1966 by C V Haynes. *Comment*: date is probably minimum for Agate Basin horizon.

C. Florida

SMU-14. Aucilla peat **37,880 ± 2000**
35,930 BC

Lower 1/3 of 5m core from bottom of Aucilla R 1.6km SW of Nutall Rise (30° 08′ N, 83° 95′ W) Jefferson Co, Florida. Numerous bones of extinct Pleistocene animals and artifacts, some paleo-Indian, were on river bottom 5 to 10cm depth. Coll and subm 1972 by R Ohmes, Chairs, Florida, and L Workman and A R Saltus, Jr, Florida Dept of State, Tallahassee. *Comment* (CVH): sample predates fauna and culture.

D. Missouri

SMU-78. Philips Spring **7870 ± 90**
5920 BC

Wood fragments from clayey peat 310cm below surface of 8m alluvial terrace of Pomme de Terre R at Philips ford (38° 03′ 37; N, 93° 19′

10″ W) Hickory Co, Missouri. Coll and subm 1973 by C V Haynes. *Comment*: dates upper part of alluvium correlated with that at Rodgers Shelter (Wood & McMillan, 1974).

E. Nebraska

Hudson-Meng series

SMU-49. Bone carbonate CO_2 #1 **115.3 ± 1.0% modern**

SMU-50. Bone carbonate CO_2 #2 **109.8 ± 1.4% modern**

8520 ± 110
SMU-51. Bone apatite CO_2 #1 **6570 BC**

8990 ± 190
SMU-52. Bone apatite CO_2 #2 **7040 BC**

Bone from extinct bison at Hudson-Meng paleo-Indian site 22km NW of Crawford (42° 49′ N, 103° 36′ W) Sioux Co, Nebraska. Bone treated to separate successive stages of CO_2 first from secondary calcite and then from apatite. Coll and subm 1971-73 by L D Agenbroad, Chadron State College. *Comment*: each successive stage is older suggesting that last stage is less contaminated.

F. New Mexico

Sandia Cave series

2250 ± 50
SMU-76. Wood (*Pinus* sp) **300 BC**

1890 ± 90
SMU-77. Charcoal **AD 60**

Samples from rodent deposit within older deposits of Sandia Cave (35° 15′ 30″ N, 106° 24′ W) 28km NW of Albuquerque, Sandoval Co, New Mexico.

G. Texas

North Sulphur River series

Samples from alluvium underlying flood plain of N Sulphur R in vicinity of Ben Franklin, Delta Co, Texas. Coll and subm by M Rainey, Southern Methodist Univ. Previous investigations by Slaughter and Hoover (1963).

2840 ± 60
SMU-62. Mussel shells **890 BC**

Shells from Unit B_2 1.6m above contact with Unit B_1 exposed in right bank Sulphur R 2.4km NE of Ben Franklin (33° 20′ 35″ N, 95° 45′ 10″ W).

660 ± 70
SMU-70. Charcoal **AD 1290**

Dispersed charcoal from late alluvium exposed by left bank of Ghost Creek 2.2km NW of Ben Franklin (33° 30′ N, 95° 40′ W).

SMU-71. Charcoal **1790 ± 50**
AD 160

Dispersed charcoal from base of Unit B_1 on truncated soil exposed in right bank Sulphur R 1.3km N of Ben Franklin (33° 29′ 40″ N, 95° 45′ 55″ W).

H. Egypt

Bir Sahara series

Sediments containing Pleistocene faunas and artifacts exposed in a deflation basin at Sahara well in Western Desert 375km W of Abu Simbal on the Nile R (22° 52′ N, 28° 36′ E). Carbonate fraction of mollusk shells analyzed. Coll 1973 by C V Haynes and subm. by F Wendorf.

SMU-75. Pelecypod shells **30,870 ± 1000**
28,920 BC

From desert surface and underlying lacustrine silt at Loc BS-15.

SMU-79. Gastropod shells **>44,680**

High-spired snail shells from lacustrine silt of younger ponding interval 20 to 50cm below surface at Loc BS-15. *Comment*: date of SMU-79 indicates that shells from surface in SMU-75 were contaminated, probably by exchange with atmospheric CO_2, despite strong acid leaching prior to analysis. Aterian horizon at Bir Tarfawi 11km E is tentatively correlated with these beds.

SMU-80. From surface (BS-13) **32,780 ± 900**
30,830 BC

SMU-82. Coll by flotation (BS-16) **40,710 ± 3270**
38,760 BC

SMU-81. Hand picked large specimens (BS-16) **>41,450**

High-spired gastropod shells (*Melanoides*?) from marl of older ponding interval. Stratigraphically below silt of SMU-79. *Comment*: results indicate contamination by exchange and secondary calcification can be avoided if high-spired shells are crushed and fragments selected for ultrasonic cleaning and leaching. Series indicates both Aterian and Mousterian occupations were prior to 44,680 BP.

I. Ethiopia

The archaeology and Quaternary geology of the Gala Lakes region of the Ethiopian rift are under investigation by scientists from Belgium, Ethiopia, Poland and the United States with support from the Natl Sci Foundation (Grant GS-27325 to Fred Wendorf) and the Inst for the Study of Earth and Man at SMU.

Efforts are being concentrated on geochronology (Albritton, 1973; Laury and Albritton, in press) and paleolithic archaeology (Wendorf and Schild, 1973) of Quaternary volcanics and sediments around W half of Lake Ziway in Shoa Prov.

SMU-60. Modern *Bulinus* shells **149.7 ± 0.5% modern**

Snail shells from shore of Lake Ziway at village of Ziway (7° 56′ 18″ N, 38° 43′ 24″ E) Shoa Prov. Coll 1973 by R Daugherty and subm 1973 by C V Haynes. *Comment*: analysis reflects nuclear-age atmospheric content of ^{14}C, indicating that no age correction is necessary for dating fossil shells of same species.

Terrace III series

Shells (6VH73) from lacustrine volcanic ash 0.5 to 1m below surface of 3rd terrace above Lake Ziway 1.7km NE of Abosa village (8° 2′ 6″ N, 38° 44′ 6″ E). Several species from same deposit analyzed to cross check for age discrepancies between species and allow for correction via SMU-60. Coll and subm 1973 by C C Albritton, R L Laury, and C V Haynes.

SMU-66. *Corbicula* shells **7880 ± 290**
5930 BC

SMU-68. *Melanoides* shells **5570 ± 90**
3620 BC

SMU-69. *Bulinus* shells **5370 ± 60**
3420 BC

Comment: SMU-60 indicates that *Bulinus* shell yields correct date and SMU-68 and -69 indicate *Melanoides* is within 2σ of correct age, but *Corbicula* shell can be 2500 yr too old.

Latrine pit series

Shells (5VH73) from upper 2 faunal zones in lacustrine volcanic ash 2m below surface of 4th terrace above Lake Ziway at S side of Abosa village (8° 01′ 18″ N, 38° 43′ 12″ E). Coll and subm 1973 by C C Albritton, R L Laury, and C V Haynes.

SMU-63. *Corbicula* shells **9090 ± 100**
7140 BC

SMU-64. *Melanoides* shells **9330 ± 100**
7380 BC

Comment: 2 species provide comparable ages despite discrepancy suggested by SMU-66 and -68.

SMU-65. *Bulinus* shells **4800 ± 70**
2850 BC

SMU-67. Same as SMU-65. **5050 ± 100**
3100 BC
Average 4930 ± 100

Shells (4VH73) from 10 to 30cm below surface in lacustrine volcanic ash exposed by rd to pantellerite quarry 3.25km W of Ziway (7° 56′ 30″ N, 38° 40′ 30″ E). Coll and subm 1973 by C C Albritton, R L Laury, and C V Haynes. *Comment*: dates are on 2 batches (splits) from same sample. Older value is probably closer to true age.

SMU-61. *Corbicula* shells **26,780 ± 440**
24,830 BC

Shells (1VH73) from lacustrine volcanic ash exposed 2 to 4m above channel in right bank of Bul Bulla R at missionary school 3.4km NE of Adamitullu (7° 53′ 24″ N, 38° 43′ 48″ E). Coll and subm 1973 by C C Albritton and C V Haynes. *Comment*: date is probably minimum because contamination by exchange with nuclear-age CO_2 is more critical with older samples.

SMU-72. Locality 19 **11,510 ± 110**
9560 BC

Charcoal (9VH73) from 80cm below surface in red soil developed in pumiceous lapilli deposit on hillside 9.6km SW of Adamitullu (7° 48′ 36″ N, 38° 37′ E). Coll and subm 1973 by R L Laury and C V Haynes. *Comment*: dates episode of ash fall and provides maximum age for soil development on ash.

Macho series

Samples from archaeologic sites in Macho area 9.3km WSW of Adamitullu (7° 50′ N, 38° 36′ 18″ E). Coll and subm 1973 by G K Humphreys, SMU.

SMU-83. Macho Site II **230 ± 50**
AD 1720

Charcoal from fire pit dug through thin pumiceous lapilli deposit overlying yellowish-brown soil on underlying ash. *Comment*: postdates latest ash fall in Macho area.

SMU-84. Macho Site I **1540 ± 60**
AD 410

Burnt stump in yellowish-brown soil in small erosional escarpment. *Comment*: dates lapilli fall that burned trees.

III. ARCHAEOLOGIC SAMPLES

A. New Mexico

Armijo Draw series

Samples from preceramic hearths exposed in pipeline trench crossing several tributaries of Armijo Draw near Cerrito Redondo, Sandoval Co, New Mexico. Coll and subm 1968 by P J Mehringer and C V Haynes. Archaeology of area is being studied by C Irwin-Williams (1968).

SMU-55. Hearth #2 humates **2210 ± 40**
260 BC

Hearth below surficial brown soil in eolian sand and 2.1km W of Cerrito Redondo (35 25′ 05″ N, 106° 53′ 50″ W).

SMU-56. Hearth #3 charcoal **3390 ± 200**
1440 BC

2770 ± 50
SMU-57. Humates from SMU-56 **820 BC**

Hearth on white sand below surficial brown soil 2.3km W of Cerrito Redondo (35° 25′ 20″ N, 106° 54′ W).

4000 ± 60
SMU-20. Hearth #6 charcoal **2050 BC**

3800 ± 220
SMU-21. Humates from SMU-20 **1850 BC**

Hearth with heating stones below truncated red soil in light brown fluvial sand 2km SW of Cerrito Redondo (35° 24′ 25″ N, 106° 53′ 20″ W). *Comment*: humates dates are consistently too young, hence SMU-55 is minimum for preceramic occupation of Armijo area.

3190 ± 80
SMU-58. Humates from charcoal **1240 BC**

Finely divided charcoal from hearth (11-1) in red soil in eolian sand on pediment surface 16km SE of Belen (34° 35′ N, 106° 40′ W) Valencia Co, New Mexico. Folsom and Bajada artifacts found on surface. Coll and subm 1966 by E Baker and C V Haynes. *Comment*: charcoal was insufficient for analysis and humate date is minimum for Archaic occupation.

B. Ethiopia

Waso series

Samples from archaeologic site on hill top 8.75km SW of Adamitullu (7° 48′ 48″ N, 38° 37′ 30″ E). Coll and subm 1973 by G K Humphreys.

1350 ± 40
SMU-85. Waso Site I **AD 600**

Burnt stump in red soil with root extending down from contact with overlying pumice lapilli deposit. *Comment*: dates ash fall that burned trees. Difference from SMU-84 is possibly due to different ages of trees.

10,330 ± 90
SMU-86. Waso Site III **8280 BC**

Charcoal from late Stone age site in red soil in volcanic ash and 10cm below contact with overlying pumice lapilli deposit. *Comment*: dates late Stone age occupation during ash deposition either before or during early stage of red soil development.

C. Israel

Aqev Spring series

Charcoal from a Late Levantine Upper Paleolithic site (E22D31), 4.5km SE of Midrasha Sde Boker (30° 49′ 02″ N, 34° 48′ 39″ E), Negev, Israel. Exposed in wadi terrace in tributary of Nahal Zin. Coll and subm 1971 by A E Marks, SMU.

17,890 ± 600
SMU-6. 30 to 40cm depth **15,940 BC**

SMU-8. 45 to 50cm depth **17,390 ± 560**
15,440 BC

SMU-5. 50 to 55cm depth **19,980 ± 1200**
18,080 BC

Comment (AEM): SMU-6 and -8 agree well with previous dates; I-5494 and -5495 (R, 1973, v 15, p 295). SMU-5 appears aberrant but overlaps with other dates at 2σ.

SMU-7. Ein Avdat **18,840 ± 680**
16,890 BC

Charcoal from fire pit at Geometric Kebaran "A" site (E22D5) on a terrace of Nahal Zin, near spring of Avdat, 0.8km SW of Midrasha Sde Boker (30° 51′ 24″ N, 34° 46′ 31″ E), Negev, Israel. Exposed at 30cm depth. Coll and subm 1971 by A E Marks. *Comment* (AEM): date is questionable given conflicts with previous dates; Tx-1121 (R, 1972, v 14, p 484) and I-5498 (R, 1973, v 15, p 296). No 2 dates are consistent.

Har Harif series

Charcoal from midden at Natufian site Rosh Horesha (E22G7) in Nahal Horesha, 26km WSW of Mitzpe Ramon (30° 30′ 50″ N, 34° 30′ 40″ E), Negev, Israel. Coll and subm 1971 by A E Marks.

SMU-9. Feature 13, 35 to 45cm **10,490 ± 430**
8540 BC

SMU-10. Features 15 & 16, 35 to 45cm **10,880 ± 280**
8930 BC

Comment (AEM): dates seem acceptable in light of other Natufian dates, indicating Natufian was not significantly later in Negev than in N, although typologically this site is not "Early Natufian". Dates are slightly younger than I-5496 (R, 1973, v 15, p 295) from same site.

SMU-3. Nahal Zin **8900 ± 180**
6950 BC

Charcoal from large fire pit in pre-Pottery Neolithic site Nahal Divshon (E22D1) in floor of Nahal Zin, 1km SSW of Midrasha Sde Boker (30° 50′ 30″ N, 34° 47′ 10″ E), Negev, Israel. Coll and subm 1971 by A E Marks. *Comment* (AEM): date agrees with I-5501 (R, 1973, v 15, p 296) and Tx-1123 (R, 1972, v 16, p 484) from same site.

D. Sudan

Wadi Halfa series

Charcoal from Site DIW-50 in post-Arkin formation silts along W bank of Nile R 4.0km N of Wadi Halfa (22° 00′ 30″ N, 31° 20′ 15″ E) Sudanese Nubia. Coll 1964 by W Chmielewska and subm 1971 by F Wendorf, SMU.

SMU-1. Trench 1, 5CH **5410 ± 150**
3460 BC

SMU-2. Trench 1, 7CH

5880 ± 150
3930 BC

Comment (FW): previous dates for same cultural level are 5600 ± 200 (WSU-174). See Chmielewska, in Wendorf (1968).

SMU-4. Trench 10 CH (DIW-53)

7910 ± 120
5960 BC

Charcoal from fire pit in post-Arkin formation silt along W bank Nile R 3.9km N of Wadi Halfa (22° 00′ 30″ N, 31° 22′ 12″ E) Sudanese Nubia. Coll 1964 by W Chmielewska and R Schild and subm 1972 by F Wendorf. *Comment* (FW): should be younger than 7440 ± 180 BC (WSU-175) and older than 3650 ± 200 BC (WSU-174). See Schild *et al*, in Wendorf (1968).

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UNIVERSITY OF TOKYO RADIOCARBON MEASUREMENTS V

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Most of the ^{14}C measurements reported here were made between August 1970 and August 1972. Chemical treatment of samples and counting technique remain as described previously (R, 1968, v 10, p 144-148; 1971, v 13, p 97-102). We have added Houtermans-Oeschger type multi-anode anticoincidence gas proportional counter, manufactured by Tokyo Atomic, Japan. The central counter tube, which has several small holes, 5mm diam, is made of aluminized polyethylene foil, 0.06mm thick, with 72mm inside diam and 300mm sensitive length. The external counter tube is made of stainless steel 4mm thick, with 93mm inside diam and 350mm length. The anode wires of both counters are also made of stainless steel 0.05mm diam. The counters are surrounded by a paraffin shield 50mm thick and encased in a 250mm shield of steel on all sides. Acetylene is used as the counting gas at 753.3mm Hg (22 ± 1°C). Counting rates of background and 95% activity of NBS oxalic acid standard were 1.25 ± 0.02cpm and 14.39 ± 0.12cpm, respectively.

Ages are calculated using the half-life value 5570 with 1950 as the reference year. The standard deviation quoted includes only 1σ counting statistics of background, sample, and standard counts. Maximum ages are given with a limit of 43,900 years BP, corresponding to sample activity less than 3σ above background.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. Japan

TK-82. Soda **15,300 ± 100**
13,350 BC

Charred wood embedded in pumice flow bed at Soda, Tsuchiya, Hiratsuka city, Kanagawa Pref (35° 20′ 11″ N, 139° 16′ 4″E). Coll 1969 by N Katayama and T Hamada, Univ Tokyo, and subm 1969 by N Katayama. *Comment* (TH): date younger than expected, probably due to state of preservation in porous flow material overlying clay at the site.

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TK-87. Lake Shiobara-ko **24,500 ± 400**
22,550 BC

Driftwood from upper part of lake sediments, Shiobara-machi, Shioya-gun Tochigi Pref (36° 58.7′ N, 139° 47.3′ E). Coll 1970 by S Yamada and subm 1970 by F Takai, Univ Tokyo. *Comment* (A Iijima, Univ Tokyo): same horizon as TK-66 (R, 1971, v 13, p 98).

Ichihino series

TK-88. **25,800 ± 400**
23,850 BC

Carbonized tree trunk, 15cm diam, from Ito pyroclastic flow, Ichihino, Hiwaki-cho, Kagoshima Pref (31° 47′ 42″ N, 130° 25′ 4″ E). Coll by S Yokoyama, Tokyo Univ Educ, and subm 1969 by S Aramaki, Univ Tokyo.

TK-89. **25,200 ± 400**
23,250 BC

Charcoal from Ito pyroclastic flow. Same locality as TK-88. Coll 1969 by S Yokoyama and subm 1969 by S Aramaki.

TK-98. Iwato **23,500 ± 300**
21,550 BC

Carbonized tree trunk, 20cm diam, from Tsumaya pyroclastic flow, Iwato, Fukuyama-cho, Kagoshima Pref (31° 42′ 34″ N, 130° 53′ 27″ E). Coll 1970 by S Yokoyama and subm 1970 by S Aramaki.

TK-104. Shinjo-fumoto **26,500 ± 500**
24,550 BC

Carbonized log, ca 5.5cm diam, from Osumi pumice fall, Shinjo-fumoto, Tarumizu city, Kagoshima Pref (31° 25′ 27″ N, 130° 45′ 43″ E). Coll 1971 by S Yokoyama and subm 1971 by S Aramaki.

B. Chile

Southern Chile series

TK-70. Puerto Varas 1 **32,000 ± 700**
30,050 BC

Wood from base of uppermost moraines at depth 3.5m, exposed in Pan-American hwy cut at crossroads W of Puerto Varas, Llanquihue Prov, Chile (41° 19′ S, 73° 0′ 50″ W). Coll 1968 by late Shukō Iwatsuka, Univ Tokyo and Atsumasa Okada, Aichi Pref Univ, and subm by Yutaka Sakaguchi, Univ Tokyo. *Comment* (AO): age is stratigraphically incompatible with measured date of TK-71, older than expected, because terminal moraines of innermost and predominant row encircling lake Llanquihue, which included this sample, were estimated to correspond to maximum stage of last glaciation (ca 20,000 yr ago).

TK-71. Puerto Varas 2 **23,300 ± 300**
21,350 BC

Wood from ca 4.5m below surface in silt underlying moraines which included TK-70 at almost same locality as Puerto Varas 1. The silt, exposed in the EW-running hwy cut, consists mostly of water-laid volcanic ash. Coll 1968 by S Iwatsuka and A Okada and subm by Y Sakaguchi.

26,000 ± 400
TK-72. SW of Puerto Montt **24,050 BC**

Wood from ca 15m below original surface at large exposure facing SW corner of Tenglo I, SW of Puerto Montt, Llanquihue Prov, Chile (41° 31′ 13″ S, 73° 0′ 11″ W). Sample was embedded in terminal moraines around Seno (Bay) Reloncavi. Coll 1968 by S Iwatsuka and A Okada and subm by Y Sakaguchi. *Comment* (AO): date suggests earlier age at maximum stage of last glacial invasion into Seno Reloncavi.

13,900 ± 120
TK-74. SE of Puerto Montt **11,950 BC**

Wood from fluvio-glacial silt exposed in a hwy cut, ca 3km SE of Puerto Montt, Llanquihue Prov, Chile (41° 29′ S, 72° 55′ W). Site is on inner side of predominant moraines along N coast of Seno Reloncavi. Strata are slightly deformed by push of glacier ice, and are locally overlain by gravel. Probably same sample was dated at 15,400 ± 400 yr (K Segerstrom, 1964). Coll 1968 by S Iwatsuka and A Okada and subm by Y Sakaguchi. *Comment* (AO): dates suggest advanced stage of piedmont glacier after maximum phase of last glaciation.

C. Bolivia

8960 ± 180
TK-73. Potosi **7010 BC**

Peat from middle horizon, 1 to 3m thick, ca 10m below surface at ca 65km SW of Potosi city, Quijarro, Potosi, Bolivia (19° 52′ S, 66° 06′ W). The peat, probably deposited in warm climate after retreat of valley glacier, is overlain by fluvio-glacial lacustrine sediments. Original surface constitutes wide valley floor, and is dissected, 13m deep, by Rio Visicia, upper stream of Rio Yura flowing into the Pilaya, a tributary of Rio La Plata. The site, +3640m alt, is in the Cordillera Real, Cordillera Los Frailes in subdivision, a W branch of E Andean range. Coll 1968 by S Iwatsuka and A Okada and subm by Y Sakaguchi.

D. Barbados

18,400 ± 200
TK-116. St Michael, Barbados **16,450 BC**

Coral (*Montastrea annularis*) id by P Enos from Black Rock, N suburb of Bridgetown, Parish of St Michael, Barbados, West Indies (13° 07′ N, 59° 38′ W). Sample from terrace sediment younger than youngest terrace, 82,000 BP reported by Broecker *et al* (1968). Coll 1971 by A Sugimura and subm 1972 by A Iijima, Univ Tokyo. *Comment* (AS): same specimen dates 26,600 ± 1400 BP (Gak-3547); the difference is unexplained.

II. ARCHAEOLOGIC SAMPLES

A. Japan

TK-99. Minatogawa **18,250 ± 650**
16,300 BC

Charcoal from clayey soil layer 15 to 16m below surface in fissure at limestone quarry, Minatogawa, Gushikami-son, Shimajiri-gun, Okinawa Pref (26° 8′ N, 127° 46′ E). Excavated 1969-1971 by Research Group for Pleistocene Man in Okinawa. The layer yielded human skeletons including crania. Coll and subm 1970 by N Watanabe.

TK-100. Takahashi village site **1770 ± 140**
AD 180

Charred wood from floor of dwelling pit No. 12 of late Yayoi period at Takahashi village site, Toyota city, Aichi Pref (35° 6′ N, 137° 11′ E). Pottery was of Kakeyama type. Coll 1967 and subm 1970 by N Watanabe.

TK-97. Toro site **2100 ± 70**
150 BC

Cryptomeria palisade board of dike from 50cm below surface of swampy ground at Toro site, Ishida, Shizuoka city, Shizuoka Pref (34° 57′ N, 138° 33′ E). Pottery is of late Yayoi type. Coll 1947 and subm 1970 by T Sekino, Univ Tokyo. *Comment* (TS): date is older than supposed archaeol age. *Cf* 1950 ± 130 (N-70), 1940 ± 120 (N-71), 1940 ± 100 (N-73): R, 1964, v 6, p 113; 2010 ± 120 (N-74a): R, 1966, v 8, p 335; and 1960 ± 80 (Gak-793), 2060 ± 90 (Gak-794), 2300 ± 120 (Gak-795), 1720 ± 90 (Gak-796), 2590 ± 100 (Gak-797), 2240 ± 90 (Gak-798): R, 1967, v 9, p 55.

B. Iran

Dailaman series

A group of ancient tombs from many sites in valley of Dailaman (ca 36° 54′ N, 49° 55′ E) in Elburz Mts. Tokyo Univ Iraq-Iran Archaeol Expedition, led by N Egami, excavated some of them in 1960 and 1964. Reports already pub (Egami, Fukai, and Masuda, 1965; 1966; Sono and Fukai, 1968; Fukai and Ikeda, 1971).

TK-95. Charcoal **3090 ± 50**
1140 BC

Charcoal from filling of No. 7 tomb in D area on Ghalekuti hill No. II (GHA II-T.7) just above stone lid covering chamber. Coll 1964 by S Miyake and subm 1970 by S Fukai, Univ Tokyo.

TK-96. Wood of coffin **1040 ± 70**
AD 910

A piece of coffin wood belonging to Islamic period recovered from GHA II-T.4. Coll 1964 by S Miyake and subm 1970 by S Fukai.

C. Syria

Douara Cave I series

Charcoal and black humic soil from deposits of Douara Cave I, ca 18km NE of Palmyra, Syria (34° 40′ N, 38° 35′ E). Coll 1970 by K Endo and subm 1971 by H Suzuki. Report was already pub (Suzuki and Takai, 1973).

TK-111a. **>43,900**

TK-111b. **>43,900**

Sample TK-111 was charcoal from hearth of Layer E assoc with Levalloiso-Mousterian industries according to sample submitter, but it resembled black humic soil. TK-111a was not pretreated. TK-111b was pretreated with cold 2N HCl by putting it into a beaker and pouring the acid over it to remove inorganic carbon contaminants. *Comment* (KE): same sample gave 30,600 $^{+2800}_{-2100}$ (Gak-3537; Suzuki and Takai, 1973, p 143-144).

TK-112. **>43,900**

Black humic soil from Layer K, ca 2.5m lower than comparable horizon of TK-111. Sample was pretreated by acid and alkali. *Comment* (KE): sample of same layer gave 29,600 ± 1600 (Gak-3535; Suzuki and Takai, 1973).

D. Lebanon

2940 ± 100
TK-113. Tripoli **990 BC**

Snail shells from reddish soil in coastal sand dunes, El-Mina, Tripori, Lebanon (34° 26′ N, 35° 49′ E). Coll 1970 by K Endo and subm 1971 by H Suzuki. *Comment* (KE): date of palaeosol intercalated in eolian sands suggests age of sand dune formation in Holocene.

E. Peru

530 ± 80
TK-93. Ancón **AD 1420**

Textile and gourd from Tomb 16, 175cm below surface, near Bahía de Ancón, Lima, Peru (11° 44′ S, 77° 10′ W). Coll 1969 by H Vidal, Mus Ancón, and subm 1972 by K Terada, Univ Tokyo. *Comment* (KT): probably Inca period.

Sechín series

Archaeol sites at Sechín, central coast, Peru (9° 30′ S, 78° 29′ W). Coll 1971 by L Samaniego, Case Cultura, and subm 1972 by K Terada.

1100 ± 70
TK-105. Sechín 3rd layer **AD 850**

Charcoal from fireplace of dwelling site No. 1.

2720 ± 60
TK-106. Sechín 4th layer **770 BC**

Charcoal from fireplace below floor of dwelling site No. 1.

TK-107. Sechín 5th layer **2940 ± 120**
990 BC

Charcoal from layer below 4th layer.

General Comment (KT): dates indicate 2 or 3 periods, including Chavín.

Kotosh series

Coll 1969 by Univ Tokyo Sci Expedition to the Andes, Kotosh, Peru (9° 56′ S, 76° 16′ W) and subm 1972 by K Terada, Univ Tokyo. See Izumi and Terada (1972).

TK-108. Kotosh, KM 03-101 **3000 ± 80**
1050 BC

Charcoal from Waira-jirca period at KM mound. *Comment* (KT): 3800 ± 110 (Gak-262), 3780 ± 90 (Gak-765), 3200 ± 80 (TK-43; R, 1969, v 11, p 514), and 3100 ± 130 (N-69-2; R, 1966, v 8, p 336).

TK-109. Kotosh, KM 03-102 **3360 ± 160**
1410 BC

TK-110. Kotosh, KM 03-103 **3470 ± 80**
1520 BC

Both were dated with charcoal from Mito period at KT mound. *Comment* (KT): 3620 ± 100 (Gak-766a), 3900 ± 100 (Gak-766b) and 3900 ± 900 (TK-42; R, 1969, v 11, p 514).

F. Chile

Cañamo series

Archaeol sites at Cañamo, Iquique, Chile (20° 48′ S, 70° 12′ W). Coll 1967 by L Núñez, Univ Chile and subm 1970 by K Terada. See Núñez, (1965).

TK-101. Cañamo-3 **1190 ± 60**
AD 760

Plant fiber of basket, offering to the dead, from tomb No. 15 containing Tiahuanacoid elements.

TK-102. Cañamo-2 **3960 ± 80**
2010 BC

Charcoal from lowermost layer of shell mound, preceramic, Stratum 4.

TK-103. Cañamo-1 **2810 ± 90**
860 BC

Charcoal from uppermost layer of shell mound, agricultural and ceramic, Stratum 1.

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TALLINN RADIOCARBON DATES II

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The following list includes samples dated in 1973. Benzene is used as the carrier of natural ^{14}C activity as previously described (Punning *et al*, 1973). We used both 1-channel and 2-channel scintillation devices. The detector shield comprises 10cm lead. Around the detector we put 16 Geiger-Mueller type counters in anticoincidence circuit with output signals from detector. It decreased the average background ca 20 to 40%.

Calculations are based on a ^{14}C half-life of 5568 ± 30 yr. All dates are reported in years before 1950.

Alasoo series

Alasoo peat bog is on the W beach of Lake Peipsi, Tartu Dist, Estonian SSR. Organic deposits (reed peat and sapropel) are buried under beach barrier. Samples are from vertical gutter-wall of prospecting shaft to 250cm and from borehole at greater depths. Coll 1971 and subm by U Paap and R Pirrus, Inst Geol, Acad Sci Estonian SSR (now Inst Geol). *Comment*: pollen analyses by R Pirrus.

1270 ± 50
Tln-39. Alasoo **AD 680**

Reed peat at depth 114 to 117cm. Pollen Zone SA 2.

2770 ± 50
Tln-61. Alasoo **820 BC**

Reed peat at depth 141 to 144cm. Boundary of Pollen Zones SA_1 and SA_2.

5935 ± 45
Tln-47. Alasoo **3985 BC**

Reed peat at depth 220 to 225cm. Pollen Zone SB21.

7745 ± 85
Tln-43. Alasoo **5795 BC**

Sapropel at depth 350 to 360cm. Pollen Zone BO2.

8340 ± 70
Tln-32. Alasoo **6390 BC**

Sapropel at depth 380 to 390cm. Pollen Zone BO1.

905 ± 90
Tln-45. Kuressaare **AD 1045**

Relic from SE excavations of Kuressaare Castle, Kingissepa Dist, I Saaremaa, Estonian SSR. Coll 1972 and subm by J Selirand, Inst Hist, Acad Sci, Estonian SSR. *Comment*: samples from excavations of Kuressaare Castle were dated earlier (Tln-5, -6, -37, -38: R, 1973, v 15, p 586-591).

Bolshaya Lagorta series

Tln-42. Bolshaya Lagorta **1760 ± 60**
AD 190

Peat from ancient lake sediments of the upstream Bolshaya Lagorta R. Two layers of organic sediments are in profile at depth to 145cm and 450 to 485cm. Loam with wood remains separates the peat layers. Coll 1972 at depth 27 to 35cm and subm by L Troitski, Inst Geog Acad Sci USSR (now Inst Geog).

Tln-55. Bolshaya Lagorta **3300 ± 110**
1350 BC

Peat from depth 60 to 68cm.

Tln-41. Bolshaya Lagorta **4385 ± 60**
2435 BC

Peat from depth 140 to 145cm.

Tln-54. Bolshaya Lagorta **4540 ± 60**
2590 BC

Peat from depth 470cm.

Tln-40. Bolshaya Lagorta **7790 ± 80**
5840 BC

Remains of wood from depth 650cm.

Tln-44. Sveagruve **8355 ± 90**
6405 BC

Shells from sandy clays from a terrace, 7m high, on W Spitzbergen, near Sveagruve. Coll 1967 and subm by L Troitski.

Tln-46. Usher **8025 ± 95**
6075 BC

Peat from a terrace at height 22m in outwash deposits on E coast of Mon Bay W Spitzbergen. Coll 1966 and subm by L Troitski.

Tln-48. Mleles Sala **≥45,500**

Plant remains underlying gravel and aleurite, at depth 185 to 190cm, from right bank of Niemen R in Druskininkai, Lithuanian SSR. Coll 1972 by J M Punning, R Rajamäe, and L Smirnova, Inst Geol.

Koleshki series

Profile Koleshki is ca 1km downstream from v Koleshki on Vaga R (tributary of Severnaya Dvina R), Arkhangelsk Dist, Russian SFSR. Two complexes of interstage sediments are in profile in sands at depth 1300 to 1320cm with many shells, and underlain by 2 thin layers of peat, at depth 1530 to 1550cm. Average alt of exposure from river level is ca 19m. Samples coll 1972 by J M Punning.

Tln-52. Koleshki-1 **31,900 ± 800**
29,950 BC

Shells at depth 1300 to 1320cm.

Tln-49. Koleshki-1 **37,135 ± 450**
35,185 BC

Reed peat at depth 1535 to 1537cm.

Tln-71. Koleshki-1 **⩾49,100**

Sedge peat at depth 1547 to 1550cm.

Tln-63. Koleshki-2 **36,500 ± 700**
34,550 BC

Peat from profile 300m downstream from Koleshki-1 (see Tln-49, -52, -71). Peat, 40cm thick, underlies aleurite at alt 260 to 300cm from river level. Coll from upper part of complex 1972 by J M Punning.

Tln-50. Krasnaya Gorka **38,300 ± 1400**
36,350 BC

Sedge peat from exposure near Rogatchov, on right bank of Dnieper R, Byelorussian SSR. Ancient sediments, 30cm thick, lie in complex of sand at depth 600cm. *Comment*: dated at Leningrad State Univ ^{14}C lab at 30,000 to 46,000 (Voznyaczyk Arslanov, 1971). Coll 1972 by J M Punning, R Rajamäe, and L Smirnova.

Tln-51. Chornyi Bereg **⩾46,000**

Buried peat from till exposure near Surazh on right bank of Zapadnaya Dvina R, Byelorussian SSR. Coll 1972 by J M Punning, R Rajamäe, and L Smirnova.

Malaya Khadata series

Tln-56. Malaya Khadata **5680 ± 120**
3730 BC

Peat, underlying loam at depth 45 to 50cm from knoll on valley bog of Malaya Khadata R, 2km S of Malaya Khadata Lake. Average thickness of peat is 160cm. Coll 1972 and subm by L Troitski.

Tln-64. Malaya Khadata **6315 ± 70**
4365 BC

Peat from depth 95 to 100cm.

Tln-53. Malaya Khadata **5590 ± 50**
3640 BC

Peat from depth 155 to 160cm. *Comment*: sample of earlier date than Tln-64 from upper layer.

Tln-86. Malaya Khadata **7960 ± 100**
6010 BC

Same as Tln-53.

Tln-83. Malaya Khadata-1 **6280 ± 70**
4330 BC

Peat 200cm thick, overlying clay loam, from peat knoll on coast of Malaya Khadata Lake, Polar Ural. From depth 40 to 45cm. Coll 1973 by L Troitski.

Tln-84. Malaya Khadata-1 **6745 ± 70**
4795 BC

Peat from depth 95 to 100cm.

Tln-85. Malaya Khadata-1 **8670 ± 100**
6720 BC

Peat from basal layer of complex, at depth 195 to 200cm.

Tln-57. Yenga **3480 ± 60**
1530 BC

Wood remains from exposure by Yenga R, Polar Ural. The ancient sediments consist of loam, gravel with wood remains, and clay. Coll 1972 and subm by L Troitski.

Tln-58. Silla **8770 ± 120**
6820 BC

Decomposed woody peat from excavations Silla, in Karula upland, Estonian SSR. Sample from depth 390 to 400cm, at a lower contact of organic sediments. Coll 1972 and subm by R Karukäpp, Inst Geol.

Tln-59. Kuigli **8865 ± 70**
6915 BC

Decomposed reed peat from excavations Kuigli in Karula upland, Estonian SSR. Bog sediment in esker hollow is 265cm thick. Sample from depth 250 to 265cm; coll 1972 and subm by R Karukäpp.

Tln-60. Yelovetch **1270 ± 70**
AD 680

Charcoal from cultural layer of settlement Yelovetch on right bank of Onega R, Arkhangelsk Dist. Coll 1971 and subm by E Devyatova, Inst Geol, Karelia Branch Acad Sci USSR.

Tln-62. Kurgesoo **865 ± 80**
AD 1085

Reed peat from lagoon sediments at depth 140 to 150cm on Isle Hiiumaa, Estonian SSR. Sample coll 1971 by H Kessel and U Sepp, Inst Geol. *Comment*: date shows change from lagoon into marshland.

Tln-65. Palivere **8640 ± 70**
6690 BC

Wood peat from under beach barrier of Ancylus Lake, near Palivere RR Sta, Haapsalu Dist, Estonian SSR. Pollen analyses by H Kessel refer the peat to Pollen Zone BO 2. Coll 1972 and subm by Ü Paap, Inst Geol.

Tln-66. Kôdu **8480 ± 90**
6530 BC

Wood peat from under beach barrier of Ancylus Lake, 20km NE of Pärnu, Estonian SSR. Sample from upper part of organic sediments, 30cm thick. Pollen analyses by H Kessel refer peat to Pollen Zone BO_2. Coll 1971 and subm by H Kessel.

Tln-67. Pervomayskyi **⩾37,000**

Sphagnum peat buried by sand and aleurite on left bank of Severnaya Dvina R, near settlement Pervomayskyi, Arkhangelsk Dist. Sample from upper part of organic sediments 70cm thick. Coll 1972 by J M Punning.

31,550 ± 350
Tln-68. Shapurovo **29,600 BC**

Plant remains buried by sandy loam and till from right bank of Kasplya R, near settlement Shapurovo, Vitebsk Dist, Byelorussian SSR. Coll 1972 by J M Punning, R Rajamäe, and L Smirnova. *Comment*: ^{14}C dates by Leningrad State Univ ^{14}C Lab are: LU-78A: 29,150 ± 850 and LU-78B: 36,400 ± 800 (Voznyaczyk, 1972).

42,600 ± 600
Tln-69. Snaigupele **40,650 BC**

Submorainic organic deposits from right bank of Snaigupele R (tributary of Niemen R), ca 2km from Druskininkai, Lithuanian SSR. Coll 1972 by J M Punning, R Rajamäe, and L Smirnova. *Comment*: according to Kondratiene (1973) interglacial organic deposits are older than Merkine (Riss-Wurm) and younger than Butenai (Mindel-Riss).

39,530 ± 450
Tln-70. Konopki Lesne **37,580 BC**

Interglacial peat from profile Konopki Lesne near Lomza in NE Poland. The profile is outside the reach of the youngest glaciation and peat is covered with sands only. Sample from depth 315 to 345cm; coll and subm 1971 by E J Mojski, Inst Geol, Warsaw. *Comment* (Borowko-Dlužakowa, 1973; Borowko-Dlužakowa, Halicki, 1957): profile indicates the bipartition of the Eemian Interglacial.

Tln-72. Lomza **⩾45,400**

Interglacial peat from profile near Lomza in NE Poland (depth 730 to 760cm). Coll and subm 1971 by E J Mojski.

37,900 ± 300
Tln-73. Yanonis **35,950 BC**

Travertine overlain by morainic loam, humified sands with plant remains (250cm) near settlement Yanonis, NE of Lithuanian SSR. Sample from upper part of layer; coll 1972 by J M Punning, R Rajamäe, and L Smirnova. *Comment*: dates from travertine upper stratum: Vs-39: 22,700 ± 360; middle: Vs-40: 24,800 ± 450, and lower: Vs-41: 27,200 ± 400 (Vaitonis *et al*, 1972).

Tln-74. Gaylyunay **⩾32,000**

Submorainic complex from left bank of Niemen R, near Druskininkai, Lithuanian SSR. Interglacial (Interstadial) complex consists of aleurite with fragments of shells, and wood remains. Average thickness is 200cm. Coll 1971 by J M Punning, R Rajamäe, and L Smirnova.

Tln-75. Kerkidon **8525 ± 85**
6575 BC

Charcoal and plant remains in flood-plain sediments, at depth 850cm, from 2nd terrace of right bank Kerkidon R, SE Fergana Valley. Coll 1972 and subm by G Pšenin and L Serebryannyi, Inst Geog.

Tln-76. Kerkidon **6665 ± 115**
4715 BC

Charcoal and plant remains at depth 700cm from profile Kerkidon (see Tln-75). Coll 1972 and subm by G Pšenin and L Serebryannyi.

Tln-77. Raibola **⩾49,000**

Wood peat from left bank of Vaga R (tributary of Severnaya Dvina R), Arkhangelsk Dist, Russian SFSR. Peat layer is embedded in sands at 500cm above river level, and is covered by till. Coll 1972 and subm by E Devyatova.

Tln-78. Sopka **8245 ± 80**
6295 BC

Moss peat from left bank of Severnáya Dvina R, Arkhangelsk Dist, Russian SFSR. Peat lies in river sediments. Coll 1972 by J M Punning.

Sista-Palkino series

Profile is on right bank of Sista R, 300m upstream from hwy bridge in Leningrad Dist, Russian SFSR. Coll 1973 by T Kakum, J M Punning, and R Rajamäe.

Tln-79. Sista-Palkino **6000 ± 80**
4050 BC

Wood peat at depth 270 to 275cm, embedded during later transgression of Littorina Sea. Pollen analyses by H Kessel refers deposits to Pollen Zone V.

Tln-80. Sista-Palkino **6570 ± 80**
4620 BC

Wood peat at depth 285 to 290cm.

Tln-81. Sista-Palkino **7980 ± 90**
6030 BC

Wood peat at depth 320 to 325cm. Pollen analyses by H Kessel refers deposits to Pollen Zone VII.

Tln-82. Chartakchay **3995 ± 70**
2045 BC

Peat from 2nd terrace left bank of Chartakchay R, 20km NE of Namangan. Peat underlies gravel in clay complex. Coll 1972 and subm by G Pšenin.

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[RADIOCARBON, VOL. 16, No. 3, 1974, P. 395-401]

UCR RADIOCARBON DATES I

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A radiocarbon facility has been installed at the University of California, Riverside (UCR) to support interdisciplinary studies including archaeologic, archaeometric, geophysical, and geologic research. The laboratory was built between 1970 and 1973. Initially, a sample pretreatment and combustion system designed for a proportional CO_2 counting system was installed. It was designed after concepts developed at the University of California Los Angeles (UCLA) and New Zealand (Institute of Nuclear Sciences) Laboratories, and began processing samples in November 1972.

A 1.7L CO_2 proportional counter was then installed in the UCR laboratory which commenced operation in late September, 1973. The counting system was assembled from components originally fabricated by G J Fergusson. Calculated radiocarbon ages are based on a 5568 yr half-life as recommended by the Eighth International Radiocarbon Dating Conference, October 1972, Lower Hutt, New Zealand. All samples are counted at a filling pressure equivalent to 76cm at 20°C. The standard for the contemporary biosphere is 0.95 NBS oxalic acid and AD 1950 constitutes the zero reference year. Statistical errors are calculated by combining the standard 1σ standard deviations of the background and sample counts. Samples which approach modern or background values are reported with 2σ limits. All samples were subjected to accepted HCl, NaOH or other special chemical pretreatments depending on specific conditions to exclude contamination.

Through the cooperation of W F Libby and Rainer Berger, the Isotope Laboratory of the Institute of Geophysics at UCLA performed radiocarbon determinations on sample gases prepared by the UCR facility for calibration and interlaboratory checks. UCR I contains the interlaboratory calibration data (Table 1) and sample descriptions for joint UCLA/UCR measurements. UCR II and subsequent lists will contain radiocarbon dates measured exclusively at the Riverside laboratory.

ACKNOWLEDGMENTS

The author wishes to express his gratitude to those who contributed to the development of the UCR radiocarbon facility. W F Libby and Rainer Berger provided continuing equipment support, advice, and encouragement. J G Fergusson, Scientific Research Equipment Corp of Baltimore, Maryland, provided technical assistance. H Suess and Donald Sullivan, Radiocarbon Laboratory, Scripps Inst of Oceanography, University of California, San Diego, provided equipment and expert assistance. Operational support came from various sources including the

American Philosophical Society, UCR Intramural Research Grants, the Graduate Division at UCR, and a Dept of Labor grant to UCR. The dedicated laboratory work of Peter Slota, Dwight Sawyer, and Stanley Sheldon is also very much appreciated. The support and encouragement of James Earley and Michael Reagan, College of Social and Behavioral Sciences, and Alan Beals and Sylvia Broadbent, Anthropology Dept, is gratefully acknowledged.

TABLE 1
Interlaboratory calibration samples

UCR sample no	Date	UCLA sample no.	Date
UCR-125*	modern (<100 yr)	UCLA-1887	modern (<100 yr)
UCR-129*	180 ± 100	UCLA-1888	190 ± 60
UCR-119F	720 ± 100	UCLA-1867F	770 ± 80
UCR-128*	940 ± 100	UCLA-1892	1170 ± 80
UCR-118D	1580 ± 150	UCLA-1800D	1650 ± 80
UCR-126*	3750 ± 100	UCLA- 900	3760 ± 80

* Descriptions for these samples will appear in UCR II.

SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

Perris Reservoir series, Riverside Co, California

Studies were conducted by the Archaeol Research Unit, UCR, as salvage excavations supported by California Dept of Parks and Recreation, Perris Reservoir, Riverside Co, California (33° 50′ N, 117° 30′ W). This site represents the most intensely studied late prehistoric archaeologic region in interior Southern California. The results of the excavations will appear elsewhere (O'Connell, *et al*). Samples were coll Spring 1971 and subm by P Wilke and T King, UCR.

870 ± 80
UCR-101/UCLA-1815. Peppertree site **AD 1080**

Charcoal from Feature 9, a hearth underlying primary living floor in Area 2 of 4-Riv-463, Peppertree site. *Comment* (PW): dates period prior to beginning of intensive site occupation.

215 ± 60
UCR-102/UCLA-1816. Peppertree site **AD 1735**

Charcoal from Feature 4, a hearth overlying primary living floor in Area 2 of 4-Riv-463, Peppertree site. *Comment* (TK): living floor represents period of most intensive use of site.

2200 ± 80
UCR-103/UCLA-1817. Peppertree site **250 BC**

Charcoal from Feature 14, a hearth, basal feature of site, in otherwise generally sterile sand of 4-Riv-463, Peppertree site. *Comment* (TK): date is compatible with other evidence of occupation of the reservoir area during the period ca 2000 BC. Other evidence includes an Elko Corner-Notched projectile point from the Charles Mott site (4-Riv-464).

210 ± 60
UCR-104/UCLA-1818. Charles Mott site AD 1740

Charcoal from Feature 13, a hearth from Loc 1, Unit 2S/18W, with cottonwood Triangular concave-base projectile point and Tizon Brown ware. *Comment* (PW): dates period of most intensive site use.

<150
UCR-105/UCLA-1819. Dead Dog site Modern

Charcoal from Loc B, Unit 7, a hearth assoc with small triangular projectile points and worked valves (*Argopecten* sp). *Comment* (TK): although it is not impossible that site was in use as late as AD 1800, date is the only evidence for it.

Buchanan Reservoir series, Madera Co, California

Human burials excavated from a mortuary complex in salvage operation in Buchanan Reservoir region (37° 13′ N, 119° 59′ E). Significance of data will be discussed elsewhere. All dates were obtained on collagen component of bone after the method of Berger *et al,* (1964). Coll 1972 by T King, UCR.

1690 ± 100
UCR-118A/UCLA-1860A. Jones site AD 260

Bone collagen from Human Burial 52, Jones site (4-Mad-159) on bedrock under 1m midden.

2750 ± 90
UCR-118B/UCLA-1860B. Schwabacker site 800 BC

Bone collagen from Human Burial 44, Schwabacker site (4-Mad-117) on bedrock under 70cm midden.

1470 ± 100
UCR-118C/UCLA-1860C. Schwabacker site AD 480

Bone collagen from Human Burial 59, Schwabacker site (4-Mad-117) on bedrock under 70cm midden.

1650 ± 80
UCR-118D/UCLA-1860D. Dancing Cow site AD 300

Bone collagen from Human Burial 24, Dancing Cow site (4-Mad-106) on bedrock under 1.5m midden.

1740 ± 100
UCR-118E/UCLA-1860E. Dancing Cow site AD 210

Bone collagen from Human Burial 11, Dancing Cow site (4-Mad 106).

970 ± 80
UCR-118F/UCLA-1860F. Schwabacker site AD 980

Bone collagen from Human Burial 21, Schwabacker site (4-Mad-117).

UCR-118G/UCLA-1860G. Schwabacker site **1745 ± 100 AD 205**

Bone collagen from Human Burial 16, Schwabacker site (4-Mad-117).

UCR-118H/UCLA-1860H. Jones site **1400 ± 90 AD 550**

Bone collagen from Human Burial 13, Jones site (4-Mad-159) on bedrock under 1m midden.

UCR-118I/UCLA-1860I. Dancing Cow site **1010 ± 80 AD 940**

Bone collagen from Human Burial 33, Dancing Cow site (4-Mad-106) on bedrock under 1.5m midden.

UCR-118J/UCLA-1860J. Jones site **1540 ± 110 AD 410**

Bone collagen from Human Burial 5, Jones site (4-Mad-159) on bedrock under 1m midden.

UCR-118K/UCLA-1860K. Schwabacker site **1310 ± 80 AD 640**

Bone collagen from Human Burial 20, Schwabacker site (4-Mad-117) on bedrock under 70cm midden.

UCR-118L/UCLA-1860L. Schwabacker site **1305 ± 80 AD 645**

Bone collagen from Human Burial 8, Schwabacker site (4-Mad-117) on bedrock under 70cm midden.

UCR-118N/UCLA-1860N. Schwabacker site **1425 ± 80 AD 525**

Bone collagen from Human Burial 36, Schwabacker site (4-Mad-117) on bedrock under 70cm midden.

UCR-118O/UCLA-1860O. Dancing Cow site **2000 ± 80 50 BC**

Bone collagen from Human Burial 1, Dancing Cow site (4-Mad-106) on bedrock under 1.5m midden.

UCR-118P/UCLA-1860P. Jones site **1630 ± 80 AD 320**

Bone collagen from Human Burial 6, Jones site (4-Mad-159) on bedrock under 1m midden.

El Morro Canyon series

Samples found during excavations conducted by California State Univ, Fullerton, in El Morro Canyon N of Laguna Beach, Orange Co, California (33° 34′ 30″ N, 117° 48′ 30″ W). Coll Spring 1972 by J L Zahniser, Dept Anthropol, California State Univ, Fullerton.

UCR-119A/UCLA-1867A. El Morro Canyon **3500 ± 100 1550 BC**

Charcoal from Unit W-45-B, 40 to 50cm below datum at Site 4-Ora-327, N side of El Morro Canyon. *Comment* (JZ): unexpectedly early date.

UCR-119B/UCLA-1867B. El Morro Canyon **940 ± 80**
AD 1010

Marine shell from Unit N1-C, 0 to 10cm below datum at Site 4-Ora-327, N side of El Morro Canyon.

UCR-119C/UCLA-1867C. El Morro Canyon **570 ± 80**
AD 1380

Marine shell from Unit N1-B-C-D, 30 to 50cm below datum at Site 4-Ora-327, N side of El Morro Canyon.

Rincon Valley series, Arizona

Samples are from excavations in habitation areas in 2 sites on N side of lower Rincon Valley, E of Tucson, Arizona. Samples were coll 1964 by J L Zahniser.

UCR-119D/UCLA-1867D. Loma Alta site **890 ± 70**
AD 1060

Charred roof timber from Unit 1, Rm 3, E half from probable roof fall at Loma Alta site (32° 8′ N, 110° 43′ W). *Comment* (JZ): radiocarbon date is ca 200 yr earlier than anticipated—early Tanque Verde phase, AD 1100 to 1300. See Zahniser (1966).

UCR-119E/UCLA-1867E. Site BB:14 **1065 ± 80**
AD 885

Charred corn (*Zea maize*) from lower fill of House No. 4, at Site BB:14 (32° 8′ 20″ N, 110° 43′ W). Fill material probably originally stored in ceramic vessels on roof of house (Zahniser, 1966). *Comment* (JZ): radiocarbon date is ca 200 yr earlier than anticipated date—early Tanque Verde phase, AD 1100 to 1300.

UCR-119F/UCLA-1867F. Loma Alta site **770 ± 80**
AD 1180

Charred roof timber from Unit 3, Rm 2, top 50cm fill, probably roof fall from Loma Alta site (32° 8′ N, 110° 39′ W).

II. GEOLOGIC SAMPLES

Earthquake Studies series

Geologic studies of a portion of the San Jacinto fault zone near San Bernardino, California were made to locate more precisely the most recently active fault trace(s) within the zone, and to determine the nature and dates of the most recent fault movements (Elders, 1973). Samples were obtained from O Huber, California Dept Water Resources, Palmdale, California (UCR-106-109) and a team of undergraduate students, Univ California, Riverside (UCR-110-117) funded under Student-oriented Studies Program, Nat Sci Foundation (GY-9667). Samples were coll June-September 1972 by O Huber and K Sieh and subm by K Sieh, Dept Geol, Univ California, Riverside.

UCR-106/UCLA-1826. Santa Ana Valley Pipeline **300 ± 80**
AD 1650

Wood from channel alluvium at Pipeline Sta 182 + 60, at depth

5.2m (34° 04′ N, 117° 18′ E). *Comment* (OH): no direct evidence that deposit was offset by San Jacinto Fault.

UCR-107/UCLA-1827. Santa Ana Valley Pipeline **100 ± 80**
AD 1850

Wood from channel alluvium at Pipeline Sta 179 + 75, at depth 4.6m (34° 04′ N, 117° 18′ E). *Comment* (OH): no direct evidence that deposit was offset by San Jacinto Fault.

UCR-108/UCLA-1828. Santa Ana Valley Pipeline **33,000 ± 900**
31,050 BC

Wood from deformed, tilted, gravelly clay, offset by San Jacinto Fault at Pipeline Sta 172 + 15, at depth 6.7m (34° 04′ N, 117° 18° E).

UCR-109/UCLA-1832. Santa Ana Valley Pipeline **550 ± 80**
AD 1400

Wood from iron-stained gravelly sand, offset by San Jacinto Fault at Pipeline Sta 174 + 25 at depth 5.8m (34° 04′ N, 117° 18′ E).

1500 ± 150
UCR-110/UCLA-1836. Barton Rd **AD 450**

Wood from root, 7.6cm diam, coll 1.2m from ground surface in silty clay in Barton Rd, Trench 3 (34° 03′ N, 117° 17′ E).

1670 ± 150
UCR-111/UCLA-1837. Barton Rd **AD 280**

Black, carbonaceous organic residue and peat from 1.5m area, 1.5m to 1.8m from surface in fine sand alternating with silt from Barton Rd, Trench 3 (34° 03′ N, 117° 17′ E).

2460 ± 160
UCR-113/UCLA-1839. Barton Rd **510 BC**

Black, carbonaceous organic residue from area 2.4m, ca 2.4m below ground in silty clay from Barton Rd, Trench 2 (34° 03′ N, 117° 17′E).

4400 ± 250
UCR-114/UCLA-1840. Walnut St **2450 BC**

Reed in black, carbonaceous, organic matrix from 2.4m zone, 2.4m below ground in an intraformational breccia from Walnut St Trench (34° 04′ N, 117° 19′ E).

3180 ± 150
UCR-115/UCLA-1841. Walnut St **1230 BC**

Wood fragments and black, carbonaceous, organic material from 2.4 to 2.7m below ground in light gray silty sand from Walnut St Trench (34° 05′ N, 117° 19′ E).

670 ± 80
UCR-116/UCLA-1842. Barton Rd **AD 1280**

Fresh water gastropods (*Limnaea adeline* Tryon, *Physa gabbi* Tryon, *Planorbis trivolvis* Say, *Succinea oregonensis* Lea) from area 6m, 12m below surface in silty clay from Barton Rd, Trench 2 (34° 04′ N, 117° 17′ E).

UCR-117/UCLA-1843. Walnut St **5540 ± 200**
3590 BC

Black, carbonaceous, organic material 4.3m below surface in silty sand in Walnut St Trench (34° 05′ N, 117° 19′ E).

General Comment (ET): except for UCR-115, ages fall into stratigraphic order and provide a preliminary date for prior movements along fault zones.

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[RADIOCARBON, VOL. 16, No. 3, 1974, P. 402-408]

UNIVERSITY OF MIAMI RADIOCARBON DATES I

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The radiocarbon dating facility is part of the UM Geochronology laboratory housed in the Department of Geology, University of Miami, Main Campus. The laboratory was established to carry out and support research in Pleistocene marine geology, particularly in the Caribbean, and to act as a specialized teaching facility of geochronologic research using radiometric age dating techniques.

The method employed is liquid scintillation counting of synthesized benzene using the basic techniques described by Noakes *et al* (1965) and Polach and Stipp (1967) converting sample $\rightarrow CO_2 \rightarrow C_2H_2 \rightarrow C_6H_6$ with an over-all yield of approximately 90 to 95%.

Counting is done on an automatic Beckman 100-C and an automatic Packard Tri-Carb 2003 liquid scintillation spectrometer with a background of 9cpm utilizing 4cc counting vials. PPO and dimethyl-POPOP are added as scintillators. Instrument stability is continuously monitored.

The dates reported here are calculated using a ^{14}C half-life of 5568 yr. The modern reference is taken as 95% of the NBS oxalic acid ^{14}C standard converted to CO_2 by a solution of potassium permanganate and sulfuric acid. Errors are reported as one standard deviation which includes only the combined counting uncertainty of the background, modern, and sample.

ACKNOWLEDGMENTS

J Clegg and D Evans of the Department of Biology generously loaned us use of their liquid scintillation counters, which enabled us to operate prior to installation of our own counter. Their counters have also served as valuable supplements during heavy load periods from student dating projects.

C Emiliani, Chairman, Division of Marine Geology and Geophysics, RSMAS, supported and encouraged the laboratory. We are particularly grateful to the National Science Foundation (IDOE Gx-36155) for funds to purchase our own counter.

We also wish to thank students M Andrejko, J Sawlan, and K Forshee for their assistance with various aspects of laboratory preparations.

Ages of check samples determined in this laboratory indicate satisfactory agreement with the results of other laboratories. Reproducibility, as indicated by multiple runs, is satisfactory.

SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

A. Guatemala

3135 ± 120
UM-101. Salinas LaBlanca 1 **1185 BC**

Charcoal from Mound 2, E side of Rio Naranjo, Mun Ocos, Dept

CHECK SAMPLES

Interlaboratory cross checks

UM sample	UM date	Other sample	Other date	Reference	Sample material
*UM-152/a	690 ± 110	IVIC-26	730 ± 120	IVIC I	charcoal
152/b	740 ± 105				
152/c	620 ± 90				
152/d	710 ± 140				
152/e	700 ± 120				
UM-154	8910 ± 165	P-1665	9475 ± 135	Penn XIV	charcoal
UM-140	12,740 ± 250	ML-821	12,600 ± 150	James, pers commun	coral
*UM-167/a	4164 ± 70	*QU-2/3	4225 ± 130	unpub	wood
167/b	4420 ± 85	2/4	4400 ± 150		
167/c	4235 ± 80	I-6003	4460 ± 140	unpub	wood
UM-168	1480 ± 70	QU-8	1490 ± 130	unpub	wood
		GSC-22(1)	1220 ± 80	unpub	wood

*Complete reruns of the same sample

San Marcos, Guatemala (14° 31′ 30″ N, 92° 10′ 30″ W). Large amount of pottery, stone and shell artifacts of early Pre-Classic Cuadros and Jocotal phases. Coll and subm 1973 by E M Shook. *Comment*: other pertinent dates are Y-1150: 2928 ± 105; Y-1151: 2715 ± 105; Y-1145: 2878 ± 105; Y-1166: 2764 ± 90 (Coe and Flannery, 1967).

UM-102. Salinas LaBlanca 2 **2770 ± 70** **820 BC**

Charcoal from Mound 'N', Mun Ocos, Dept San Marcos, Guatemala (14° 35′ 30″ N, 92° 08′ 15″ W). Large amount of pottery and stone artifacts of the Middle Pre-Classic Las Conchas phase. Coll and subm 1973 by E M Shook. *Comment*: other pertinent date is Y-1167: 2740 ± 60 (*ibid*, above).

B. United States

UM-121. Lakeland wood **2845 ± 90** **895 BC**

Wood sample from drainage ditch of phosphate mine NE of Lakeland, Florida (28° 30′ N, 81° 30′ W). Sample was extracted from beneath 1.5m muck, under fibrous peat. Wood is believed part of an early watercraft of fire and water process, possibly used by N Florida indians. Coll 1972 and subm 1973 by A Rosenberg. *Comment*: other pertinent dates are I-1662: 2600 ± 130; I-1661: 3040 ± 115 (Bullen and Brooks, 1967).

Arch Creek shell midden series

Shell samples from Arch Creek site, Dade Co, Florida (25° 08′ 17″ N, 80° 10′ 55″ W), studied to determine period midden was used by early

Florida indians. Dated samples are remains of one of major shellfish food sources found within the midden. Pottery and other artifacts from same area indicate occupation during the Glades-II period AD 400 to 1000. Variables affecting validity of dates are disturbance by development, pothunters, vandals, and some heavy vegetational growth above sample area. Coll and subm 1972 by M Andrejko.

1170 ± 140
UM-41. Arch Creek shell midden IM-1302 **AD 780**
Shell (*Phacoides pectinata*).

1490 ± 100
UM-42. Arch Creek shell midden IM-1303 **AD 460**
Shell (*Strombus gigas*).

1135 ± 100
UM-43. Arch Creek shell midden IM-1304 **AD 815**
Shell (*Phacoides pectinata*).

II. GEOLOGIC SAMPLES

North Key Largo series

Cores from 3 sites in the mangroves of North Key Largo, Florida. Red Mangrove Peat was dated to help determine sediment depth and physical and chemical properties of the substratum. Sites were chosen to represent different situations.

Core A (25° 18′ 15″ N, 80° 17′ 17″ W) contained shallow organic sediment near Dispatch Creek, where water flows quite freely and there is extensive exchange with the Creek.

Core B (25° 18′ 15″ N, 80° 17′ 06″ W) was taken at the point between the Creek and the ridge where the rock substratum is ca 1.5m deep and the organic layer is relatively thick.

Core C (25° 18′ 15″ N, 80° 17′ 06″ W) was taken at the transition point between scrub mangroves and the ridge where the rock substratum is ca 1.5m deep and the organic layer is relatively thin. This is a location in a channel of flow.

Visible roots were removed by the submitter before chemical conversion. The most evident consistency is that in areas with good surface flow (Cores A and C) the material near the surface is older than in those with impeded surface flow (Core B); thus, there is an appreciable difference in the process of building mangrove peat. Coll 1972 by Brooke and Cronholm and subm 1972 by Rio Palenque, Inc, Miami, Fla.

UM-11. North Key Largo **Modern**
Red mangrove peat from surface (Core A).

2310 ± 100
UM-26. North Key Largo **360 BC**
Red mangrove peat from 46cm beneath surface (Core A).

UM-12. North Key Largo **2370 ± 170**
420 BC

Red mangrove peat from 91cm beneath surface (Core A).

UM-27. North Key Largo **2180 ± 125**
230 BC

Red mangrove peat from 122cm beneath surface (Core A).

UM-13. North Key Largo **2900 ± 100**
950 BC

Red mangrove peat from 152cm beneath surface (Core A).

UM-14. North Key Largo **Modern**

Red mangrove peat from surface (Core B).

UM-15. North Key Largo **Modern**

Red mangrove peat from 46cm beneath surface (Core B).

UM-16. North Key Largo **1115 ± 135**
AD 835

Red mangrove peat from 76cm beneath surface (Core B).

UM-17. North Key Largo **1015 ± 110**
AD 935

Red mangrove peat from 102cm beneath surface (Core B).

UM-18. North Key Largo **2400 ± 100**
450 BC

Red mangrove peat from 122cm beneath surface (Core B).

UM-19. North Key Largo **2315 ± 120**
365 BC

Red mangrove peat from 152cm beneath surface (Core B).

UM-20. North Key Largo **3570 ± 100**
1620 BC

Red mangrove peat from 198cm beneath surface (Core B).

UM-21. North Key Largo **2030 ± 130**
80 BC

Red mangrove peat from 259cm beneath surface (Core B).

UM-22. North Key Largo **Modern**

Red mangrove peat from surface (Core C).

UM-23. North Key Largo **500 ± 135**
AD 1450

Red mangrove peat from 61cm beneath surface (Core C).

1790 ± 235

UM-24. North Key Largo **AD 160**

Red mangrove peat from 91cm beneath surface (Core C).

1315 ± 135

UM-25. North Key Largo **AD 635**

Red mangrove peat from 122cm beneath surface (Core C).

1055 ± 125

UM-28. North Key Largo **AD 895**

Red mangrove peat from 152cm beneath surface (Core C).

Anastasia Island series

6930 ± 110

UM-29. Anastasia Island 11-C **4980 BC**

Shell fragments from 90cm beneath surface near base of sec, Anastasia I, 56km SSE of Jacksonville, Florida (29° 51′ 55″ N, 81° 16′ 00″ W). Dated to determine age of base of N beach deposits on Anastasia I. Shells firmly cemented were expected to be much older. Coll 1972 by P Murphy and subm 1972 by R D Perkins, Duke Univ.

8670 ± 165

UM-30. Anastasia Island 2-J **6720 BC**

Shell fragments from 90cm beneath surface on top of sec, Anastasia I, 56km SSE of Jacksonville, Florida (29° 48′ 43″ N, 81° 16′ 11″ W). Dated to determine age of top of S beach deposits on Anastasia I. Shells were not cemented but were between 2 cemented layers with reworked shells from older rock. Sample was expected to be much older. Coll 1972 by P Murphy and subm 1972 by R D Perkins.

Sanibel Island series

Aragonitic mollusk shell dated to establish chronologic deposition of Sanibel Island, Florida. Coll 1972 and subm 1973 by T M Missimer, Florida State Univ.

547 ± 74

UM-66. S Wulfert Ridges **AD 1403**

Sample from side of canal cut through highest-standing beach ridge, elev .9m above MSL, S part of Sanibel I, Florida (26° 28′ 52″ N, 82° 10′ 25″ W).

2131 ± 98

UM-67. N Wulfert Ridges **181 BC**

Sample from oldest Wulfert ridge, elev 3m above MSL, W part of Sanibel I, Florida (26° 25′ 39″ N, 82° 10′ 10″ W).

1871 ± 76

UM-76. Tarpon Bay E Ridges **AD 79**

Sample from side of drainage ditch cut through a set of low-lying beach ridges, elev 1.5m above MSL, E part of Sanibel I, Florida (26° 27′ 00″ N, 82° 03′ 15″ W).

848 ± 90
UM-77. Sanibel Slough Ridge Set **AD 1102**

Sample from a high beach ridge set in central portion of interior, elev 1.2m above MSL, E part of Sanibel I, Florida (26° 26′ 30″ N, 82° 02′ 46″ W).

1365 ± 68
UM-78. Tarpon Bay Truncation **AD 585**

Sample from a truncation line between 2 beach ridge sets, elev 2m above MSL, S part of Sanibel I, Florida (26° 25′ 30″ N, 82° 04′ 52″ W).

4310 ± 120
UM-98. Wulfert 2-A **2360 BC**

Sample from a high-standing beach ridge in Wulfert Set, elev 1.5m above MSL, Sanibel I, Florida (26° 28′ 51″ N, 82° 10′ 00″ W). *Comment*: see UM-99, a 2nd run of this sample with a different mollusk species; age: 3948 ± 80 BP.

3948 ± 80
UM-99. Wulfert 2-B **1998 BC**

Sample is from same location as UM-98. *Comment*: see UM-98, 1st run of this sample with a different mollusk species; age: 4310 ± 120 BP.

2102 ± 85
UM-100. Wulfert 3 **152 BC**

Sample from highest-standing beach ridge in Wulfert Set, elev 3m above MSL, Sanibel I, Florida (26° 28′ 49″ N, 82° 09′ 50″ W). *Comment*: see UM-98, UM-99 for other dates of Wulfert Ridge Set.

968 ± 60
UM-110. Wateree River flood plain **AD 982**

Wood fibers from 7.6m beneath surface from channel-lag at base of a meander scar, 6.4km S of Lugoff, South Carolina (34° 10′ 07″ N, 80° 40′ 09″ W). Dates of plant material incorporated in channel-lag sediment are to fix period of higher river discharge during development of Wateree River flood plain. Coll and subm 1973 by L J Bruning, Duke Univ. *Comment*: expected age: ca 6000 yr based on similar samples dated from other flood plains. Duplicate runs of sample gave 915 ± 70 BP and 1020 ± 70 BP, verifying radioactive content.

Key Biscayne series

Red mangrove peat and shell from lagoonal mud cored 183m N of fossil mangrove reef, Key Biscayne, Florida (25° 25′ N, 80° 09′ W). Study to establish a time correlated stratigraphic sequence for N shore of Key Biscayne. Coll and subm 1973 by R Martinek and J McEneaney.

3232 ± 120
UM-127. Key Biscayne **1282 BC**

Red mangrove peat from 0.3m beneath surface.

1900 ± 120
UM-128. Key Biscayne **AD 50**

Red mangrove peat from 24cm beneath surface.

2370 ± 80
UM-130. Key Biscayne **420 BC**

Shell material from 50cm beneath surface in lagoonal mud.

2900 ± 70
UM-131. Key Biscayne **950 BC**

Shell material from 85cm beneath surface in lagoonal mud.

UM-132. Key Biscayne **>30,800**

Shell material from 150cm beneath surface in lagoonal mud.

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[Radiocarbon, Vol. 16, No. 3, 1974, P. 409-420]

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[1] The ^{3}H—Laboratorium of this institute (directed by Klaus Fröhlich) should be addressed separately.

[1a] Lists from this laboratory have not been submitted to RADIOCARBON. See Gdansk I, Acta Physica Polonica, vol 22, p 189, 1962 Gdansk II, *ibid,* vol 32, p 39, 1967.

[2] This designation Gif supersedes both Sa (Saclay) and Gsy (Gif-sur-Yvette). The only Gsy date list to be published is Gsy I (Coursaget and Le Run, RADIOCARBON, v 8).

[3] From January 1, 1961 the Gro numbers have been replaced by GrN numbers. "New" dates are referred to the NBS oxalic-acid standard.

[4] Early dates from this laboratory were given a code designation that represents the name of the sponsoring institution, e g, I (AGS) for American Geographical Society (Heusser, RADIOCARBON SUPPLEMENT, v 1).

[5] Formerly Hazelton Nuclear: code designation HNS has been dropped.

[6] Some dates from this laboratory were published with the code designations S (Pringle *et al,* 1957, Science, v 125, p 69-70).

[7] See SM.

[8] See Gif.

[9] Some dates from this laboratory have been published with the code designation RC (Flint and Gale, 1958, AM JOUR SCI, v 256, p 698-714). The code designation MP published in volume 1 of the RADIOCARBON SUPPLEMENT (1959, p 216) has been changed to SM in conformity with the wishes of the laboratory, and is explained by the change of the company's name from Magnolia Petroleum Company to Socony Mobil Oil Company, Inc.

[10] Formerly Texas-Bio-Nuclear, then Kaman Instruments. The laboratory is no longer operating.

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CORRECTION

Ly-61, v 15, p 141 should read: Ly-61a.

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