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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 20, no. 2 must be submitted in *duplicate* before October 1, 1977, for vol 20, no. 3 before February 1, 1978.

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). 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.

Reprints. Thirty copies of each article, without covers, will be furnished without cost. Additional copies and printed covers can be specially ordered.

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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. In accordance with the decision of the Ninth International Radiocarbon Conference, Los Angeles and San Diego, 1976, the designation of AD/BC, obtained by subtracting AD 1950 from conventional BP determinations is discontinued in Radiocarbon.

Authors or submitters may include calendar estimates as a comment, and report these estimates as AD/BC, citing the specific calibration curve used to obtain the estimate.

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 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). The Ninth International Radiocarbon Conference, Los Angeles and San Diego, 1976, recommended that the reference standard, 0.95 times NBS oxalic acid activity, be normalized to $\delta^{13}C = -19‰$.

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.

Citations. A number of radiocarbon dates appear in publications without laboratory citation or reference to published date lists. We ask that laboratories remind submitters and users of radiocarbon dates to include proper citation (laboratory number and date-list citation) in all publications in which radiocarbon dates appear.

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 $10.00 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, 1977. 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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EDITORIAL STATEMENT TO CONTRIBUTORS

Since its inception, the basic purpose of Radiocarbon has been the publication of compilations of ^{14}C dates produced by various laboratories. These lists are extremely useful for the dissemination of basic ^{14}C information. An increasing number of ^{14}C dates, however, appear in more general articles and are never published in a datelist. Inclusion in Radiocarbon of some of the articles containing scientific knowledge derived from ^{14}C data should broaden the scope of the journal and increase its readership. Starting immediately, the editors of Radiocarbon will consider such articles for publication. The content of these articles can be either general or technical. For instance, the type of article considered suitable for inclusion in the Journal would contain subject matter normally presented at International Radiocarbon meetings.

All correspondence and manuscripts should be sent to the Managing Editor, Radiocarbon, Box 2161, Yale Station, New Haven, Connecticut 06520.

The Editors

[RADIOCARBON, VOL. 19, NO. 2, 1977, P. 143-160]

Radiocarbon

1977

BRITISH MUSEUM NATURAL RADIOCARBON MEASUREMENTS IX

RICHARD BURLEIGH, ANDREW HEWSON, and NIGEL MEEKS

Research Laboratory, The British Museum, London WC1B 3DG

The following list consists of dates for archaeologic samples from countries other than the British Isles measured with a few exceptions over the period of mid-1970 to June 1974.* The dates were obtained by liquid scintillation counting of benzene using a Model 3315 Packard Tricarb Liquid Scintillation Spectrometer. The laboratory procedures used were those outlined in the previous date list (R, 1976, v 18, p 16). As before, the dates, relative to AD 1950, are based on the Libby half-life for ^{14}C of 5570 years, are corrected for isotopic fractionation (relative to the PDB standard) and are expressed in radiocarbon years uncorrected for natural ^{14}C variations. NBS oxalic acid is used as the modern reference standard.

Descriptions, comments, and references to publications are based on information supplied by the persons who submitted the samples.

ACKNOWLEDGMENTS

We wish to thank H Barker for helpful criticism and advice.

SAMPLE DESCRIPTIONS

ARCHAEOLOGIC SAMPLES

BM-760. Lake Varna boat, Bulgaria **559 ± 40** **AD 1391**

Wood (*Quercus frainetto* Ten) from structure of boat taken from L Varna, Stalin, Black Sea coast, Bulgaria (43° 20′ N, 27° 75′ E). Coll 1970 and subm by A Michailov, Natl Inst Cult Properties, Sofia, Bulgaria. *Comment*: when 1st recovered boat considered prehistoric; actual date is clearly much more recent.

BM-728. Mylodon Cave, Chile **12,984 ± 76** **11,034 BC**

Collagen from femur of mylodon (giant sloth, *Grypotherium listai*) from Cueva del Milodon Grande, Puerto Consuelo, Ultima Esperanza, Chile (51° 36′ S, 72° 36′ W). Coll ca 1900 from cave floor deposits beneath fallen roof debris (British Mus [Nat Hist] ref M8748; purchased from G A Milward, 1904). Subm by A J Sutcliffe, British Mus (Nat Hist) to

* Dates obtained over the same period for samples from the British Isles formed the previous list, British Museum VIII.

date these animal remains (Hauthal *et al,* 1899) long the subject of controversy because of surviving flesh and hair. *Comment*: date confirms Pleistocene age of remains and agrees with C-484: 10,832 ± 400, for giant sloth droppings from same site (Libby, 1952, p 94).

Carrizal series, Colombia

Charcoal from protohist Carrizal phase occupation levels overlying Antigua levels at Carrizal, Municipio Barichava, Santander, Colombia (6° 40′ N, 73° 14′ W). Coll 1970 and subm by W Bray, Inst Archaeol, Univ London.

603 ± 63

BM-802. Carrizal **AD 1347**

Carrizal stratigraphic trench, Levels 4 and 5, 30 to 50 cm below surface. Dates middle part of Carizal phase occupation.

682 ± 66

BM-803. Carrizal **AD 1268**

Carrizal stratigraphic trench, Level 7, 60 to 70 cm below surface. *Comment*: samples should date transition from underlying Antigua phase (see BM-804-806, below) but appear contemporaneous with BM-802 from middle of Carrizal phase.

Cueva la Antigua series, Colombia

Charcoal from Antigua phase levels at Cueva la Antigua, Municipio of San Gil, Santander, Colombia (6° 35′ N, 73° 10′ W). Coll 1970 and subm by W Bray. Samples date newly defined Antigua phase pottery styles, earliest so far discovered in northern part of highland Colombia.

1368 ± 103

BM-804. Cueva la Antigua **AD 582**

Trench 1/2, Spit 1 of Antigua phase. Dates transition from Antigua phase to subsequent protohist Carrizal phase.

1988 ± 98

BM-805. Cueva la Antigua **38 BC**

Trench 1/2, Unit 2, 1.68m below surface. Sample from near base of deposit containing Antigua style pottery.

1670 ± 44

BM-806. Cueva la Antigua **AD 280**

Trench 1/2, Unit 2, Spit 6. Sample from just above base of deposit containing Antigua style pottery.

895 ± 59

BM-807. Muisca figurine, Colombia **AD 1055**

Charcoal from clay and charcoal core of copper figurine cast by lost wax process. No exact provenance or archaeol assoc but figurine is in Muisca (Chibcha) style of area around Bogota, Colombia (4° 40′ N, 74° 10′ W). Subm by W Bray, from colln of Cambridge Univ Mus Archaeol & Ethnog (ref 46.22). *Comment*: figurine is well-known type assoc with protohist Muisca but not yet found in controlled excavation.

Knossos series, Crete

Charcoal from pre-Palace settlement levels at Knossos, N Central Crete (35° 31′ N, 25° 10′ E). Coll 1969 and subm by J D Evans, Inst Archaeol, Univ London. Samples date duration of later Neolithic phases (except BM-578, which dates Early Minoan phase; Evans, 1972). Previous dates in BM Knossos series appear in R, 1963, v 5, p 104; R, 1969, v 11, p 279-280 (Evans, 1964; 1968; 1971).

BM-575. Knossos **5636 ± 94** **3686 BC**

Late/Middle Neolithic transition (W Court of Minoan Palace).

BM-577. Knossos **5884 ± 188** **3934 BC**

Late Early-Neolithic II (Central Court of Minoan Palace).

BM-578. Knossos **3745 ± 137** **1795 BC**

Early Minoan II (W Court of Minoan Palace; from Early Minoan II building).

BM-579. Knossos **5534 ± 76** **3584 BC**

Late Neolithic (W Court of Minoan Palace).

BM-580. Knossos **5522 ± 88** **3572 BC**

Late Middle-Neolithic (W Court of Minoan Palace).

BM-581. Knossos **5588 ± 145** **3638 BC**

Late Neolithic (Central Court of Minoan Palace).

General Comment (JDE): dates are acceptable (except BM-578, which is much too late) though total duration of later Neolithic appears surprisingly short; Knossos dates so far fall into 2 distinct groups — aceramic and earliest Neolithic in 1st half of 6th millennium BC, later Neolithic phases ca 4400 to 3500 BC — followed by 500 to 700 yr gap before Early Minoan I begins.

BM-690. Skouriotissa, Cyprus **2139 ± 51** **189 BC**

Wood (*Pinus* sp) from pit prop from 60m below ground level in ancient mine exposed by modern open-cast commercial excavation at Skouriotissa, Morphou, N Cyprus (35° 10′ N, 33° 0′ E). Coll 1970 and subm by Michael Ayrton. *Comment*: mines in Cyprus have been worked for copper from Bronze age until Roman times (see Forbes, 1950). Sample dates from later part of mining activity; *cf* dates for wood from Apliki Mine, Cyprus, Bonn-677: 2380 ± 60 BP; Bonn-678: 2280 ± 60 BP (R, 1970, v 12, p 37-38); Birm-107: 2330 ± 90 BP (R, 1970, v 12, p 398).

Ayios Epiktitos Vrysi series, Cyprus

Charcoal from sealed deposits in a Neolithic settlement at Ayios Epiktitos Vrysi, 10km E Kyrenia, Cyprus (35° 20′ N, 33° 26′ E). Coll 1973 and subm by E J Peltenburg, Univ Glasgow. Samples date early and middle phases of settlement (Peltenburg, 1972).

BM-843. Vrysi — **5355 ± 67** / **3405 BC**
Sample Ref H2A.4

BM-844. Vrysi — **5275 ± 47** / **3325 BC**
Sample Ref H2B.8

BM-845. Vrysi — **5360 ± 57** / **3410 BC**
Sample Ref H4A.5

BM-846. Vrysi — **5372 ± 92** / **3422 BC**
Sample Ref H4B.8

BM-847. Vrysi — **5389 ± 53** / **3439 BC**
Sample Ref H7.4B

BM-848. Vrysi — **5330 ± 57** / **3380 BC**
Sample ref Passage B East. 3, 4

BM-849. Vrysi — **5224 ± 78** / **3274 BC**
Sample ref Area VD.7

General Comment (EJP): dates are consistent with proposed phasing of settlement (Peltenburg, 1974): Early phase, BM-846, 847; transitional, BM-845; Middle phase, BM-843, -844, -848; transitional-Late, BM-849. GU-522: 5420 ± 80, 3470 BC; GU-523: 5340 ± 95, 3390 BC; GU-524: 5255 ± 120 BC (Peltenburg, 1975) are also statistically acceptable within same framework but Birm-182: 5825 ± 145 BC (R, 1971, v 13, p 155) and Birm-337: 5740 ± 140 (R, 1973, v 15, p 468) appear too old for Middle phase. Dates show site flourished for much shorter period than expected and indicate that evolution of Cypriot Neolithic painted pottery styles was rapid and regionally based (GU-dates reported by Peltenburg, 1975, as 453-455 and with slightly different ages; lab nos and dates quoted here are those subsequently amended by issuing lab; Peltenburg, pers commun).

Khirokitia series, Cyprus

Charcoal from aceramic levels at settlement of Khirokitia, S Cyprus (34° 48′ N, 33° 21′ E). Coll 1972 and subm by N P Stanley Price for Dept Antiquities, Cyprus Mus, Nicosia. Samples date aceramic Neolithic phase

in Cyprus and length of occupation of one structure, Tholos XLVI (Dikaios, 1973).

BM-852. Khirokitia **7294 ± 78**
5344 BC

Tholos XLVI (I), roof collapse.

BM-853. Khirokitia **7451 ± 81**
5501 BC

Tholos XLVI (I), Floors I, II, and III.

BM-854. Khirokitia **7442 ± 61**
5492 BC

Tholos XLVI (II), Floors V and VI.

BM-855. Khirokitia **7308 ± 74**
5358 BC

Tholos XLVI (II), Floor VII and pre-Floor VII deposit.

General Comment (NPSP): samples coll from sounding at site previously excavated by Dikaios (1953) and belong to successive floor levels of a single structure (Stanley Price & Christou, 1973; Stanley Price, 1975). Results compare well with 3 previous dates: St-414-416 (Östlund and Engstrand, 1960).

Bylany series, Czechoslovakia

Charcoal from levels and pits at site of Bylany, 3 km SW Kutna Hora, Stredocesky region, Bohemia, W Czechoslovakia (49° 55′ N, 15° 20′ E). Coll ca 1958-1966 by B Soudsky, Archaeol Inst Czechoslovak Acad Sci, Prague; subm by Ruth Tringham, Dept Archaeol, Univ Harvard. Samples date early Neolithic, Linear Pottery culture, and middle Neolithic, Lengyel culture, occupations.

BM-561. Bylany **6038 ± 87**
4088 BC

Feature 921 (Level 1 in oven).

BM-562. Bylany **6184 ± 89**
4234 BC

Feature 2214 (Level 0-1 of bldg pit; 3rd phase of Period I).

BM-563. Bylany **6686 ± 53**
4736 BC

Feature 378 (bldg pit; "violet" settlement phase pre-optimal part of Period II).

BM-564. Bylany **5756 ± 51**
3806 BC

Feature 806 (Level 2 of bldg pit; "dark green" phase post-optimal part of Period II).

BM-565. Bylany **6023 ± 77**
4073 BC

Feature 2101 (Level 3 of bldg pit: "red-yellow" phase—end of Period II).

6178 ± 134

BM-566. Bylany **4228 BC**

Feature 11 (bldg pit; "yellow" phase—1st part of Period III).

4571 ± 75

BM-567. Bylany **2621 BC**

Feature 913 (Level 4 of bldg pit; "blue II" phase—transition Periods III-IV).

5635 ± 65

BM-568. Bylany **3685 BC**

Feature 1230 (Level 3 of bldg pit "middle—dark brown" phase—middle of Period IV—Sarka).

6754 ± 96

BM-569. Bylany **4804 BC**

Feature 900 (Level 1-6 of bldg pit; "dark brown" phase—end of Period IV—Sarka).

4309 ± 108

BM-570. Bylany **2359 BC**

Feature 1728 (Level 1 of bldg pit; early period of stroke-ornamented ware immediately following final Sarka pottery).

5789 ± 82

BM-571. Bylany **3839 BC**

Feature 1217 (bldg pit; Lengyel).

5729 ± 78

BM-572. Bylany **3779 BC**

Feature 1901 (bldg pit; Lengyel).

General Comment (RT): dates fall generally in range of other dates for Linear Pottery culture sites of Central and W Europe, 4500 to 3800 BC, but there are some detailed differences between dates obtained and those expected from archaeol evidence (Soudsky, 1966; Tringham, 1971). Compared with expected dates BM-569, -563, -571 and -572 are too early; -562, -565, -568, -564, -567, and -570 are too late (-567 and -570 appear invalidated by misassoc). *Cf* GrN-4752 (with BM-563): 6170 ± 45; GrN-4754 (with BM-564); 6270 ± 65; GrN-4755 (with BM-568, -569): 6180 ± 45; GrN-4751 (with BM-570): 5810 ± 65; GrN-4753 which should compare on archaeol evidence with BM-571, -572 gave anomalously high age of 9470 ± 55 (GrN dates: R, 1967, v 9, p 131).

Southern Sierra region series, Ecuador

Charcoal samples from sites in Southern Sierra region, Ecuador (ca 3° S, 80° W). Coll 1972 and subm by Elizabeth Carmichael, Mus Mankind, London. Sites yielded fine pottery expected earlier than pottery from coastal region, itself among earliest in S America. Dates help determine relationship between coast and Sierra.

BM-896. Cerro Narrio **3928 ± 60**
1978 BC
Ref 12B1.

BM-897. Chaullabamba **2909 ± 55**
959 BC
Ref 14B1.

BM-898. El Carmen **1817 ± 56**
AD 133
Ref 1B3, 5, 6, 7.

BM-899. Uchucay **2242 ± 48**
292 BC
Ref 2.

BM-900. Pirincay **2581 ± 66**
631 BC
Ref 9E3.

BM-901. Pirincay **2697 ± 49**
747 BC
Ref 9C3.

BM-902. Pirincay **1729 ± 49**
AD 221
Ref 9B6a.

BM-903. Pirincay **2635 ± 77**
685 BC
Ref 9C4.

BM-904. El Carmen **2334 ± 61**
384 BC
Ref 8C3.

BM-736b. Asasif, Egypt **3101 ± 52**
1151 BC

Small tree roots from tree pits of Tuthmosis III causeway at Asasif, Luxor, Egypt (25° 41′ N, 32° 24′ E). Coll 1970 and subm by M Bietak, Vienna. *Comment*: date corrected for natural ^{14}C variations (Damon *et al,* 1972; Ralph *et al,* 1973) is ca 1450 BC. This agrees with archaeol evidence that causeway dates to last year of reign of Tuthmosis III, 1504-1450 BC.

Sakkara series

Charcoal and reed samples from Sacred Animal Necropolis at Sakkara, Egypt (29° 51′ N, 31° 14′ E). Coll 1971-1973 and subm by G T Martin, Dept Egyptol, Univ College, London.

BM-967. Sakkara **2136 ± 54**
186 BC
Charcoal from Block 5 (9), Sec 7, floor, occupation level (Sample 16).

2117 ± 53
BM-968. Sakkara **167 BC**

Charcoal from Block 5 (9), Sec 7, fuel bin on N side, occupation level (Sample 17).

2290 ± 43
BM-969. Sakkara **340 BC**

Reeds used as bonding between mud-brick courses, Block 1, Sec 7, N wall (Sample 80). Reign of Nectanebo II.

2212 ± 47
BM-1098. Sakkara **262 BC**

Charcoal from Block 5 (D), Sec 7, hearth (Sample 60).

2477 ± 42
BM-1099. Sakkara **527 BC**

Reeds used as bonding between mud-brick courses, Sec 3 (Nectanebo II temple), E wall (Sample 135).

2205 ± 42
BM-1100. Sakkara **255 BC**

Reeds used as bonding between mud-brick courses, main N-S cross wall (S end), Block 7, Sec 7.

General Comment: dates accord well with archaeol evidence (Martin, 1973; 1974), particularly in light of further excavations since these samples were coll (H S Smith, in press) and agree with hist evidence when allowance is made for natural ^{14}C variations.

Sitagroi series, Greece

Charcoal from prehistoric settlement mound at Sitagroi, Plain of Drama, Macedonia, Greece (41° 05′ N, 24° 01′ E). Coll 1968 to 1969 and subm by A C Renfrew, Dept Archaeol, Univ Southampton. Samples date occupation phases revealed by stratigraphy of mound (Renfrew, 1970; 1971).

6265 ± 75
BM-648. Sitagroi **4315 BC**

Wood charcoal, Phase I, Level ZA67.

5904 ± 66
BM-649. Sitagroi **3954 BC**

Wood charcoal from flotation, Phase II, Level ZA50.

4363 ± 56
BM-650a. Sitagroi **2413 BC**

Wood charcoal from flotation, Phase IV, Level ZB112.

5367 ± 85
BM-650b. Sitagroi **3417 BC**

Wood charcoal, Phase III, Level ML118.

4332 ± 79
BM-651. Sitagroi **2382 BC**

Acorns from flotation, Phase IV, Level ZB108.

3803 ± 59

BM-652. Sitagroi **1853 BC**

Wood charcoal from post-hole, Phase Va, Level PO162.

3790 ± 78

BM-653. Sitagroi **1840 BC**

Vetch seeds, Phase Vb, Level QO8.

General Comment: sequence of dates for Sitagroi fits well with stratigraphy and harmonizes adequately with Bln series for the site; BM-648 and Bln-779: 6625 ± 170 BP, 4675 BC, and BM-650a and Bln-880: 4510 ± 100 BP, 2560 BC date same samples (Renfrew 1970; 1971).

Baba Jan series, Iran

Charcoal from stratigraphic series from Baba Jan, between Kermanshah and Khorramabad, Luristan, Iran (34° 24′ N, 46° 59′ E). Coll 1966 to 1969 and subm by Clare Goff, Inst Archaeol, Univ London. Samples were intended to date 4 major building levels and assoc pottery styles, and to provide dates for major phase of Luristan bronze industry (Goff, 1969; 1970; Goff-Meade, 1968).

2205 ± 58

BM-586. Baba Jan **255 BC**

Burnt roof beam, lowest floor (Stratum 8a, Level III), Central Hall (Rm 4) of Fort on E Mound (Sample 1).

2176 ± 55

BM-587. Baba Jan **226 BC**

Burnt roof beam, lowest floor (Stratum 9, Level III), Rm 5 of Fort on E Mound (Sample 2).

2096 ± 50

BM-589. Baba Jan **146 BC**

Burnt material from floor of Groom's Kitchen, reoccupation level of Fort (Stratum 6, Level II); assoc with imported pottery and elbow fibulae (Sample 4).

2144 ± 52

BM-597. Baba Jan **194 BC**

Burnt beam on floor, Level III, Painted Chamber (Sample 12).

General Comment: dates are very much later than those expected (1500 to 600 BC) and cannot be reconciled with archaeol evidence.

6846 ± 182

BM-483. Choga Mami, Iraq **4896 BC**

Charcoal (Sample 6) from prehistoric site of Choga Mami, nr Mandali, Diyala Liwa, Iraq (33° 45′ N, 45° 33′ E). Coll 1967 to 1968 and subm by Joan Oates, British School Archaeol in Iraq. Sample dates transitional Samarra/Hajji Muhammad level (Oates, 1969; see Oates, 1972 for discussion of this and related dates).

10,046 ± 318

BM-764. Nahal Oren, Israel **8096 BC**

Animal bone (collagen) from Upper Natufian level at Nahal Oren, ca 15km S of Haifa, Israel (32° 40′ N, 35° E). Coll 1971 and subm by A J Legge, Univ London for British Acad proj for early hist of agric (Noy *et al,* 1973).

2043 ± 78

BM-1073. Punic ship, Italy **93 BC**

Small branches of wood from dunnage in wreck of Punic ship, 200m off N shore of Isola Lunga, Marsala, W Sicily (37° 48′ N, 12° 27′ E). Coll 1973 and subm by Honor Frost, Punic Ship Excavation, British School in Rome. Sample dates closed group of Punic Greek and Roman pottery carried on ship (Frost, 1972-1974; Culican & Curtis, 1974). *Comment*: chemically separated cellulose fraction only used for dating; *cf* HAR-499: 2050 ± 60 BP, 100 BC, date for portion of same sample pretreated with acid and alkali only.

Jericho series, Jordan

Charcoal from Early Bronze age levels at Jericho, Jordan (31° 53′ N, 35° 27′ E). Coll ca 1960 and subm by Kathleen Kenyon.

4175 ± 48

BM-548. Jericho **2225 BC**

Phase XADii, Stage XIV—xliva. First appearance of structures in area of Trench III.

4204 ± 49

BM-549. Jericho **2254 BC**

Phase XAJ—XAK, Stage XV. li to lii. Major destruction of fire within Stage XV.

4126 ± 50

BM-550. Jericho **2176 BC**

Phase XAQ—XAR, Stage lxi—lxii. Major destruction, probably following collapse of town wall.

4080 ± 42

BM-551. Jericho **2130 BC**

Phase XAS—XAT, Stage lxv—lxvi. Destruction involving collapse of timber roofs.

4115 ± 39

BM-552. Jericho **2165 BC**

Phase XAVi, Stage XVII. lxviiia.

3922 ± 78

BM-553. Jericho **1972 BC**

Phase XAY, Stage XVIII. lxxii. Assoc with earliest surviving town wall in area of Trench II.

4170 ± 42

BM-554. Jericho **2220 BC**

Phase XBB, Stage XIX. lxxvi. Penultimate Early Bronze age phase.

General Comment: samples were from levels belonging to later part of Early Bronze age and probably mostly to EB II; main stages represent complete changes in plan, subsiduary divisions represent important structural changes. Expected calendar dates ca 2700 to 2350 BC; when corrected for natural ^{14}C variations these dates appear too old. (See R, 1963, v 5, p 106 and R, 1969, v 11, p 290 for other BM dates for earlier levels at Jericho.)

2627 ± 99

BM-946. Gua Cha, Malaysia **677 BC**

Human bone (collagen) from Burial 2 at Gua Cha, Kelantan, W Malaysia (5° N, 101° 45′ E). Coll 1954 and subm by G de G Sieveking, British Mus. Deposits at site contain extended burials assoc with Cord-Impressed Neolithic pottery and polished stone axes, and contracted burials in levels containing an earlier Hoabinhian industry (Sieveking, 1956a). *Comment* (GdeGS): dates Neolithic burial; other burials contained insufficient collagen for dating purposes and date is surprisingly late compared to that of BM-43: 3450 ± 150 BP, 1500 BC (Am Jour Sci R Supp, 1960, v 2, p 29) found with fully comparable pottery types.

1657 ± 60

BM-958. Pontian boat **AD 293**

Wood from ancient boat found ca 1925 at Pontian, Pahang, W Malaysia (3° 30′ N, 102° 30′ E). Subm by G de G Sieveking. Sample dates characteristic style of assoc earthenware storage vessel termed Pontian jar (Sieveking, 1956c) also found as sherds at Tanjong Rawa (see BM-959, below).

1767 ± 50

BM-959. Selinsing boat **AD 183**

Wood from boat (canoe burial) at Tanjong Rawa, Selinsing estuary, Perak, W Malaysia (4° 30′ N, 100° 30′ E). Coll 1955 and subm by G de G Sieveking. Sample dates primary burial and Kalumpang ware (Sieveking, 1956b, c); Pontian ware found in later levels on this site (see BM-958, above).

Tarxien series, Malta

Carbonized seeds, id by J M Renfrew (1972) from Tarxien Cemetery, Valletta, Malta (35° 52′ N, 14° 32′ E). Subm by A C Renfrew from colln of Natl Mus, Valletta for comparison with BM-101: 4485 ± 150 BP, 2535 BC (R, 1963, v 5, p 107) and BM-141: 3880 ± 150 BP, 1930 BC (R, 1968, v 10, p 5) both unexpectedly early dates.

3286 ± 72

BM-710. Tarxien **1336 BC**

Carbonized 6-row barley (*Hordeum vulgare* L) and horse beans (*Vicia faba* L) from Glass Jar 1 in Natl Mus colln, originally from cinerary urn from Tarxien Cemetery and belonging to Cemetery phase.

3354 ± 76

BM-711. Tarxien **1404 BC**

Carbonized horse beans (*Vicia faba* L) from Glass Jar 5 in Natl Mus colln. Same provenance as BM-710 above.

General Comment: BM-710 and -711 fit much more satisfactorily with emerging radiocarbon chronology for Malta and confirm that BM-101 does not date Cemetery phase (see Renfrew, C, 1972 for full interpretation and discussion of dates).

4478 ± 56

BM-712. Skorba **2528 BC**

Charcoal (*Phillyrea* sp) from floor of Hut of the Querns at Skorba Temple, NW Malta (35° 55′ N, 14° 23′ E). Coll 1962 by D H Trump and subm 1971 by A C Renfrew from coll of Natl Mus, Valletta for comparison with BM-142: 5240 ± 150 BP, 3290 BC (R, 1968, v 10, p 5). *Comment*: sample is from Ggantija phase and confirms BM-142 too early for that phase: BM-712 also harmonizes well with dates for succeeding and preceding phases, BM-143: 4380 ± 150 BP, 2430 BC and BM-147: 5000 ± 150 BP, 3050 BC (R, 1968, v 10, p 5). See also general comment to BM-710 and -711 above and Renfrew, C, 1972.

3912 ± 64

BM-808. Qala Pellegrin **1962 BC**

Animal bone (collagen) from Neolithic site at Qala Pellegrin, Ras il-Pellegrin, between Gnejna Bay and Fomm ir-Rih Bay, NW coast Malta (35° 56′ N, 14° 23′ E). Coll 1970 by R Virzi and subm by E Coleiro, Royal Univ, Msida, Malta.

Taruga series, Nigeria

Charcoal from iron smelting furnaces at Taruga, Nigeria (ca 7° N, 10° E). Coll 1968-1972; subm by B Fagg, Pitt Rivers Mus, Univ Oxford.

2042 ± 126

BM-532. Taruga **92 BC**

Furnace 4, charcoal from within and below slag horizon (TA3, Sample 3).

2269 ± 143

BM-533. Taruga **319 BC**

Sq 015a3, Layer 3, NW quarter, -55 to -90cm (TA2, Sample 8).

2121 ± 116

BM-534. Taruga **171 BC**

Sq 015a3, Layer 3, NW quarter, -90 to -107cm (TA2, Sample 9).

BM-938. Taruga **2541 ± 74**
591 BC

Furnace 1 (Sample J13d1).

BM-939. Taruga **222 ± 40**
AD 1728

Furnace 12 (Sample K14a2, K14a3).

BM-940. Taruga **2488 ± 84**
538 BC

Furnace 7 (Sample K13a1).

BM-941. Taruga **2541 ± 104**
591 BC

Loto D (Sample N15d4).

BM-942. Taruga **2291 ± 133**
341 BC

Furnace 4 (*cf* BM-532, above).

General Comment: except for BM-939 which appears to be intrusive, samples provide dates for early iron smelting in W Africa and indirectly for terra-cotta sculpture of Nok (Fagg & Fleming, in press); *cf* I-1459: 2230 ± 120 BP, 280 BC (Taruga Lf, layer 3); I-2960: 2390 ± 140 BP, 440 BC (TA2, 015a3); I-3400: 2250 ± 100 BP, 300 BC (TA3, Furnace 2).

BM-535. Katsina Ala **384 ± 45**
AD 1566

Charcoal from Katsina Ala, Nigeria (7° 10′ N, 9° 30′ E) from an occupation site comparable with Taruga, Nigeria (BM-532-534, BM-938, BM-940-942, this list above). Coll 1968; subm by B Fagg, Pitt Rivers Mus, Univ Oxford. Sample from large mass of charcoal in Nok culture occupation layer. *Comment*: date expected to compare with those for furnaces at Taruga, above.

Inca sites, Peru

Samples from Inca buildings in Cuzco region of Peru (ca 13° 30′ S, 72° W). Coll 1970 and subm by Ann Kendall, Inst Archaeol, Univ London.

BM-924. Choqepuqio **674 ± 58**
AD 1276

Wood.

BM-925. Canarraccay **413 ± 59**
AD 1537

BM-926. Cuzco **231 ± 71**
AD 1721

Charred bone (collagen), Sample Q11AC3.

BM-927. Keannbamba **217 ± 67**
AD 1733

Grass and wood.

BM-928. Urco **203 ± 63**
AD 1747
Grass and wood, Sample I.

BM-929. Urco **298 ± 40**
AD 1652
Wood, Sample J.

BM-930. Cuzco **460 ± 89**
AD 1490
Charcoal, Sample 1676L.

BM-931. Cuzco **286 ± 52**
AD 1664
Wood, Sample 1676P.

Comment: dates agree reasonably well with those expected when allowance is made for secular ^{14}C variations.

BM-936. Castelo do Giraldo, Portugal **2685 ± 65**
735 BC
Charcoal from Late Neolithic settlement at Castelo do Giraldo nr Valverde, Evora, Portugal (38° 32′ N, 8° 00′ W). Coll 1972 and subm by J M Arnaud, Nat Mus Archaeol & Ethnol, Lisbon. Sample intended to date Neolithic settlement related to megaliths of Alentejo. *Comment* (JMA): sample coll from supposed undisturbed Neolithic or Chalcolithic level but date indicates area, like other parts of same site, was occupied during transition Bronze—Iron age, attested by stroke—burnished ware and bronze tools. TL dates for sherds from same layer were ca 3000 BC and ca 1150 BC, confirming disturbance.

Parpalló series, Spain

Bone and antler (collagen) from stratified early Upper Palaeolithic levels in cave of Parpalló, Valencia Prov, Spain (38° 55′ N, 0° 20′ W). Coll 1930 by L Pericot Garcia; subm by I Davidson, Dept Archaeol, Univ Cambridge.

BM-858. Parpalló **>40,000**
Pre-Solutrean level, depth ca 7.5m; vertebrae of *Cervus ibex* and *C elaphus*.

BM-859. Parpalló **+900 20,490 −800 18,540 BC**
Lower Solutrean level, depth 6.5 to 7m; bone and antler fragments (*C elaphus*).

BM-861. Parpalló **+850 18,080 −770 16,130 BC**
Upper Solutrean level, depth 4.75 to 5m; antler fragments (*C elaphus*).

General Comment: date of > 40,000 is older than expected for Parpalló sequence where earliest remains were described as Gravettian (Pericot Garcia, 1942) but BM-859 agrees well with date for Lower Solutrean of Laugerie-Haute Est, France, GrN-1888: 20,890 ± 300 BP, 18,940 BC (R, 1963, v 5, p 167); although BM-861 suggests Solutrean lasted longer in Valencia than in Dordogne, dates for Parpalló appear to show remarkable similarity in age with Solutrean industries of SW France (Davidson, 1974).

Spirit Cave series, Thailand

Charcoal from Hoabinhian levels (Gorman, 1969) at Spirit Cave, Mae Hongson, Thailand (19° 40′ N, 98° E). Coll 1966 by C F Gorman, Dept Anthropol, Univ Hawaii; subm by G de G Sieveking.

BM-501. Spirit Cave — **7907 ± 198** / **5957 BC**

Site 19, A2-B2 (2); Sample 1.

BM-502. Spirit Cave — **9073 ± 112** / **7123 BC**

Site 19, C2-N wall (3); Sample 2.

BM-503. Spirit Cave — **9510 ± 160** / **7560 BC**

Site 19, B2-NW corner (5); Sample 3.

BM-504. Spirit Cave — **9202 ± 106** / **7252 BC**

Fire pit, B2-C2 (5); Sample 4.

Amerindian palaeopathology series, United States

Five bone (collagen) samples from skeletons showing evidence of pathologic lesions. Samples came from various mus collns and form part of program for study of early history of disease in the New World (Brothwell & Burleigh, 1975). Subm by D R Brothwell, Inst of Archaeol, Univ London.

BM-462. Californian Amerindian — **857 ± 52** / **AD 1093**

Californian Amerindian (ca 35° N, 120° W) of Late Horizon period from Berkeley colln (Ref Scr. I. 83. 4434) showing evidence of treponemal infection.

BM-463. Californian Amerindian — **622 ± 63** / **AD 1328**

Californian Amerindian (ca 35° N, 120° W) of Late Horizon period from Berkeley colln (Ref Cco. 138. 6091) showing evidence of spinal osteitis probably indicating tuberculosis.

563 ± 104

BM-464. "Prehistoric" Amerindian **AD 1387**

Amerindian from May's Lick, Kentucky (ca 37° N, 85° W). From Am Mus Nat Hist colln, New York (Ref 20/915). One of nine individuals showing vault changes suggestive of treponematoses.

735 ± 83

BM-465. Horr's Island Amerindian **AD 1215**

"Late prehistoric" Amerindian from Horr's Is, Florida (ca 28° N, 82° W). From Smithsonian colln, Washington, DC (Ref 352156). Assoc with individuals showing osteitic changes suggestive of treponematoses.

852 ± 120

BM-466. Horr's Island Amerindian **AD 1098**

"Late prehistoric" Amerindian from Horr's Is, Florida (ca 28° N, 82° W). From Smithsonian colln, Washington, DC (Ref 352162). Assoc with individuals showing osteitic changes suggestive of treponematoses.

General Comment: dates support view that treponemal diseases were established in the New World before Columbian contact (see Brothwell and Burleigh, 1975 for a fuller discussion of dates).

Divostin series, Yugoslavia

Charcoal from storage pits in Neolithic settlement site at Divostin, Kragujevac, E Yugoslavia (44° 02′ N, 20° 50′ E). Coll 1969 and subm by A McPherron, Dept Anthropol, Univ Pittsburgh and Ruth Tringham, Univ Harvard (McPherron & Srejović, 1971).

6935 ± 98

BM-573. Divostin **4985 BC**

Feature 120 E, 105cm below surface; Starcevo level.

5247 ± 144

BM-574. Divostin **3297 BC**

Feature 121 (sample from various depths in undisturbed storage pit below floor of Vinca Plocnik "D" house).

General Comment (AMcP and RT): BM-573 agrees with Bln-896: 6945 ± 100 BP, 4985 BC, date for portion of same sample; dates for Starcevo occupation at Divostin fall within range of dates for other early Neolithic settlements of SE and Central Europe (Azmak, Gornja Tuzla, Vrsnik); similarities suggest Starcevo layers at Lepenski Vir (undated) and Divostin were contemporaneous. BM-574 is consideraly later than expected and differs from Bln-898, 5860 ± 100 BP, 3910 BC for same sample but agrees with Bln-867, 5250 ± 100 BP, 3300 BC and fits with ceramic chronology of Divostin and with dates for Eneolithic (Bodrogkerestur culture) settlements of SE Europe.

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[RADIOCARBON, VOL. 19, NO. 2, 1977, P. 161-164]

INSTITUT FONDAMENTAL D'AFRIQUE NOIRE RADIOCARBON DATES II

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Treatment of samples and counting equipment have remained essentially the same as described previously (R, 1974, v 16, p 404-306). Sample CO_2 is used to fill a 1.2L steel proportional counter at 740mmHg.

Age calculations are based on a ^{14}C half-life of 5568 ± 30 yr and 0.95 of activity of the NBS oxalic acid standard. 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.

ARCHAEOLOGIC SAMPLES

These samples were coll by IFAN Prehist Dept from different districts of Senegal.

DaK-201. IFAN 108 **867 ± 117**

Charcoal from Senegambian Megalithic site, Sine-Ngayene, Nioro du Rip Senegal dist (13° 41′ N, 15° 32′ W); depth 110cm, 80km from sea. Megalithic circle containing 29 human tombs; assoc objects: iron weapons, copper ornaments, ceramic, carnelian beads. Coll 1975 by G Thilmans and subm by G Thilmans and C Descamps, IFAN Prehist Dept. *Comment*: dates period of Senegambian Megalithic civilization.

DaK-177. IFAN 97 **5070 ± 110**

Charcoal from Megalithic site, Tiekene-Boussoura, Koupentoum dist, Senegal (14° 00′ N, 14° 35′ W); Megalithic circle no. 8 containing human tombs. Coll 1974 by G Thilmans and subm G Thilmans and C Descamps. *Comment*: dates period of Senegambian Megalithics.

DaK-162. IFAN 81 **751 ± 100**

Shells of ostrich egg from Rao tumulus, Massar dist, Bas-Senegal (15° 58′ N, 16° 20′ W). Coll 1942 by Joire and G Duchemin and subm by Prehist Dept, IFAN. *Comment*: dates famous golden pectoral (breastplate) excavated from tumulus.

DaK-167. IFAN 85 **2126 ± 110**

Charcoal from Tiekene-Boussoura Megalithic site, Koupentoum dist Senegal (14° 00′ N, 14° 35′ W); depth 105cm. Coll 1974 by G Thilmans and subm by G Thilmans and C Descamps. *Comment*: dates a period of Senegambian Megalithics. Cross-check was made with Nancy lab: Ny-357 = 1980 ± 60. Both dates seem to agree.

DaK-155. IFAN 82 **1363 ± 120**

Charcoal from Sintiou-Bara site, Matam dist, Senegal (15° 42′ N, 13° 24′ W), depth 280 cm. Assoc with pottery, iron, and silver objects.

Coll 1973 and subm by A Ravise, IFAN Prehist Dept. *Comment*: dates period of Senegalese protohistory.

DaK-192. IFAN 83 **900 ± 100**

Charcoal from same site as DaK-155, depth 225cm. Coll 1973 and subm by A Ravise.

DaK-191. Khant 11-75 **5415 ± 10**

Shells (*Arca senilis*) from Khant II site, 25km NNE of Saint-Louis du Senegal (16° 05′ N, 16° 20′ W), depth 100cm. Assoc with human skeleton. Coll 1974 and subm by A Ravise. *Comment*: dates Neolithic skeleton and assoc industry.

The following samples are coll by Hist Dept, Fac Lettres, Dakar, from Mauritanian archaeol sites: Tegdaoujt Aoudaghost, and Koumbi Saleh (Robert, 1971).

DaK-156. KS AO_I44 (C) **981 ± 114**

Charcoal from Koumbi Saleh archaeol site, Timbedra dist Mauritania (15° 40′ N, 8° 5′ W), depth 510cm, 945km from sea. Assoc with Medieval ceramics. Coll 1972 and subm by A Cros and S Robert. *Comment*: dates archaeol Layer IIIa.

DaK-157. KS 72 AO_I44 (D) **1122 ± 125**

Charcoal from Koumbi Saleh site, depth 510cm, 945km from sea. Coll 1972 by A Cros and subm by A Cros and S Robert. *Comment*: dates archaeol Layer IIIa.

DaK-158. TEG 73 AO_V79 **633 ± 120**

Charcoal from Tegdaoujt archaeol site, Tamchakett dist, Mauritania (17° 25′ N, 10° 25′ W); depth 500cm, 586km from sea. Assoc with ceramics. Coll 1973 by A Cros and subm by A Cros and S Robert. *Comment*: dates assoc industry.

DaK-172. TEG 73 C VII 27 **1017 ± 100**

Charcoal from Tegdaoujt site, depth 260cm, 580km from sea. Assoc with Medieval ceramics. Coll 1973 and subm by C Vanaecker and S Robert. *Comment*: dates assoc industry.

DaK-173. TEG 73 C VII 103 **1031 ± 100**

Charcoal from Tegdaoujt site, depth 115cm. Coll 1973 and subm by Claudette Vanaecker and S Robert. Assoc with Medieval ceramics. *Comment*: dates Medieval ceramics.

DaK-194. TEG 73 SRV **1851 ± 100**

Charcoal from Tegdaoujt site, assoc with modern ceramics; depth 100cm. Coll 1973 and subm by S Robert. *Comment*: dates assoc industry.

DaK-195. TEG-73 SY III **1170 ± 100**

Charcoal from Tegdaoujt site, depth 335cm. Assoc with Medieval ceramics. *Comment*: dates assoc industry.

GEOLOGIC SAMPLES

Benin series

Evolution of the Benin shoreline during the late Quaternary is studied here. The actual shoreline approximates that which existed in the yr 0 and even that of the last 2 millennium BC. DaK-197 and -198 confirmed indications of DaK-182: prior to beginning of our era, sea level of Benin region of West African coast was lower than present sea level (Paradis, 1976).

DaK-182. DY Cot 1 **2040 ± 110**

Shells (*Arca senilis*) from "crique d'Akpakpa", Cotonou Benin (6° 27′ 30″ N, 2° 28′ W); depth 20cm below sea, 200cm from shore. Coll 1974 and subm by Guilhan Paradis, Bot Lab, Univ Cotonou, Benin. *Comment*: dates sea shoreline at time of shell deposit.

DaK-183. DY Dje 2 **3900 ± 140**

Shells (*Spisula*) from Djeffa dist, Benin (6° 23′ N, 2° 33′ 40″ W); depth 90 to 100cm, 4.5km from sea. Coll 1975 and subm by G Paradis. *Comment*: dates ancient mangrove lagoon Tchonvi-Djeffa-Kpodji.

DaK-184. DY Dje 3 **640 ± 100**

Shells (*Pachymelania aurita*) from Djassin-Quinvie, near Porto-Novo town, Benin (6° 29′ N, 2° 37′ W); depth 200cm under water, 12km from sea. Coll 1974 and subm by G Paradis. *Comment*: dates ancient brackish lagoon at foot of dead cliff of surf-deposited sand.

DaK-196. DY ouid 6 **180 ± 115**

Shells (*Arca senilis*) from Sehomi dist, W Aheme lake, Benin (6° 30′ 10″ N, 1° 58′ W); 23km from sea. Coll 1975 and subm by G Paradis. *Comment*: dates kitchen midden on Ahme Lake shore.

DaK-197. DY ouid 7 **2930 ± 130**

Shells (*Ostrea tulipa*) from Djegbame Benin dist, Benin (6° 19′ 48″ N, 1° 58′ 15″ W); depth 120 cm, 3km from sea. Coll 1974 and subm by G Paradis. *Comment*: dates lacustrine deposits.

DaK-198. DY ouid 9 **2510 ± 120**

Shells (*Cardium ringens, Arca senilis*) from Djegbadji W Ouidah town, Benin (6° 19′ N, 2° 05′ 10″ W); depth 50cm, 500m from sea. Coll 1975 and subm by G Paradis. *Comment*: dates shoreline at time of shell deposition.

DaK-199. DY Cot 8 **2675 ± 120**

Charcoal from Cocotomey dist, "carriere colas", Benin (6° 23′ 40″ N, 2° 18′ 10″ W); 5km from sea. Coll 1975 and subm by G Paradis. *Comment*: dates layer of yellow sand considered to mark ancient shoreline.

DaK-200. DY Cot 12 **865 ± 115**

Peat (*Rhizophora*) from Togbin dist, W Cotonou town, Benin (6° 20′ 50″ N, 2° 18′ 20″ W); 500m from sea. Coll 1975 by G Paradis. *Comment*: dates formation of *Rhizophora* mangrove at site.

Saloum series

In this series, the late Quaternary shoreline of SW Senegal is studied. Dates are established within framework of a UNESCO 10-yr project, aiming at "River Flood and Lake Level Changes": Internatl Geol Correlation Prog (IGCP).

Whereas DaK-1974 corresponds to Nouakchott transgression, DaK-175 and -176 concur and correspond to final phase of late alluvium of Saloum R delta; alluvium could be contemporary with off-shore sand bars of Saloum R delta.

DaK-174. E 8 **5530 ± 150**

Shells (*Arca senilis*) from Gandoul I., Saloum estuary, Senegal (13° 58′ N, 17° 35′ W); 16km from sea. Coll 1975 and subm by El Hadj Salif Diop, Geog Dept, Fac Lettres, Dakar. *Comment*: dates Nouakchottian transgression. Oldest bank dated in Saloum Is.

DaK-175. E 21 **2695 ± 100**

Shells (*Arca senilis*) from Sangomar Cape, Saloum, Senegal (14° 53′ N, 17° 47′ W); 500cm from sea. Coll 1974 and subm by El Hadj Salif Diop. *Comment*: dates final phase of late alluvium, contemporary to formation of off-shore sand bars of Saloum delta.

DaK-176. P_2 E.3 **2550 ± 100**

Shells (*Arca senilis*) from Dienewar dist, Gandoul I, Senegal (13° 54′ N, 17° 44′ W); 1km from sea. Coll 1974 and subm by El Hadj Salif Diop and Sall, Geog Dept, Fac Lettres, Dakar. *Comment*: dates final phase of late alluvium; could be contemporary with formation of off-shore sand bars of Saloum delta.

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[RADIOCARBON, VOL. 19, NO. 2, 1977, P. 165-169]

FLORENCE RADIOCARBON DATES III

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This list comprises age measurements carried out from January 1976 to July 1976. Dated samples are all of archaeologic interest, from Italian territory. Pretreatment of samples, production of purest CO_2 and counting techniques have been described elsewhere (Azzi, 1972; Azzi *et al,* 1973; Azzi *et al,* 1974). Ages of samples are calculated using the conventional half-life of 5570 ± 30 yr and refer to 1950. Errors are stated in terms of one standard deviation of counting statistics.

ACKNOWLEDGMENTS

We thank submitters for providing financial support.

SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC AND HISTORIC SAMPLES

A. Italy

Grotta Paglicci series

Charcoal from Grotta Paglicci on left side of Settepenne V on S side of Gargano promontory near Rignano Garganico, 15km E St Severo, prov Foggia, Apulia (41° 39′ 8″ N, 15° 36′ 51″ E). Coll 1972 to 1975 and subm 1975 by A Palma di Cesnola, Ist Antropol e Paleontol Umana, Siena. Layers of this series contain different cultural horizons of Superior Paleolithic Age. Detailed information about the structure of the site was previously reported (Azzi *et al,* 1974).

F-94. Grotta Paglicci 3,a — **11,440 ± 180** / **9490 BC**

Charcoal from Layer 3,a. Final Epigravettian industry with many geometric miroliths.

F-95. Grotta Paglicci 4,a,c — **11,950 ± 190** / **10,000 BC**

Charcoal from Layer 4,a,c. Final Epigravettian industry.

F-96. Grotta Paglicci 5,b,c — **13,590 ± 200** / **11,640 BC**

Charcoal from Layer 5,b,c. Final Epigravettian industry with truncated backed blades.

F-64. Grotta Paglicci 6 — **14,270 ± 230** / **12,320 BC**

Charcoal from Layer 6 related to final Epigravettian industry.

F-65. Grotta Paglicci 7 — **14,820 ± 210** / **12,870 BC**

Charcoal from Layer 7. Last layer with final Epigravettian industry.

15,460 ± 220

F-66. Grotta Paglicci 8 **13,510 BC**

Charcoal from Layer 8. Evolute Epigravettian.

15,270 ± 220

F-67. Grotta Paglicci 9 **13,320 BC**

Charcoal from Layer 9. Industry like F-66.

15,320 ± 250

F-68. Grotta Paglicci 10 **13,370 BC**

Charcoal from Layer 10. Industry probably related to initial phase of Evolute Epigravettian age.

General Comment (APC): ages of Layers 10 to 8 agree with chronology of Evolute Epigravettian found in Riparo C, Grotta delle Cipolliane, Str 3 (Lecce, Apulia); dates of Layers 7 to 5 resemble Final Epigravettian of Ugento, Lecce (R-271: 14,170 ± 170; R-272: 13,870 ± 110) and Riparo Tagliente, Layers 15 and 16 (R-605a: 13,430 ± 180; R-605: 13,330 ± 160). Dates of Layers 4, 3, and 2 can be related to many settlements of Final Epigravettian found in N and S Italy: Grotta Romanelli, Lecce, Layers A and B (R-56: 11,930 ± 520; R-58: 11,800 ± 600), (Alessio *et al*, 1964); Grotta Erica, Salerno, Str C, Sec B, Cut 3 and 4 (F-38: 11,275 ± 360; F-39: 11,690 ± 370); Grotta Perciata, Palermo (F-27: 11,960 ± 330); Grotta dei Genovesi, Trapani (F-19: 11,710 ± 295); Nicchia Gamba, Salerno (F-25: 11,630 ± 230); Grotta del Romito, Cosenza, Lev 6a (R-299: 11,500 ± 200); Grotta della Cala, Salerno, Str H (F-21: 12,030 ± 220); Grotta della Madonna, Praia a Mare, Cosenza, Str X inf (R-293: 12,100 ± 150); Riparo Tagliente, Verona, Str 14 (R-604: 12,000 ± 400; R-371: 12,040 ± 170), (Alessio *et al*, 1970).

4020 ± 150

F-69. Torre Mozza **2070 BC**

Charcoal from open site with fireplace and pottery from Località Torre Mozza, com Piombino, prov Livorno (42° 56′ 33″ N, 14° 12′ 08″ E). Coll 1976 by A Galimberti, Ist Antropol, Siena, and subm 1976 by A Palma di Cesnola. Charcoal from base of anthropozoic level with pottery probably related to Final Bronze age. Date does not agree with typology (pers commun).

29,850 ± 870

F-70. Grotta della Cala Atrio **27,900 BC**

Charred bones from the front part of Cala Cave, Salerno, S Italy (40° 00′ 02″ N, 15° 22′ 57″ E). Coll and subm 1975 by P Gambassini, Ist Antropologia, Siena. Layer contains an Aurignacoid lithic industry with carinated, muzzle and scrapers; it underlies Q Layer of Gravettian age (F-22, F-23 and F-24: R, 1973, v 15, p 483).

Castelcivita series

Charred bones from base (Lev 10-11) and middle (Lev 9) levels of a reddish sand layer in Castelcivita Cave, Salerno, S Italy (40° 29′ 41″ N,

15° 12′ 36″ E). Coll and subm 1975 by P Gambassini. Layers contain a lithic industry of an early phase of Upper Paleolithic with marginal backed blades of Dufour type. Fauna include *Equus, Cervus,* and micromammals (Gambassini, 1976).

F-71. Castelcivita 10,11 **32,470 ± 650** **30,520 BC**

Charred bones from Level 10 and 11.

F-72. Castelcivita 9 **32,930 ± 720** **30,980 BC**

Charred bones from Level 9.

Dicomano series

Charcoals from different levels of a Bronze age layer coll in open site of Dicomano, prov Florence (43° 53′ 26″ N, 13° 04′ 26″ E). Coll 1974 and subm 1976 by L Sarti, Ist Antropol, Siena. Analyzed layers, contained broken pottery and lithic industry, lay between 2 alluvial layers.

F-73. Dicomano I **2850 ± 80** **900 BC**

Charcoal, from —1.45m depth between archaeol and alluvial layer, which contains medieval remains.

F-74. Dicomano 2 **3270 ± 80** **1320 BC**

Charcoal, —2.50m deep in core of archaeol layer.

General Comment (PG): typologically, Dicomano settlement belongs to Middle Bronze age; date agrees with typologic estimate.

Riparo del Belvedere series

Charcoals from Monfenera, Low Valsesia, prov Vercelli, Piemonte (45° 42′ 30″ N, 8° 19′ 30″ E). Samples set a chronologic frame for Belvedere stratigraphy, unique in N Italy, except for Veneto.

F-75. Riparo del Belvedere MF 4 196:0 **1225 ± 70** **AD 725**

Charcoal from D 15 area, R.2 fireplace, R.2 superior layer. Sample assoc with Late Roman and Early medieval materials. Coll 1969 and subm 1976 by F Fedele, 1st Antropol, Torino. *Comment* (FF): date establishes chronologic position of Early Medieval settlements in NW Italy and agrees with hypothesis.

F-76. Riparo del Belvedere MF 4 744:1 **3440 ± 150** **1490 BC**

Charcoal from B 22 NE area, Gr-W fireplace, Grcb unit, R.3 layer. Coll 1972 and subm 1976 by F Fedele. Sample assoc with pottery and bones fragments. *Comment* (FF): date of this Neolithic settlement in Piemonte establishes chronology of VBQ culture in NW Italy.

General Comment (FF): first 2 dates of these cultures found in NW Italy.

St Martin de Corléans series

Charcoal from prehistoric and archaeol settlement of St Martin de Corléans, from W suburbs of Aosta, Val d'Aosta (45° 27′ N, 17° 40′ E) at +586m, near St. Martin de Corléans Church. Samples coll in N part of settlement, which was divided in 2 areas, called, respectively, St Martin Nord and St Martin Sud. Samples belong to a large settlement containing Megalithic constructions raised between end of Neolithic and Eneolithic ages. Materials analyzed coll 1969 to 1971 and subm 1975 by F Mezzena, Sov Antichità, Aosta.

F-77. St Martin de Corléans P7 — **4720 ± 150** / **2320 BC**

Charcoal from wooden pile, without stone base.

F-78. St Martin de Corléans P 12 — **5020 ± 180** / **3070 BC**

Charcoal from wooden pile, with stone base.

F-79. St Martin de Corléans P 13 — **4325 ± 170** / **2375 BC**

Charcoal from wooden pile, without stone base.

F-80. St Martin de Corléans P 15 — **4800 ± 170** / **2850 BC**

Charcoal from wooden pile, with stone base.

F-81. St Martin de Corléans P 16 — **4840 ± 190** / **2890 BC**

Charcoal from wooden pile, with stone base.

F-82. St Martin de Corléans P 17 — **4910 ± 200** / **2960 BC**

Charcoal from wooden pile, with stone base.

F-83. St Martin de Corléans P 19 — **4450 ± 180** / **2250 BC**

Charcoal from wooden pile, without stone base.

General Comment (FM): samples were found in big holes, in which were erected probably totemic piles, with alignment NE-SW; perhaps settlement was a worship area (Mezzena, 1974).

Isola Santa series

Charcoal from an open settlement with Mesolithic industry in Isola Santa, in Turrite Secca R Valley, Alpi Apuane, com Careggine, prov Lucca (44° 03′ 48″ N, 14° 15′ 22″ E). Samples coll and subm 1975 by C Tozzi, 1st Antropol, Pisa.

F-89. Isola Santa L 3 — **1270 ± 120** / **AD 680**

Charcoal from L 3 Layer, probably disturbed, supposition confirmed by date that is too recent and does not agree with typology.

9370 ± 150
F-90. Isola Santa L 4 a,b,c **7420 BC**

Charcoal from superior part of Layer L 4.

9980 ± 160
F-91. Isola Santa, L 4 d,e **8030 BC**

Charcoal from inferior part of Layer L 4.

General Comment (CT): F-90 and -91 oldest dates of Mesolithic settlements (Sauveterroid type) and agree with absolute chronology given by Epipaleolithic and Upper Paleolithic of Adige Valley deposits.

4050 ± 140
F-92. S Maria di Leuca **2100 BC**

Charcoal from Level 5 of Sec C in Bronze age village of S Maria di Leuca, prov Lecce (39° 47′ N, 18° 22′ E). Coll 1975 by G Cremonesi, Univ Lecce, and subm 1975 by C Tozzi. Sample from a level in which a fireplace and much pottery of Apenninic culture were found. Date is probably too old topologically.

4920 ± 210
F-93. Catignano **2970 BC**

Charcoal from Structure 59 in Neolithic village of Catignano, prov Pescara (42° 21′ 27″ N, 13° 44′ 08″ E). Coll and subm 1975 by C Tozzi. Date seems too recent; in relation to pottery and stratigraphy of Grotta dei Piccioni and Grotta S Angelo, Catignano village is older than beginning of Ripoli culture.

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HAMBURG UNIVERSITY RADIOCARBON DATES II

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Radiocarbon measurements mainly on soil samples and soil organic matter fractions are being continued. Sample benzene preparation follows Scharpenseel & Pietig (1969; 1970a). Radioactivity is measured in single screw cap quartz vials using a Packard Tri-Carb 3075 as well as a Berthold Betaszint BF 5000.

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SAMPLE DESCRIPTIONS

I. SOIL SAMPLES

Pretreatment of soil samples described in Scharpenseel & Pietig (1969), and Scharpenseel (1972).

A. Germany

Sequence of mud, topped by low moor peat and sand cover at fringes of refilled old river bed of Ems R. In adjacent sandy bank of Ems R artifacts of ren hunter group (Ahrensberg culture) dated ca 9000 BC. Samples to determine approx age of low moor.

HAM-280. Rietberg (51° 48′ N, 8° 25′ E), mud, 30.3% organic — 6680 ± 90

HAM-281. Rietberg, low moor, 80% organic — 4540 ± 70

Samples coll and subm 1975 by H Mertens, Geol Landesamt NRW, Krefeld. *Comment*: dates indicate time of development of mud and low moor, which overlie archaeol predated river bank planum.

Brown earth (ochrept) profile rich in humus down to deep layers on terrace gravel.

HAM-631. Holzkirchen, near Munich-Salzburg Hwy, 47° 55′ N, 11° 43′ E), Ah1 0 to 5cm — 117.3 ± 0.6%

HAM-632. Ah2 5 to 25cm — 105.1 ± 0.5%

HAM-633. Ah3 25 to 45cm — 2510 ± 50

HAM-634. Bt 45 to 65cm — 123.8 ± 0.8%

Samples coll and subm 1975 by H Grottenthaler, Bayer Geol Landesamt, Munich, FRG. *Comment*: samples reworked or contaminated, bomb C at depth of 45 to 65cm.

B. Argentina

Brunizem soils from Argentina (Udolls with argillic horizon)

HAM-231.	Brunizem, Profile B 5, Rafaela 96m alt, (31° 15′ S, 61° 27′ W), typical Brunizem with B_2-horizon, sampling after crop of corn, Ap 0 to 15cm	110.0 ± 0.5%
HAM-232.	Ah/AhBv 15 to 30cm	320 ± 60
HAM-233.	Bt1 30 to 40cm	114.7 ± 0.5%
HAM-234.	Bt1 40 to 50cm	101.1 ± 0.4%
HAM-235.	Bt1 50 to 60cm	260 ± 70
HAM-236.	Bt2 60 to 70cm	104.3 ± 0.5%
HAM-237.	Bt2/Bt3 70 to 80cm	480 ± 80
HAM-238.	Typical Brunizem, profile B 7, Esperanza 38m alt (31° 26′ S, 61° 87′ W), experimental plot, Ap 0 to 13cm	113.8 ± 0.6%
HAM-239.	Ah 15 to 30cm	200 ± 60
HAM-240.	AhBv 30 to 40cm	100.2 ± 0.3%
HAM-241.	Bt1 40 to 50cm	480 ± 60
HAM-242.	Bt1 50 to 60cm	1100 ± 60
HAM-243.	Bt2 60 to 70cm	2000 ± 80
HAM-244.	Bt2 70 to 80cm	2030 ± 80
HAM-245.	Slightly planosolic Brunizem, profile B 8, Angel Gallardo, 16m alt (31° 33′ S, 60° 43′ W) weed covered fallow, Ap 0 to 10cm	112.5 ± 0.4%
HAM-246.	Ap/P/Ah 10 to 30cm	101.1 ± 0.4%
HAM-247.	AlBv 30 to 40cm	980 ± 60
HAM-248.	Bt1 40 to 50cm	1930 ± 140
HAM-249.	Bt1 50 to 60cm	2110 ± 80
HAM-250.	Bt1 60 to 70cm	2420 ± 80
HAM-251.	Bt1 70 to 80cm	2550 ± 70
HAM-252.	Bt2 80 to 90cm	2780 ± 80
HAM-253.	Brunizem under cropping pattern, till 30cm rooted, fragipan, Profile B 9, Villa Conception des Tio, 110m alt (31° 33′ S, 60° 43′ W), Ap 0 to 15cm	112.8 ± 0.5%
HAM-254.	Ah/B 18 to 27cm	460 ± 60

HAM-255.	Bt	27 to 35cm	1080 ± 100
HAM-256.	Bv	35 to 45cm	1370 ± 90
HAM-257.	Bv	45 to 55cm	1870 ± 90

Samples coll and subm 1974 by S Stephan, Inst Soil Sci, Bonn Univ, FRG. *Comment*: dates of deepest humus containing fringes younger than 5000 to 6000 BP as found in Holocene Mollisols of N Europe (Scharpenseel, 1972). Pronounced clay infiltration carrying organic matter could be responsible for some rejuvenation.

C. Tunisia

Fossil soil horizons in Bou Huertma alluvium (36° 37′ N, 8° 55′ E).

HAM-258.	Pit hole in alluvium 2km N Hwy, 1% C, 110cm	3400 ± 80
HAM-259.	Same site, 1.1% C, 160cm	4930 ± 80

Samples coll and subm 1974 by K Kirschey, Ordinariat f Bodenkunde, Hamburg Univ, FRG. Supporting samples for series HAM-157-174 (R, v 18, p 282-283). *Comment*: samples indicate time of soil formation in Medjerdah-Bou Huertma alluvial deposits.

D. Humic acid samples of Lower Saxonian soils

Humic acid samples, produced by continuous extraction from various soil materials (especially from peaty, podzolic or chernozemic soil materials) using alkaline and neutral extractants. Peat samples of surface near origin from spots unaltered by recent human activities (peat cutting, recultivation). All soils sampled within boundaries of Lower Saxonia-state, between Elbe R and Ems R.

HAM-260.	Humic acid sample, Sonnenberger Moor, high moor, Harz, *Vaccinium* vegetation.	180 ± 70
HAM-261.	Fringes of Sonnenberger Moor, high moor, *Picea* vegetation.	1210 ± 100
HAM-262.	Teufelsmoor near Bremen, high moor, "white peat".	3210 ± 100
HAM-263.	Gnarrenburger Moor, highly decomposed "black peat".	1610 ± 80
HAM-264.	Königsmoor near Bremen, high moor, "white peat", 30 cm.	2430 ± 80
HAM-265.	Königsmoor near Bremen, albic horizon in sand below peat of high moor	2350 ± 70
HAM-266.	Königsmoor near Bremen, spodic horizon in sand and peat, spodosol underneath high moor	2770 ± 100
HAM-267.	Kolbecksmoor, highly decomposed low moor peat	4200 ± 110

HAM-268.	Highly decomposed low moor peat from Lake Dümmer near Hannover	3030 ± 110
HAM-269.	Moderately decomposed low moor peat near Stade I	3330 ± 90
HAM-270.	Highly decomposed low moor peat near Stade II	2670 ± 80
HAM-271.	Highly decomposed low moor peat from "groβer Bruch" near Jerxheim, calcareous site (30% $CaCO_3$)	2480 ± 100
HAM-272.	Erica Podzol, spodic horizon, Vogtei, pH 7-extract	730 ± 80
HAM-273.	Erica Podzol, spodic horizon, Vogtei, pH 14-extract	650 ± 80
HAM-274.	Calluna Podzol, spodic horizon, Steyerberg, pH 14-extract	230 ± 90
HAM-275.	Brown coal (Kasseler Braun) Steinberg, Hannoversch Münden	19,800 ± 710
HAM-276.	Peaty sand from sand pit Honerdingen near Walsrode, Südheide	18,210 ± 670
HAM-277.	Argiudoll near Hildesheim, field culture, Ap 10cm	340 ± 80
HAM-278.	Argiudoll near Hildesheim, forest, Ah 10cm	230 ± 80
HAM-279.	Argiudoll near Hildesheim, forest, Ah 35cm	103.6 ± 0.6%

Samples coll and subm 1974 by W Rochus, Interfak Lehrgebiet Chemie, Göttingen Univ, FRG. *Comment*: near surface samples from Sonnenberger High Moor seem to be influenced by contemporary and bomb carbon sources. The Königsmoor samples (HAM-264-266) belong to high moor superimposed on pronounced Spodosol. Peat and albic horizon-C are slightly younger than carbon of the accumulating spodic horizon. This is a "wurzelechtes Hochmoor," which means that plants producing peat are still rooted in mineral soil. Almost equal age of peaty, albic and spodic horizon confirms this model; equal age reflects uniform supply to all horizons with modern C by deeply rooting plants. Among the low moor peats the one from the calcareous Jerxheim site with the fastest turnover of organic matter is dated youngest. The Podzol samples are all highly rejuvenated by organic leachates. Organic matter in basal sands of sand pit Honerdingen is relic of former patches of peat, covered by Pleistocene fine sands. If no leaching of organic matter through 6 to 8m dune sand did occur, date indicates age of dune sand deposition (Rochus, 1975). Brown coal from Steinberg should consist of dead carbon. Date indicates admixture of younger organic constituents. Humic acid

from Chernozem near Hildesheim originates from near surface samples, rejuvenated with modern C and influenced by bomb carbon.

II. FRACTIONS OF SOIL ORGANIC MATTER

Podzol (Spodosol) from Gravel pit Weber, Scherpenseel, near Dutch border (50° 56′ N, 6° 1′ E). Fractionation of Na–pyrophosphate/NaOH extract by Sephadex G 50 gel permeation.

HAM-282.	Podzol Scherpenseel, average sample, Bh 105 to 130cm	2470 ± 70
HAM-283.	Total Na–pyrophosphate/NaOH extract of same sample, extracted under protective gas and precipitated by HCl	2940 ± 60
HAM-284.	Same sample eluate after passage through 100cm column of Sephadex G 50	2230 ± 70
HAM-285.	Same sample, Sephadex G 50, retained/ delayed fraction	5410 ± 90

Samples prepared and subm 1975 by H W Scharpenseel and E Kruse, Inst Soil Sci, Bonn Univ, FRG. Related samples: BONN-90 (R, v 10, p 20), BONN-1688-1698 (R, v 15, p 267). *Comment*: Sephadex fractionation indicates selective enrichment of smaller-sized retained fraction with older C compared to larger-sized passing fraction with relatively younger C.

Chernozem (Mollisol) from Aseler Wald near Hildesheim (52° 10′ N, 10° 1′ E). Production of organic matter fractions by benzene extraction, classical fractionation according to Flaig *et al* (1955), Sephadex gel permeation and acid hydrolysis.

HAM-286.	Aseler Wald, C of soil in total, AC 55 to 65cm	2470 ± 60
HAM-287.	Benzene extracted lipids, waxes	3220 ± 80
HAM-288.	Fulvic acids, undialized	370 ± 70
HAM-289.	Fulvic acids, dialized	380 ± 70
HAM-290.	Humic acids	2100 ± 70
HAM-291.	Humic acid, Sephadex G 50, passing fraction	1480 ± 60
HAM-292.	Humic acid, Sephadex G 50, retained/ delayed fraction	2940 ± 90
HAM-293.	Humines	2460 ± 60
HAM-294.	Humines, Sephadex G 75, passing fraction	151.6 ± 0.8%
HAM-299.	Humines, Sephadex G 75, retained/ delayed fraction	124.8 ± 0.6%
HAM-295.	Humus coal	2920 ± 70

HAM-296. 6 N HCl hydrolysis of whole soil, dissolved part — 104.4 ± 0.5%

HAM-297. 6 N HCl hydrolysis of whole soil, residue — 3160 ± 70

Samples and fractions prepared and subm 1975 by H W Scharpenseel and E Kruse. Related samples from a site nearby. BONN-1809-1811 (R, v 15, p 266). *Comment*: as expected, age of fulvic acids is lower than of humic acids and humines. The retained fraction due to Sephadex G50 permeation is older than leaching fraction. Sephadex fractionation of humines in Sephadex G 75 failed. Some of the column filling of G 75 was not quite new. Microbial decay products apparently transferred bomb carbon into sample fractions. Humus coal is oldest of classical fractions. Benzene extracted lipids are older as Grant-Taylor (1972) reported before. The gap between hydrolysate and hydrolysis residue, found already by Paul *et al* (1964) seems most encouraging to do more hydrolysis fractionation work with other soil materials in order to establish a correction method for rejuvenated soil samples.

Fossil A horizon in Würmian loess, on top trachyt tuff from Alleröd volcanism, Mendig, near Laach L (50° 24′ N, 7° 17′ E). Some rejuvenation by deep roots. Production of organic matter fractions by classical fractionation (Flaig *et al,* 1955), Sephadex gel permeation, benzene extraction and acid hydrolysis.

HAM-298. Mendig, gravel pit Xaver Michels, fA 180 to 190cm, C of soil in total — 10,600 ± 120

HAM-300. Benzene extracted lipids and waxes — 4130 ± 100

HAM-301. Fulvic acids, undialized — 1140 ± 200

HAM-302. Fulvic acids, dialized — 136.3 ± 0.8%

HAM-303. Humic acids — 6970 ± 210

HAM-304. Humic acids, Sephadex G 50, passing fraction — 6110 ± 100

HAM-305. Humic acids, Sephadex G 50, retained/ delayed fraction — 6830 ± 130

HAM-306. Humines — 10,320 ± 140

HAM-307. Humus coal — 9940 ± 140

HAM-308. 6 N HCl hydrolysis of whole soil, dissolved part — 2510 ± 100

HAM-309. 6 N HCl hydrolysis of whole soil, residue — 11,360 ± 150

HAM-310. Charcoal — 10,330 ± 120

Samples and fractions prepared and subm 1975 by H W Scharpenseel and E Kruse. Samples dated from pedogenetically same horizon few km apart: BONN-96 (R, v 10, p 16), BONN-763 (R, v 12, p 35), BONN-1681-1684 (R, v 15, p 266). *Comment*: ages of fulvic acids and soil hy-

drolysate are youngest. Dialized fulvic acids seem to be contaminated. Benzene extracted lipids did not show older age as in preceding sample from Aseler Wald (HAM-287). Humines, humus coal and charcoal are distinctly older than other samples. Widest gap is between carbon from acid hydrolysate and hydrolysis residue. Latter fraction is relatively oldest of the whole series.

Highly clayey low moor soil, vertic during very dry summers, Koislhof, lower terrace of Isar R. Production of organic matter fractions by stepwise extraction of soil in Soxhlet-extractors by means of solvents with increasing polarity, by clasical fractionation (Flaig *et al,* 1955), Sephadex gel permeation and acid hydrolysis.

HAM-318.	Low moor soil Koislhof, 38% C, Hn 50 to 80cm, total soil	7200 ± 210
HAM-311.	Petroleum benzene extracted C of same sample	3290 ± 320
HAM-312.	Benzene extracted Sample C	6630 ± 130
HAM-313.	Methanol extracted Sample C	6380 ± 90
HAM-314.	Acetone extracted Sample C (extremely small sample, questionable)	4020 ± 360
HAM-315.	Acetonitrile extracted Sample C (extremely small sample, questionable)	2240 ± 440
HAM-316.	Dimethylformamide extracted Sample C	10,760 ± 130
HAM-317.	Dimethylsulfoxide extracted Sample C	13,140 ± 200
HAM-319.	6 N HCl hydrolysis of whole soil, dissolved part	7270 ± 140
HAM-320.	6 N HCl hydrolysis of whole soil, residue	9730 ± 170
HAM-321.	Fulvic acids after previous extraction with organic solvents	6860 ± 250
HAM-322.	Fulvic acids, same origin, but dialized	7060 ± 110
HAM-323.	Humic acids	8810 ± 120
HAM-324.	Humic acids, Sephadex G 50, passing fraction	7590 ± 120
HAM-325.	Humic acids, Sephadex G 50, retained/delayed fraction	7820 ± 90
HAM-326.	Humines	7110 ± 110
HAM-327, 328.	Humines fractionated by Sephadex G 75, microbiologically contaminated just as HAM-294, 299, above.	
HAM-329.	Humus coal	7230 ± 110

Samples and fractions prepared and subm 1975 by H W Scharpenseel and E Kruse. Samples dated from same location: HAM-14-21, HAM-65

(R, v 18, pp 269, 273). *Comment*: organic solvent extraction is unrewarding for concentration of older Sample C. Tiny acetone and acetonitrile extracted C samples are unreliable. Dimethylformamide and dimethysulfoxide extracted C is contaminated with petrochemical solvent C, proven by $\Delta^{13}C$ measurement, despite thorough vacuum drying of soil after extractions ($\Delta^{13}C$ measurements were carried out by H Willkomm, Kiel Univ). In this sample classical fractionation and also Sephadex column fractionation as well as acid hydrolysis were carried out on soil material previously subjected to the stepwise extraction process by organic solvents of increasing polarity. This apparently reduced differences among other fractions. Age difference between fulvic acids and humic acids, humines, humus coal is small. For details see Scharpenseel (1976).

Chernozem (Mollisol) clay pit Asel, near Hildesheim (52° 10′ N, 10° 1′ E). Organic matter fractions obtained by repeated 6 N HCl hydrolysis. One aliquot of each repetitious hydrolysis treatment measured.

HAM-623.	Asel, whole soil, Ah 35 to 45cm	> 100%
HAM-624.	1. step of 6 N HCl hydrolysis, residue	> 100%
HAM-625.	2. step of 6 N HCl hydrolysis, residue	2530 ± 80
HAM-626.	3. step of 6 N HCl hydrolysis, residue	2410 ± 70
HAM-627.	4. step of 6 N HCl hydrolysis, residue	2340 ± 80
HAM-628.	5. step of 6 N HCl hydrolysis, residue	2770 ± 80
HAM-629.	6. step of 6 N HCl hydrolysis, residue	2560 ± 90
HAM-630.	7. step of 6 N HCl hydrolysis, residue	2960 ± 80
HAM-801.	8. step of 6 N HCl hydrolysis, residue	3260 ± 100

Samples and fractions prepared and subm 1976 by H W Scharpenseel and T Manukyan, Ordinariat f Bodenkunde, Hamburg Univ, FRG. For dates from nearby sites, see Aseler Wald series, above, HAM-286-297. *Comment*: not including the bomb-carbon-dominated samples, repeated hydrolysis treatment produced age increases of ca 30% by increasing removal of acid soluble younger components.

Gleyey transition of Mollisol to histosol Ergolding, near Landshut (48° 35′ N, 12° 12′ E). Production of organic matter fractions by repeated acid hydrolysis. One aliquot of each repetitious hydrolysis treatment subjected to dating.

HAM-782.	Ergolding, AhHn 50 to 60cm, whole soil	4640 ± 90
HAM-800.	Whole soil, but pyrolized under N_2 before combustion	4570 ± 110
HAM-783.	1. step of 6 N HCl hydrolysis, residue	5610 ± 80
HAM-784.	2. step of 6 N HCl hydrolysis, residue	5820 ± 110

HAM-785. 3. step of 6 N HCl hydrolysis, residue 5700 ± 100

HAM-786. 4. step of 6 N HCl hydrolysis, residue 5540 ± 110

HAM-787. 5. step of 6 N HCl hydrolysis, residue 6110 ± 90

HAM-788. 6. step of 6 N HCl hydrolysis, residue 5790 ± 90

Samples and fractions prepared and subm 1976 by H W Scharpenseel and T Manukyan. *Comment*: again, by repeated hydrolysis treatment ca 30% of initial age was added by removing younger acid soluble components. Pretreatment of recent soil samples by repeated acid hydrolysis appears to be a useful preparation technique.

III. GEOLOGIC AND GEOGRAPHIC SAMPLES

Loose dune material with roots of Nebka forming plants (Ziziphus spec.), from dune (Nebka), near wheat cultivation, Rabta, Ben Aoun, Tunisia (34° 47′ N, 9° 11′ E). Dead *Ziziphus* roots could indicate age of Nebka formation, which indicates desertification progress.

HAM-717. Dune sand with roots of *Ziziphus* sp, Sample 2 550 ± 90

HAM-718. Dune sand with roots of *Ziziphus* sp, Sample 3 160 ± 70

HAM-764. Dune sand with roots of *Ziziphus* sp, Sample 4 142.2 ± 0.6%

Samples coll and subm 1975 by H Mensching, Geog Inst, Hamburg Univ, FRG. *Comment*: very young ages of *Ziziphus* roots indicate desertification progress in recent period of time. More samples will be tested.

Sea level-coast line studies based on peat dating, shore of Northern Sea.

HAM-765. Start of peat growth, deepest position, −82 to −88cm, bore hole 8/74 (53° 51′ N, 8° 34′ E) 4240 ± 130

HAM-767. Start of peat growth on terrace, +101 to +89cm, bore hole 10/75 (53° 50′ N, 8° 34′ E) 4540 ± 120

HAM-768. Start of peat growth on terrace, +160 to +155cm, bore hole 4/75 (53° 50′ N, 8° 34′ E) 3850 ± 80

HAM-769. Start of peat growth on terrace, +90 to +84cm, bore hole 3/75 (53° 50′ N, 8° 34′ E) 3880 ± 80

HAM-770. Basal peat, red brown, +16 to +11cm, bore hole 8/74 (53° 51′ N, 8° 34′ E) 3650 ± 90

HAM-771. Basal peat, red brown, +30 to +23cm, bore hole 2/75 (53° 50′ N, 8° 34′ E) 3760 ± 100

HAM-772. Basal peat, red brown, +144 to +134cm, bore hole 10/75 (53° 50′ N, 8° 34′ E) 3580 ± 90

HAM-773. Basal peat, red brown, +177 to +172cm, bore hole 4/75 (53° 50′ N, 8° 34′ E) 6130 ± 240

HAM-774.	Basal peat, red brown, +107 to +109cm, bore hole 25/75 (53° 50′ N, 8° 34′ E)	4320 ± 140
HAM-775.	Highest occurrence of peat, +192 to +187cm, bore hole 4/75 (53° 50′ N, 8° 34′ E)	3820 ± 90
HAM-776.	End of peat growth, +57 to +52cm, bore hole 8/74 (53° 51′ N, 8° 34′ E)	3210 ± 80

Samples coll and subm 1975 by G Linke, Hamburg Geol Landesamt, Hamburg, FRG. *Comment*: ages of peat samples at well defined levels will be used in context with other experimental data to determine coast line chronology.

Humus containing alluvial clay from Elbe R alluvium, Billwerder-Allermöhe, S Hamburg, measurement of date of deposition.

HAM-791.	Alluvium of Elbe R, Billwerder-Allermöhe, construction pit, cross rds Marshhwy and Oberer Landweg, (53° 28′ N, 10° 10′ E), peat, 115 to 130cm below surface	1590 ± 80
HAM-792.	Same site, tree bark and branches, 115 to 130cm	1770 ± 90
HAM-793.	Same site, some leaves embedded in alluvial clay	2720 ± 100
HAM-794.	Profile pit on highest level of vaulted field, alluvium of Elbe R, Billwerder-Allermöhe (53° 28′ N, 10° 11′ E), 66 to 75cm, humus-rich alluvial clay	1650 ± 80
HAM-795.	Same site, 75 to 83cm, alluvial clay, very rich in humus	1710 ± 80
HAM-796.	Same site, 83 to 96cm, alluvial clay, very rich in humus	1870 ± 80
HAM-797.	Another profile pit on highest level of vaulted field, alluvium of Elbe R, Billwerder-Allermöhe (53° 28′ N, 10° 11′ E), 74 to 76cm, humus containing alluvial clay	3170 ± 100
HAM-798.	Same site, 76 to 79cm, humus containing alluvial clay	
HAM-799.	Same site, 79 to 82cm, humus containing alluvial clay	3370 ± 100

Samples coll, subm, prepared, and measured 1976 by B Hintze, Ordinariat Soil Sci, Hamburg Univ, FRG. *Comment*: profile HAM-797-799 overlain by shallow extremely clayey layer, impeding rejuvenation from above by root growth, animal transport, infiltration through cracks. This clay protection does not exist in profile HAM-794-796. Furthermore, humus containing alluvial clay continues below depth of profile pits.

Analogous layers in different pits need not be located at same depth. Age > 3000 indicates at least Sub-boreal deposition of those alluvial clays, now found at 70 to 85cm depth.

IV. ARCHAEOLOGIC SAMPLES

HAM-622. Wood sample of Celtic boat, from construction pit near Frankfurt, Germany (50° 4′ N, 8° 41′ E). Sample coll and subm 1975 by H Zakosek, Inst Soil Sci, Bonn Univ, FRG. — 1580 ± 60

Comment: since Celts had already left Germany at the end of La-Tène period, date is slightly younger than expected.

Inclan series, Peru

HAM-602. Charcoal, Inclan, Dist Sama Grande, Prov Tacna, Dept Tacna (17° 45′ S, 70° 15′ W), charcoal, 155cm below desert sand surface — 850 ± 60

HAM-603. Vegetable coal, 110cm below desert sand surface — 740 ± 70

HAM-604. Charcoal, 110cm below desert sand surface — 670 ± 70

HAM-605. Textile fragment, 40cm below desert sand surface — 143.6 ± 1.5%

HAM-606. Wooden remains, 90cm below desert sand surface — 400 ± 70

HAM-607. Charcoal, 100cm below desert sand surface — 124.6 ± 1.1%

HAM-608. Wooden relics, 100cm below desert sand surface — 103.3 ± 0.9%

HAM-609. Charcoal, 130cm below desert sand surface — 150.0 ± 2.0%

HAM-610. Wood, 100cm below desert sand surface next to collapsed bldg — 920 ± 80

Quebrada de la Vaca series, Peru

HAM-611. Vegetable cane, Quebrada de la Vaca, Dist Chala, Prov Caraveli, Dept Arequipa, Peru (13° 48′ S, 74° 24′ W), 80cm below floor inside storage bldg — 240 ± 70

HAM-612. Cotton and cotton seeds from sand filled storage bldg, small sample — > 100%

HAM-613.	Wood, 60cm below collapsed bldg surrounded by desert sand	600 ± 70
HAM-614.	Chili pepper, at base of stone-constructed storage bldg, locked by stones	270 ± 70
HAM-615.	Charcoal, 140cm below floor in storage bldg	130.5 ± 2.7%
HAM-616.	Wool fibers in circular storage bldg, small sample	> 100%
HAM-617.	Remains of textile fabric, 80cm below floor in sand-filled storage bldg	101.9 ± 0.9%
HAM-618.	Cotton sample in pot dug out of sand	101.2 ± 1.0%
HAM-619.	Charcoal, 50cm depth, below desert sand in rubbish pile	90 ± 110
HAM-620.	Guano (bird dung) in guano filled storage bldg	164.5 ± 1.6%
HAM-621.	Dung remains from 100cm depth in storage bldg	360 ± 80

Samples coll and subm 1975 by H Trimborn and R Santos Ramirez, Inst f Völkerkunde, Bonn Univ, FRG. *Comment*: samples of site Inclan, Sama Grande, Tacna, are from still existing supposedly pre-Spanish settlement. Dates from 670 to 920 yr confirm this supposition, some samples are modern and contain bomb carbon. Sample site Quebrada de la Vaca, Chala was previously studied: BONN-1659-1661 (R, v 16, p 163). These 3 charcoal samples were dated at AD 860 to 1130, pre-Spanish. HAM-611-621, except for HAM-613, are all younger, post-Spanish, most of them even modern with bomb carbon. Most samples > 100% are textile fabrics and fibers, seeds or dung.

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[RADIOCARBON, VOL. 19, NO. 2, 1977, P. 183-187]

MOST RADIOCARBON DATES I

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The Laboratory of Applied Nuclear Physics of the Brown Coal Research Institute in Most started the radiocarbon dating of archaeologic samples in 1972. Dates presented in this list were obtained from 1973 to 1974.

Samples of compact wood to be dated were filed to remove surface layers and then were treated in 3N hydrochloric acid for 48 hours, after which they were carbonized in an iron retort at 560°C for 2 hours. Badly preserved wood, charred wood, charred grain, and charcoal were mechanically cleaned and treated for 24 hours in 3N hydrochloric acid and for 24 hours longer in 2% sodium hydroxide. The samples were then washed in distilled water, acidified by hydrochloric acid to pH $\leqq$ 4, and carbonized. Charcoal obtained in this way was filled into a steel reaction vessel together with an excess of metalic lithium and heated slowly up to 800°C, similar to the procedure described by Tamers (1969). The prepared lithium carbide was decomposed by dead water with phosphoric acid and the liberated acetylene was catalytically trimerized into the benzene, after Noakes *et al* (1963). The pearl-type catalyst NEU, product of Kali-Chemie Co, was used (Pietig and Scharpenseel, 1966). The prepared benzene was very pure, according to gas-chromatographic analysis it contained only 0.04% unknown nonaromatic hydrocarbon and 0.08% water. All the benzene prepared from each sample was transferred into a nylon vial without being diluted. PBD and the POPOP were added, 8mg and 0.1mg per lg of benzene, respectively. Reference samples were prepared by quantitative wet oxidation of the U S NBS oxalic acid standard of modern carbon, followed by reaction of the released carbon dioxide with metalic lithium (Barker, 1953) at 650°C and then in the same way as the samples of unknown age. Background samples were prepared from north-bohemian brown coal by means of the same method as archaeologic charcoal samples.

Samples were counted in an Intertechnique liquid scintillation counter Model SL-30. Counting efficiency is ca 64%, using the part of spectrum above the end-point of tritium. Background is from 9 to 13cpm, according to the mass of the sample benzene. The net count rate, corresponding to 95% of NBS oxalic acid standard, is 8.03 $\pm$ 0.03 cpm/g carbon. Each measured set contained 1 or 2 reference samples, from 3 to 5 background samples of different masses, and several samples of unknown age.

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Ages were calculated according to the formula:

$$\tau = 18\ 503 \lg d \frac{0.95\ m_S\ (R-B_R)}{m_R\ (S-B_S)}$$

where m_S and m_R are, respectively, masses of the benzene in the unknown sample and in the reference sample in grams, calculated as arithmetic averages of the values, observed before and after the counting. S and R are average count rates of the unknown sample with background, after elimination of wrong values, based on the 3 sigma rule, and B_S and B_R are background rates corresponding to masses m_S and m_R. B_S and B_R were calculated (Veselý *et al*, 1973) or graphically interpolated from results of background counts. The formula is adequate for benzene sample mass between 3 and 17g.

All listed dates are based on the Libby half-life value of 5570 yr and referred to 1950. The dates are not corrected for ^{13}C. The reported mean errors are calculated by the formula:

$$\sigma = 8036 \left[\left(\frac{\sigma S-B_S}{S-B_S} \right)^2 + \left(\frac{\sigma R-B_R}{R-B_R} \right)^2 + \left(\frac{\sigma m_S}{m_S} \right)^2 + \left(\frac{\sigma m_R}{m_R} \right)^2 \right]^{0.5}$$

where $\sigma S-B_S$, $\sigma R-B_R$, ... , are theoretical standard statistical deviations of the values $S-B_S$, $R-B_R$, ...

The laboratory received samples with no information, and carried out measurements without knowing even the approximate age of samples.

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SAMPLE DESCRIPTIONS

2835 ± 110
885 BC

MOC-20. Počerady, Pit 1

Charcoal from a piriform pit at Počerady, dist Louny, containing no datable archaeol finds. Nearby features could be dated to the La Tène period, 2nd half of 1st millennium BC. Excavated by E Neustupný in 1966. *Comment:* considerably contaminated. Date corresponding to Late Bronze age, absent at the site.

1500 ± 70
AD 450

MOC-26. Rusovce

Charred grain strewn over last habitation layer of the Roman camp Gerulata, Rusovce, Bratislava dist. Excavated in 1967 by J Dekan. *Comment:* should be 5th century AD. Date agrees with archaeol estimate.

1560 ± 80
AD 390

MOC-27. Kadaň, Pit 12

Charcoal from Pit 12, Jezerka at Kadan, Chomutov dist. Site revealed finds mostly from Hallstatt D and Early La Tène periods, 6th to

5th centuries BC. Pit 12 was originally believed to be of this age. Coll 1968 by V Kruta. *Comment:* considerably contaminated and attacked by mildew. Date sharply disagreed with archaeol expectation. Finds from Pit 12 were reinspected and found to contain sherds from possibly the 5th century AD. This is corroborated by P-1915: 1560 ± 50 (R, 1975, v 17, p 199) for another part of the same sample, and by a thermoluminiscence date AD 400. obtained on a sherd from Pit 12 by J Kvasnička (pers commun).

680 ± 70

MOC-44. Most, No. 240 **AD 1270**

Charred grain from a destroyed oven in the yard of House No. 240 in Most, Most dist. Archaeol age was believed to be 13th century AD. Coll 1972 by J Klápště. *Comment*: date agrees with archaeol estimate.

2655 ± 50

MOC-52. Rvenice **705 BC**

Rotted wood from a massive beam used for construction of burial chamber at Rvenice, Louny dist. Grave belonged to "princely" class of the Bylany culture (Hallstatt C period, 7th century BC archaeol chronology). Coll 1961 by D Koutecký. *Comment*: date, especially if calibrated, suggests older age, 9th century BC, than expected archaeol. This is surprising but agrees with other dates obtained in Philadelphia for Hallstatt B2 and D periods: P-1907: 2730 ± 60 Hallstatt B2, P-1913: 2630 ± 60 and P-1914: 2550 ± 50 Hallstatt D (R, 1975, v 17, p 198).

Mohelnice series

An extensive Neolithic site was partly destroyed by a sandpit at Mohelnice, N Moravia, from 1971 to 1973. It lay near the upper course of the Morava R, whose water-table could be reached by wells several m deep. The wells contained much organic material suitable for radiocarbon dating.

4800 ± 70

MOC-69. Mohelnice CCLV **2850 BC**

Wet wood from Eneolithic well CCLV at Mohelnice, Šumperk dist. Pottery from feature probably belongs to an early phase of the TRB culture. Coll 1971 by R Tichý. *Comment*: agrees well with expected archaeol age. Groningen measurement of the same sample is 4985 ± 40: GrN-6604.

6220 ± 80

MOC-70+91. Mohelnice CCLIV **4270 BC**

Wet wood from Neolithic well CCLIV at Mohelnice, Šumperk dist. Pottery fragments from well belong to a somewhat developed earliest phase of Linear Pottery culture. Coll 1971 by R Tichý. *Comment*: as sample MOC-70 did not contain sufficient amt of carbon, only 2.6g benzene yield, it was mixed in benzene form with sample MOC-91, from the same piece of wood. Both samples were measured together. Resulting

date agrees well with archaeol expectation and with a Groningen measurement of another sample from same well, GrN-6610: 6240 ± 65 BP.

6330 ± 140

MOC-91. Mohelnice CCLIV **4380 BC**

Description as MOC-70+91. *Comment*: separate count is less accurate than MOC-70+91, because of smaller mass.

3340 ± 50

MOC-71. Mohelnice CCLVI **1390 BC**

Wet wood from a prehistoric well, feature CCLVI, at Mohelnice, Šumperk dist. Wood was presumably shaped by means of a metalic tool and is therefore believed to be of Bronze age date. Coll 1972 by R Tichý. *Comment*: date indicates Middle Bronze age. Another sample from the same well was measured in Groningen, giving 3875 BP (pers commun).

General Comment: as everything inside the wells was perfectly conserved there was some doubt as to their antiquity; prehistoric pottery could have been deposited secondarily. Radiocarbon dates showed that the wells did belong to the Neolithic, Eneolithic, and Bronze ages, despite their modern appearance. Wells from those periods are to be expected in other sites with similar geol conditions. They are of paramount archaeol interest in view of the fact that they contain well preserved artifacts of organic materials and wooden beams.

Meclov series

Meclov-Březí is an extensive site in W Bohemia. Excavations led by E Čujanová revealed finds from beginning of Middle Bronze age, ca 1900 BC calibrated radiocarbon chronology. The pottery, however, is badly preserved, weathered surface, and comes mostly from a shallow cultural layer (Čujanová, 1967).

1890 ± 70

MOC-88. Meclov, Hut 1 **AD 60**

Charcoal from a fireplace in Hut 1. *Comment*: radiocarbon age is ca 2000 yr later than expected archaeol. *Cf General Comment,* below.

1525 ± 70

MOC-89. Meclov, Pit 32 **AD 425**

Charcoal from a hearth in Pit 32. *Comment*: same sample as MOC-98 and LJ-2501: 1537 ± 50 (pers commun). Ca 2300 yr later than expected archaeol. *Cf General Comment,* below.

1410 ± 80

MOC-98. Meclov, Pit 32 **AD 540**

Charcoal from a hearth in Pit 32. *Comment*: same sample as MOC-89.

2280 ± 60

MOC-90. Meclov, Pit 36 **330 BC**

Charcoal from a fireplace in Pit 36. *Comment*: same sample as MOC-97. Ca 1600 yr later than expected. *Cf General Comment,* below.

2300 ± 70
MOC-97. Meclov, Pit 36 **350 BC**

Charcoal from a fireplace in Pit 36. *Comment*: same sample as MOC-90.

General Comment: other samples from Meclov were measured by H Suess in La Jolla and thermoluminiscence, preliminary results, was measured by J Kvasnička (pers commun). The evidence may be summarized as follows:

Feature	La Jolla	Most	Thermoluminiscence dates BP
Pit 36		2300±70:MOC-97 2280±60:MOC-90	3867±390
Hut 1		1890±70:MOC-88	1410±170
Pit 32	1537±50:LJ-2501	1525±70:MOC-89 1410±80:MOC-98	
Hut 3	1537±50:LJ-2499		
Pit 1959			1500±220

The only non-archeol evidence for Middle Bronze age occupation is the thermoluminiscence date for Pit 36. Radiocarbon samples from the same feature, however, indicate 5th century BC, which is the Early La-Tène period in archaeol classification. Thermoluminiscence date for Hut 1 also differs from the corresponding radiocarbon age. La Jolla and Most agree perfectly on a group of dates, both radiocarbon and thermoluminiscence, for Pit 32, Hut 3, and Pit 1959: an occupation is definite ca AD 400. Traditional archaeol methods discovered only 1 occupation while radiocarbon and thermoluminiscence dating clearly shows at least 3.

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UNIVERSITY OF PENNSYLVANIA RADIOCARBON DATES XIX

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INTRODUCTION

This date list includes most of the archaeologic and geologic samples dated in this laboratory since publication of our last date list (R, 1975, v 17, p 196-215) as well as many samples dated previously which lacked adequate sample information.

The BP ages are based on AD 1950, and have been calculated with the half-life value of 5568 yr. An asterisk (*) before an AD/BC date indicates a date that has been calculated with the half-life value of 5730 yr and then corrected by means of MASCA correction factors. For further explanation see Univ of Pennsylvania Dates XVI (R, 1974, v 16, p 198-218) and Ralph *et al*, 1973.

All samples were counted at least twice for periods of not less than 1000 min each. Errors quoted for each sample include the sum of the statistical counting uncertainties in the measurement of the sample, the background, and several counts of our mid-19th century oak sample, but do not include the possible half-life errors. Corrected AD/BC errors quoted are the same as above, but do not include any additional errors associated with the correction factors.

In addition to our 2 8L counters, a small 1L counter has been constructed for counting undersized samples. Larger errors associated with these dates are a direct result of small sample size and consequent reduced number of counts. In all counters we continue to use pure CO_2.

All samples were pretreated with 3N HCl and some, where noted, were given additional pretreatment with 2% NaOH for the removal of possible humic acid contaminants.

Our mid-19th century calibration samples have an average age of 141 yr. When corrected for this age, they have ^{14}C contents equal to 95% of the NBS oxalic acid standard. The average ^{13}C relationship between the oak standard and the NBS limestone standard #20 is $-25.7 \pm 1.3‰$ as measured on the Univ of Pennsylvania mass spectrograph. Where $^{13}C_w$ is reported, the ^{13}C relationship has been measured with respect to the oak standard and the results accordingly corrected for isotopic fractionation.

For the design and construction of new components, we wish to thank Raymond Costa and Jeffrey Klein. They, as well as the authors and previous graduate students, have processed the samples. In this date list, Bernard Fishman prepared the Egyptian and related dates for publication; Hamish Forbes, the Aegean and other dates; Barbara Lawn, the introduction, general supervising, and editing.

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SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

A. Mediterranean

1. Cyprus

Phaneromeni series

Middle Cypriote Bronze age settlement site located at Phaneromeni (Episkopi), Limassol Dist, Cyprus (34° 40′ N, 32° 55′ E). Coll and subm 1975 by J R Carpenter, Dept Romance Languages & Classics, Kent State Univ, Kent, Ohio (Weinberg, 1956).

General Comment: samples expected to be contemporaneous with each other.

P-2386. Sample 1 — **3720 ± 70** / ***2170 ± 70 BC**

Charcoal, Sample 1, from Operation A6, Lot 5 (Excavator's Ref Ph 75-2). Sample from beside house wall, but underlying stones from its collapse, ca 1.05m below surface.

P-2387. Sample 3 — **3620 ± 60** / ***2110 ± 60 BC**

Charcoal, Sample 3, from Operation A6, Lot 5 (Excavator's Ref Ph 75-3). Sample from beside house wall, but underlying stones from its collapse, ca 1.05m below surface.

P-2388. Sample 2 — **3520 ± 70** / ***2040 ± 70 BC**

Charcoal, Sample 2, from Operation A13, Lot 6 (Excavator's Ref Ph 75-6). Possibly hearth or fire pit, near house wall, covered by collapsed stones, ca 1.27m below surface.

2. Greece

P-2101. Athenian Agora — **2390 ± 40** / ***490 ± 50 BC**

Wood (Deposit J5:1) from public well at NW corner of Agora Sq, Athens, Greece (38° 00′ N, 23° 44′ E). Sample from layer dating to 1st half of 2nd century BC. Coll 1971 and subm by T L Shear, Dir, Agora Excavations, Am School Classical Studies at Athens. Well in use from late 5th century BC through Hellenistic period and partially reopened in 10th century AD (Shear, 1973, p 130-134).

Franchthi Cave series

Franchthi cave (37° 26′ N, 23° 8′ E) is near W tip of high, rugged headland, directly across from village of Koilada near Porto Cheli in S Argolid, Peloponnese, Greece. Site is especially important for its apparent

continuous stratified sequence from Late Paleolithic through Mesolithic and the critical transition to Neolithic. There are no stratified prehistoric remains later than Late Neolithic. Samples coll and subm 1974 by T W Jacobsen, Indiana Univ, Bloomington, Indiana (1968; 1969a, b, c; 1973a, b; 1974; 1976). For additional dates for this site, see R, 1971, v. 13, p 364-367; R, 1974, v 16, p 220-221; R, 1975, v 17, p 201-203.

P-2227. F/A Balk, Unit 195S **9430 ± 160**

Carbonized matter from F/A Balk, Unit 195S, dark reddish occupation layer, 7.62m depth (max). Below P-2108, 9250 ± 120 (R, 1975, v 17, p 203). Date expected to be Mesolithic. *Comment*: date calculated with 5730 half-life, but *not* corrected = 7760 ± 160 BC.

P-2228. F/A Balk, Unit 195S **9060 ± 110**

Carbonized matter from F/A Balk, Unit 195S, 7.62 depth, below P-2108, 9250 ± 120 (R, 1975, v 17, p 203). Sample coll by flotation in water sieving device using mixture of fresh and sea water (Jacobsen, 1973, p 57; French, 1971). Date expected to be Mesolithic and comparable to P-2227 (above). *Comment*: NaOH pretreatment. Date calculated with 5730 half-life, but *not* corrected = 7380 ± 110 BC.

P-2229. F/A Balk, Unit 197S **9210 ± 110**

Charred bone and other carbonized material from F/A Balk, Unit 197S, ash lens in dark reddish occupation layer, 7.76m depth (max). Below P-2227 and -2228, above. Date expected to be early Mesolithic. *Comment*: date calculated with 5730 half-life, but *not* corrected = 7530 ± 110 BC.

P-2230. F/A Balk, Unit 197S **9280 ± 110**

Carbonized matter from F/A Balk, Unit 197S, 7.76m depth (max), below P-2227 and -2228, above. Sample coll by flotation in water-sieving device (see above). Date expected to be Mesolithic and comparable to P-2229, above. *Comment*: date calculated with 5730 half-life, but *not* corrected = 7610 ± 110 BC.

P-2231. F/A Balk, Unit 204S **10,260 ± 110**

Charcoal and soil from F/A Balk, Unit 204S, red clay deposit with evidence of human occupation, 8.27m depth (max). Below P-2229 and -2230, above. Date expected to be Upper Paleolithic. *Comment*: date calculated with 5730 half-life, but *not* corrected = 8620 ± 110 BC.

P-2232. F/A Balk, Unit 207S **10,840 ± 510**

Soil and charcoal from F/A Balk, Unit 207S, near base of red clay deposit above rockfall layer, 8.52m depth (max). Below P-2231, above. Date expected to be Upper Paleolithic. *Comment*: sample counted in small counter. Date calculated with 5730 half-life, but *not* corrected = 9210 ± 520 BC.

P-2233. H-1, Quad B, Unit 191-192 21,480 ± 350

Soil and carbonized matter from H-1, Quad B, Unit 191-192, red-brown clay matrix with considerable angular gravels, 6.31m depth (max). Sample stratigraphically between 2 earliest dates from site, P-1827, 12,540 ± 180 (R, 1974, v 16, p 221) and I-6140, 22,330 ± 1270 (R, 1976, v 18, p 187). Date expected to be Upper Paleolithic. *Comment*: date calculated with 5730 half-life, but *not* corrected = 20,170 ± 360 BC.

P-2234. F/F1 (W scarp) 6830 ± 60

Soil and charcoal from F/F1 (W scarp), near top of grayish occupation layer at 3.30 to 3.40m depth. Date expected to be Middle Neolithic, slightly later than P-1922-A, 6730 ± 70 (R, 1974, v 16, p 221). Date calculated with 5730 half-life, but *not* corrected = 5070 ± 70 BC.

P-2235. F/F1 (W scarp) 6750 ± 80

Soil and charcoal from F/F1 (W scarp), near base of moderate brown

3380 ± 60

P-1601. Akrotiri, Trench Arvaniti 3 *1730, 1690 ± 60 BC

Charcoal (*Olea sp*) id by B F Kukachka, Forest Prod Lab, US Dept Agric, Madison, Wisc. From erosion soil at base of 6m trench in pure Middle Cycladic II-Late Cycladic I context. Coll and subm 1968 by Emily Vermeule, Mus Fine Arts, Boston. Expected date from pottery, 1470-1540 BC. *Comment* (EV): should be at least 200 yr later than P-303, 3520 ± 50 from Lerna V (Kohler and Ralph, 1961, p 365). Date expected to be comparable to L-362, 3370 ± 100 (R, 1959, v 1, p 20) (Galanopoulos, 1958; Marinatos, 1968).

P-1602. Akrotiri, 3420 ± 40
Trench Arvaniti 3 *1870, 1760, 1720 ± 40 BC

3480 ± 70

P-1891. Akrotiri, AK-18 ***2000-1960 ± 70 BC**

Charcoal, probably from shrubs id B F Kukachka, from pit dug for modern roof pillar No 11 within Structure Beta. Coll 1969 by Spyridon Marinatos, subm 1971 by Christos Doumas.

3990 ± 70

P-1893. Akrotiri, AK-19 ***2600 ± 70 BC**

Charcoal (*Pinus sp*) id B F Kukachka from area E of Rm 4 in structure Delta. Coll 1970 by Spyridon Marinatos, subm 1971 by Christos Doumas.

3310 ± 70

P-1894. Akrotiri, AK-20 ***1680 ± 70 BC**

Charcoal, probably from shrubs, id B F Kukachka, from Rm 3 of Structure Delta, under paved floor. Coll 1970 by Spyridon Marinatos, subm 1971 by Christos Doumas. *Comment*: NaOH pretreatment.

3320 ± 50

P-1895. Akrotiri, AK-17 ***1690 ± 50 BC**

Charcoal, probably from shrubs, id B F Kukachka, from pit dug for modern pillar No 2, within Structure Beta, destruction level. Coll 1969 by Spyridon Marinatos, subm by Christos Doumas.

2990 ± 70

P-1619. Akrotiri, Bronos Bridge ***1300-1270 ± 70 BC**

Earth with small amounts of carbon, from Bronos Bridge. Coll 1969 and subm by Spyridon Marinatos. *Comment*: sample undersized; counted by Isotopes (I-4442) and was undersized in their counter (76% filling).

3330 ± 50

P-1892. Akrotiri, Bronos Bridge, A-16 ***1690 ± 50 BC**

Charcoal, probably from shrubs, id B F Kukachka, from Area 6 of Bronos Bridge, destruction level. Coll 1969 by Spyridon Marinatos and subm by Christos Doumas. *Comment*: NaOH pretreatment.

3070 ± 60

P-1697. Boudouroglou Mine ***1450-1400 ± 60 BC**

$\delta^{13}C_{vp} = +0.9‰$

Carbonized beans, possibly "fava", from mining installation of Boudouroglou and Co, between villages of Akrotiri and Moghalochai. Sample related to expansion of Minoan culture on Thera. Sample from brink of precipitous side of caldera. Found in large jug underneath lower volcanic layer of pumice. Coll by Spyridon Marinatos, subm 1968 by Christos Doumas.

3. Italy

P-2403. Nuraghe Genna Maria, Villanovaforru, Sardinia **2920 ± 50** ***1210-1990 ± 50 BC**

Sample 5, charcoal from Hut 17, S corner, 110cm depth at Bronze age or Early Iron age site of Nuraghe Genna Maria, Villanovaforru (Cagliari) Sardinia, Italy (38° 38′ N, 8° 50′ E). Coll 1975 by Enrico Atzeni, subm by M S Balmuth, Tufts Univ, Massachusetts (Atzeni, 1972).

Ortu Comidu, Sardara, series

Complex of stone structures at Ortu Comidu, Sardara (Cagliari), Sardinia, Italy (38° 36′ N, 8° 50′ E). Area M produced Nuraghic (8th century BC and earlier) and Punic (6th century BC and later) material. Area N produced Nuraghic material only. Coll 1975 and subm by M S Balmuth, Tufts Univ, and Patricia Phillips, Sheffield Univ, England.

2910 ± 250

P-2399. Sample 1, Area N, 3 ***1190-1170 ± 260 BC**

Charcoal from 30 to 40cm depth. *Comment*: sample counted in small counter.

2910 ± 220

P-2400. Sample 2, Area N, 4, 5, 7 ***1190-1170 ± 220 BC**

Charcoal from 40 to 79cm depth. *Comment*: sample counted in small counter.

3080 ± 60

P-2401. Sample 3, Area M ***1450-1400 ± 60 BC**

Charcoal from 40 to 50cm depth. *Comment*: NaOH pretreatment.

2970 ± 50

P-2402. Sample 4, Area M ***1300-1270 ± 60 BC**

Charcoal from 40 to 50cm depth. *Comment*: NaOH pretreatment.

B. Near East

1. Egypt

Most of the following Egyptian samples are closely dated on archaeol or other grounds, and so form a control series of known-age samples against which corrected ^{14}C dates may be compared. For further explanation, see Univ of Pennsylvania Dates XVI (R, 1974, v 16, no 2, p 198-218); Ralph and Michael, 1967, p 3-11; 1970, p 109-118; and Ralph *et al,* 1973. Only samples P-1883 and -2337 are exceptions, both being from mummies for which independent assessments of date were unavailable. These Pennsylvania known-age samples constitute part of larger, ongoing MASCA study by H N Michael (HNM), Univ Mus, Univ Penna, Philadelphia and James Weinstein (JW), Univ Mus. This study (ms in preparation) includes analyses of 233 radiocarbon dates, obtained by various labs, of Egyptian dynastic materials.

Where possible, deviant radiocarbon dates have been explained, although subtle errors in assigning archaeol provenance cannot be assessed. Attention must be paid to the special nature of deviant dates derived from some of the halfa grass samples, below (Lucas, 1962, p 129, 131; Täckholm, 1956, p 521; Greiss 1957, p 5-30). Comparisons between radiocarbon dates of wood, charcoal, and grass samples derived from the same structures suggest that grasses growing in or close to the Nile or its previous flood waters may have acquired some older carbon from water-soluble carbonates, and may thus have become unsuitable for ^{14}C dating.

All hist dates used below are based upon the chronology of the 3rd ed of the *Cambridge Ancient History* (Hayes, 1970, p 173-193).

2630 ± 50

P-1883. PUM I ***840-820 ± 50 BC**

$\delta^{13}C_w = -2.93‰$

Linen wrappings from Univ Mus mummy PUM I (E 2813 A 4), of unknown provenance and date. Donated 1905 by John Wanamaker. Subm 1972 by H N Michael, following mummy's autopsy.

3400 ± 60

P-2337. ROM II ***1870-1720 ± 60 BC**

$\delta^{13}C_w = +4.56‰$

Human tissue consisting of tongue and some attached skeletal muscle from well-preserved mummified head of unknown provenance. Coll 1910 in Egypt by Trick Corelli, founder, Royal Ontario Mus, Toronto. Subm May 1975, by Patrick Horne, Dept Histopathol, Toronto Gen Hospital, Banting Inst, Toronto. *Comments*: sample pyrolized in N_2 before normal acid treatment. (PH): X-ray and exam of histologic sec of left temporal bone of this specimen revealed evidence of middle ear disease and mastoiditis, never before shown in such ancient material.

2990 ± 70

P-1831. Nebhepetre Mentuhotep, Dynasty XI ***1290 ± 70 BC**

Fragments of triangular loaves of bread (Ac No 25.3.230-235) from Metropolitan Mus Art, New York, excavations of Dynasty XI, ca 2133-1991 BC, temple of Nebhepetre Mentuhotep (Winlock, 1924, p 10, fig 6), located at Deir el Bahri on W side of Nile, Egypt (25° 40′ N, 32° 30′ E). Sample from original temple axis in sealed foundation deposits between N postern and temple grove. Subm 1971 by H N Michael. *Comment*: anomalous date evidently explained when sample was found to be impregnated with insect frass, as well as fumigated in 1959 with ethylene oxide and CO_2 while in mus storage.

3600 ± 70

P-1821. Sesostris III, Dynasty XII ***2110 ± 70 BC**

Outside rings of wood sample from cedar deck plank of funerary boat of Sesostris III (ca 1878-1843 BC), found at Dashur, Egypt (29° 48′ N, 31° 13′ E). Coll 1969 by James VanStone, Chicago Mus Nat Hist; subm 1971 by H N Michael. *Comment* (HNM & JW): date is archaeol consistent, given age of cedar wood. Other dates of samples from same boat plank

show excellent inter-lab agreement; see C-18, 3620 ± 180 (Arnold and Libby, 1951, p 111); GrN-1157, 3550 ± 60; GrN-1178, 3610 ± 50 (de Vries and Waterbolk, 1958, p 1555; Deevey *et al*, 1967, p 36); BM-22, 3530 ± 150 (R, 1959, v 1, p 83); UCLA-900, 3640 ± 80 (R, 1965, v 7, p 354); TF-564, 3570 ± 80 (R, 1975, v 17, p 221); UCR-126, 3750 ± 110 (R, 1975, v 17, p 404).

3150 ± 50

P-1830. Puhorsenbu, Dynasty XVII ***1500 ± 50 BC**

Wood, id as *Ficus sycamorus* by B F Kukachka, Forest Prod Lab, US Dept Agric, Madison, Wisconsin, from a Rishi type coffin found in 1918 by Metropolitan Mus at Assasif, E of Pabasa, Egypt (25° 40′ N, 32° 30′ E). From Burial 6A X B44, Field No. 30104, Exped Negative Nos 6A 156-7, 204 M11C 118,124 (Hayes, 1959, p 31). Dated to period of Dynasty XVII (ca 1650-1567 BC). Subm 1971 by H N Michael. *Comment*: date slightly young, although coffin, on stylistic grounds, could date to earliest Dynasty XVIII. Sample taken from outermost (youngest) rings of hollowed out sycamore log used as coffin.

3310 ± 70

P-1828. Ahmose, Dynasty XVIII ***1680 ± 70 BC**

$\delta^{13}C_w = -4.78‰$

Wood id as *Ficus sycamorus* (B F Kukachka) from coffin of Ahmose (Metropolitan Mus no. 12.181.298) found at Dra Abu el-Naga, opposite Luxor, Egypt (25° 43′ N, 32° 38′ E). Excavated 1912 by G S Carnarvon for Metropolitan Mus of Art, New York, and independently dated to early Dynasty XVIII, ca 1567-1500 BC (Carnarvon and Carter, 1912, Pl LXII, fig 2, LVIII, fig 2, and p 84, paragraph 73, Hayes 1935, p 80-81, footnote 34, p 91, p 134, fig 23). Subm 1971 by H N Michael. *Comment*: date consistent with archaeol expectations, given 100 yr maximum estimated life-time for sycamore tree.

Malkata series

Malkata, palace-settlement of Amenhotep III (reigned ca 1417-1379 BC), near Gurna, opposite Luxor, on W bank of Nile, Egypt (25° 43′ N, 32° 38′ E). Presumed to be single period site relating to Amenhotep III's ambitious residential constructions and the possible interests of his immediate successors. Site is, however, immediately adjacent to a variety of both earlier and later monumental structures. Samples coll March 1973, subm 1973 by E K Ralph, Univ Penna, Phila, and Barry Kemp, Cambridge Univ, Cambridge, England.

General Comment: samples from sealed deposits, and believed contemporary with each other and later part of Dynasty XVIII (ca 1420-1320 BC).

P-1997. Malkata M73/J/ba 40, Dynasty XVIII **2980 ± 50**

***1300-1270 ± 50 BC**

$\delta^{13}C_w = 0.00‰$

Charcoal in mud from Level 2. *Comment*: this late Dynasty XVIII date consistent with archaeol expectations.

3180 ± 50

P-2043. Malkata Site K, Dynasty XVIII *1540, 1510 ± 50 BC

$\delta^{13}C_w = +12.40‰$

Halfa grass from walls of Trench ag 11-al 11, portion of roofing of mudbrick bldg, undisturbed since its demolition in late Dynasty XVIII. *Comment* (HNM-JW): this anomalous date unexplained; perhaps due to dating problems peculiar to grasses.

3040 ± 50

P-2042. Malkata Site K, Dynasty XVIII *1370, 1340 ± 60 BC

$\delta^{13}C_w = +11.51‰$

All particulars as P-2043 (above). *Comment* (HNM-JW): date meets archaeol criterion.

Horemheb series

3400 ± 50

P-2111. Horemheb, Dynasty XVIII *1870-1720 ± 50 BC

$\delta^{13}C_w = +3.15‰$

Fragment, apparently sycamore, from composite wooden statue presently in Cairo Mus, Cairo (P-12 W3 Jour No. 46888). Found in cliff tomb of Horemheb (reigned ca 1348-1320 BC) in Valley of the Kings on W bank of Nile, opposite Luxor, Egypt (25° 40′ N, 32° 30′ E) (Daressy, 1912, p 107, no. 7). Coll 1973, by Henri Riad, Dir, Cairo Mus; subm 1973 by H N Michael. *Comment* (HNM-JW): even allowing for maximum age of 100 yr for sycamore, this date is deviant by over 200 yr, and remains unexplained.

3190 ± 50

P-2112. Horemheb, Dynasty XVIII *1560-1520 ± 50 BC

$\delta^{13}C_w = +2.78‰$

Wood, otherwise unid, from wedge binding sandstone blocks in Ninth Pylon of Temple of Amun, on E bank of Nile, Egypt (25° 43′ N, 32° 39′ E). Pylon apparently built by Horemheb (reigned ca 1348-1320 BC). Coll 1971 by Zaki Iskander, Org Egyptian Antiquities, Cairo. Subm by H N Michael. *Comment*: date not inconsistent with Dynasty XVIII construction. For other date for sample from same structure, see CRCA-5, 2162 ± 100 (R, 1974, v 16, p 2). Another CRCA date for portion of same sample, 3310 ± 100 (personal commun from S M Nakhla to H N Michael).

3230 ± 50

P-1996. Horemheb, Dynasty XVIII *1600-1570 ± 50 BC

$\delta^{13}C_w = +7.48‰$

Charcoal inclusions, perhaps *Acacia*, from mudbricks constituting Second Pylon of small temple N of Dynasty XX temple of Medinet Habu, on W bank of Nile, opposite Luxor (25° 47′ N, 32° 39′ E). Second Pylon built in late Dynasty XVIII by Horemheb (reigned ca 1348-1320 BC), last king of Dynasty (Hölscher, 1934, pl 33). Coll March 1973 by Barry Kemp and E K Ralph, subm 1973 by Barry Kemp. *Comment*

(HNM-JW): date somewhat earlier than expected, likely due to age of wood when burned.

Dra Abu el-Naga series

Dra Abu el-Naga S, on W bank of Nile opposite Luxor, Egypt, constitutes a portion of the vast Theban necropolis (25° 43′ N, 32° 38′ E). Samples taken from pyramidal tomb superstructures, built of courses of mud brick separated by beddings of halfa grass, with occasional use of timber reinforcement. Unless otherwise specified, coll and subm 1970 by Lanny Bell, Univ Mus, Univ Penna.

General Comment (LB): "Primary" describes sample taken farthest from surface layers of pyramid, with the least chance of disturbance by human activity; "Secondary" describes sample taken closer to the pyramid surface; "Tertiary" describes sample taken from pyramid surface, thus most likely to have been disturbed. Tentative known dates for owners of tombs are:

1. Nebwenenef (Tomb 157), maximum tenure as High Priest of Amun, yrs 1-17 of Ramses II, = ca 1304-1287 BC (Kees, 1953, p 118).

2. Nakhtmin (Tomb 282), attested as Chief of Bowmen of Kush within 1st 2/3 of reign of Ramses II, = ca 1304-1260 BC (Habachi, 1968, p 111, Seele, 1959, p 7-9, and Lefebvre, 1929b, p 264).

3. Bekenkhons I (Tomb 35), maximum tenure as High Priest of Amun, later in reign of Ramses II, = ca 1264-1237 BC (Plantikow-Münster, 1969, p 126-127).

4. Roma-Roy (Tomb 283), maximum tenure as High Priest of Amun, late in reign of Ramses II into reign of Seti II, = ca 1250-1210 BC (Lefebvre, 1929a, p 3-4, 23-24; 1929b, p 254).

5. Tjanefer (Tomb 158), attested in reign of Ramses III, = ca 1198-1166 BC (Habachi, 1968, p 111, Seele, 1959, p 7-9, and Lefebvre, 1929b, p 264).

Nebwenenef series

P-1730. Nebwenenef, Dynasty XIX **3120 ± 50** ***1480 ± 50 BC** $\delta^{13}C_{vb} = +6.6‰$

Portion of palm rachis (*Phoenix dactylifera*) id by D F Cutler, Jodrell Lab, Royal Bot Gardens, Surrey, England. Primary sample from pyramid of Nebwenenef. *Comment*: unexplained anomalous date suggested dating of 2nd portion (P-1730-A, below).

P-1730-A. Nebwenenef, Dynasty XIX **3210 ± 50** ***1590-1560 ± 50 BC** $\delta^{13}C_{vb} = +10.01‰$

Portion of P-1730 (above). *Comment*: this anomalous date remains unexplained.

3010 ± 60

P-1731. Nebwenenef, Dynasty XIX *1360, 1330-1300 ± 60 BC

$\delta^{13}C_w = +14.56‰$

Halfa grass, (?) (*Desmostachya bipinnata)* id by D F Cutler. Secondary sample from pyramid of Nebwenenef. *Comment*: date consistent with archaeol expectations.

3030 ± 60

P-1732. Nebwenenef, Dynasty XIX *1370, 1340 ± 60 BC

$\delta^{13}C_w = +13.8‰$

Halfa grass, (?) (*Desmostachya bipinnata*) id by D F Cutler. Tertiary sample from pyramid of Nebwenenef. *Comment*: date consistent with archaeol expectations.

2940 ± 50

P-1825. Nebwenenef, Dynasty XIX *1240-1220 ± 50 BC

$\delta^{13}C_w = +7.65‰$

Halfa grass, (?) (*Desmostachya bipinnata*) id by D F Cutler. Secondary sample from pyramid of Nebwenenef. *Comment*: portion of British Mus sample BM-658b. Consistent with archaeol expectations.

Nakhtmin series

2920 ± 50

P-1733. Nakhtmin, Dynasty XIX *1210-1190 ± 50 BC

$\delta^{13}C_w = +21.8‰$

Halfa grass, (?) (*Desmostachya bipinnata*) id by D F Cutler. Primary sample from within pyramid of Nakhtmin. *Comment*: date consistent with archaeol expectations.

3400 ± 60

P-1734. Nakhtmin, Dynasty XIX *1870-1840, 1770 ± 60 BC

$\delta^{13}C_w = +17.43‰$

Halfa grass, (?) (*Desmostachya bipinnata*) id by D F Cutler. Secondary sample from pyramid of Nakhtmin. *Comment*: unexplained anomalous date suggested dating of 2nd portion (P-1734-A, below).

1660 ± 50

P-1739-A. Bekenkhons I, Dynasty XIX ***AD 290-320 ± 50**

$\delta^{13}C_w = +24.3‰$

Halfa grass, (?) (*Desmostachya bipinnata*) id by D F Cutler. Primary sample from pyramid of Bekenkhons I. *Comment* (LB): evidently taken from intrusive Late Roman wall within pyramid.

3000 ± 60

P-1740. Bekenkhons I, Dynasty XIX ***1300 ± 60 BC**

$\delta^{13}C_w = +6.66‰$

Halfa grass, (?) (*Desmostachya bipinnata*) id by D F Cutler. Secondary sample taken from pyramid of Bekenkhons I. *Comment*: date consistent with archaeol expectations.

Roma-Roy series

3130 ± 40

P-1735. Roma-Roy, Dynasty XIX ***1490 ± 40 BC**

$\delta^{13}C_w = +16.1‰$

Halfa grass, (?) (*Desmostachya bipinnata*) id by D F Cutler. Primary sample from pyramid of Roma-Roy. *Comment*: date older than expected.

3280 ± 50

P-1736. Roma-Roy, Dynasty XIX ***1650 ± 50 BC**

$\delta^{13}C_w = +19.11‰$

Halfa grass, (?) (*Desmostachya bipinnata*) id by D F Cutler. Secondary sample from pyramid of Roma-Roy. *Comment*: anomalous date unexplained.

3120 ± 50

P-1737. Roma-Roy, Dynasty XIX ***1480 ± 50 BC**

$\delta^{13}C_w = 0.00‰$

Tjanefer series

P-1696. Tjanefer, Dynasty XX

3080 ± 60
***1450-1400 ± 60 BC**
$\delta^{13}C_w = +12.3‰$

Halfa grass (*Desmostachya bipinnata*) id by D F Cutler. Primary sample from pyramid of Tjanefer. *Comment*: date older than expected. Previous dates for samples from this pyramid BM-336, 2890 ± 100; -337, 3080 ± 75 (R, 1971, v 13, p 162); UCLA-1393, 3060 ± 60; and -1394, 3030 ± 60 (Berger, 1970, p 28).

P-1698. Tjanefer, Dynasty XX

2990 ± 50
***1290 ± 50 BC**
$\delta^{13}C_w = +12.3‰$

Halfa grass (*Desmostachya bipinnata*) id by D F Cutler. Primary sample from pyramid of Tjanefer. *Comment*: date older than expected.

P-1699. Tjanefer, Dynasty XX

3010 ± 50
***1360-1300 ± 50 BC**
$\delta^{13}C_w = 0.00‰$

Wood (*Acacia*) id by B F Kukachka, sawn from branch protruding from pyramid of Tjanefer. *Comment*: date consistent with archaeol expectations, when probable age of wood is considered.

Medinet Habu series

Medinet Habu, on W bank of Nile, opposite Luxor, Egypt (25° 47′ N, 32° 39′ E), is portion of Theban necropolis area in which Dra Abu el-Naga, Deir el-Bahri, and Malkata are also located. Medinet Habu is dominated by monumental funerary temple and appended palace of Ramses III (reigned ca 1198-1166 BC); earlier and later structures are also within temple complex; these include Dynasty XXI House of Butehamon from which Sample P-1994, below, was taken. Girdle wall surrounding temple was subject to Dynasty XXI (ca 1085-945 BC), Coptic, and post-Coptic alterations and rebuildings.

P-1819. Medinet Habu, Dynasty XX

960 ± 100
***AD 1020 ± 100**
$\delta^{13}C_w = -3.83‰$

Halfa grass, constituting part of the bonding between mud-brick courses of upper part of N enclosure wall of temple. Coll and subm 1971 by H N Michael. *Comment* (HNM-JW): sample evidently from post-Coptic additions to the wall.

P-1820. Medinet Habu, Dynasty XX

1110 ± 50
***AD 860-880 ± 50**
$\delta^{13}C_w = +8.6‰$

Macerated straw from straw-dung bonding material between courses of upper part of S enclosure wall of temple. Coll 1971 and subm 1971 by H N Michael. *Comment* (HNM-JW): evidently from post-Coptic additions to wall.

P-1995. Medinet Habu, Dynasty XX

2810 ± 50
***1050-1020 ± 50 BC**
$\delta^{13}C_w = +5.55‰$

Charcoal fragments (*Pistacea*) id by R C Koeppen, Forest Prod Lab, US Dept Agric, Madison, Wisconsin. Found as inclusions in N, W, and S inner enclosure walls of temple. Taken from ground level to height of 2m. Coll 1973 by Barry Kemp and E K Ralph; subm 1973 by E K Ralph. Expected date Dynasty XXI (ca 1085-945 BC). *Comment*: this mid-Dynasty XXI date consistent with archaeol expectations.

P-1994. House of Butehamon, Dynasty XXI

3150 ± 40
***1510 ± 40 BC**
$\delta^{13}C_w = +8.33‰$

Charcoal fragments, palm wood, id by R C Koeppen. Found as inclusions in mud-brick walls of reception rm of House of Butehamon. Coll 1973 by Barry Kemp and E K Ralph; subm 1973 by E K Ralph. Expected date during reign of Pinudjem I, early Dynasty XXI (ca 1050 BC). *Comment* (HNM-JW): since charcoal is from relatively short-lived palm wood, reconciliation of 500-yr deviance cannot be made.

P-1955. Faya, Dynasty XXI

2890 ± 40
***1180-1160 ± 40 BC**
$\delta^{13}C_w = -0.97‰$

Wood (*Salix*) id by R C Koeppen, from coffin lid of Lady Faya, now in Chicago Mus Nat Hist (Cat No. 31840). Of unknown provenance, independently dated to period of Dynasty XXI (ca 1085-945 BC). Coll 1973 and subm 1973 by H N Michael. *Comment* (HNM-JW): Dynasty XX date for wood consistent with construction of coffin lid in Dynasty XXI.

P-1956. Faya, Dynasty XXI

2980 ± 60
***1300-1270 ± 70 BC**
$\delta^{13}C_w = -0.77‰$

Wood (*Ficus*) id by R C Koeppen, from coffin of Lady Faya. Subm 1973 by H N Michael. *Comments*: see P-1955, above. (HNM-JW): Dynasty XIX date for wood not inconsistent with Dynasty XXI date for construction of coffin.

Pasebakhaienipet series

Of unknown provenance, but probably from Deir el-Bahri (25° 43′ N, 32° 38′ E), coffin and wrapped mummy of Pasebakhaienipet were acquired by Brooklyn Mus, New York (Brooklyn Mus 08.480 Ia-b). Assemblage was independently dated to period of Dynasty XXI (ca 1085-945 BC). Subm 1971 by H N Michael.

General Comment (HNM-JW): Pasebakhaienipet dates confirm re-use of older materials. The coffin is a composite one, the sides and bottom of sycamore are held in place by much older slabs of appropriately slotted cedar wood.

P-1816. Pasebakhaienipet, Dynasty XXI

2730 ± 50
***930 ± 50 BC**
$\delta^{13}C_w = -1.9‰$

Wood chips (*Ficus sycamorus*) id by B F Kukachka, from bottom of coffin of Pasebakhaienipet. *Comment*: sample derived from outer rings of sycamore, and consistent with construction of coffin in Dynasty XXI.

P-1817. Pasebakhaienipet, Dynasty XXI

3780 ± 50
***2190 ± 60 BC**
$\delta^{13}C_w = +1.83‰$

Wood chips (*Cedrus libani*) id by B F Kukachka, from joint between side and bottom of coffin of Pasebakhaienipet. *Comment*: excessive age of wood highly suggestive of its re-use, especially in view of reduced Egyptian access to sources of cedar during this period, and unusually intensive Dynasty XXI re-use of other materials.

P-1818. Pasebakhaienipet, Dynasty XXI

2790 ± 60
***1010 ± 60 BC**
$\delta^{13}C_w = -0.91‰$

Linen wrappings from mummy of Pasebakhaienipet. *Comment*: consistent with archaeol expectations. This short-lived sample should provide best evidence for actual date of burial.

Djedmutesankh series

Coffin and wrapped mummy of Djedmutesankh (Cat No. 25.3.2 A-B) were excavated by Metropolitan Mus Art, New York, in Tomb 60, Chamber No. 5 at Deir el-Bahri (25° 43′ N, 32° 38′ E), on W side of Nile, opposite Luxor, Egypt (Winlock, 1924, p 24-28, figs 28-29; 1926, p 19ff). Burial was dated independently to period of Dynasty XXI (ca 1085-945 BC). Subm 1973 by H N Michael. *Comment* (HNM-JW): this series may also show evidence of timber re-use, as with P-1817, above.

P-1815. Djedmutesankh, Dynasty XXI

3550 ± 50
***2070 ± 60 BC**
$\delta^{13}C_w = +0.91‰$

Wood (*Cedrus libani*) id by B F Kukachka, from inner coffin of Djedmutesankh (Field No. 25059, Exped Negative No. M6C 261-272). *Comment* (HNM-JW): date indicates cedar wood either from extremely old tree, or re-use.

P-1954. Djedmutesankh, Dynasty XXI

2930 ± 40
***1240-1220 ± 40 BC**
$\delta^{13}C_w = +1.93‰$

Wood (*Ficus sycamorus*) id by B F Kukachka, from coffin lid of Lady Djedmutesankh (Chicago Mus Nat Hist Cat No. 30000). *Comment*: this Dynasty XIX-Dynasty XX date is inconsistent with late Dynasty XXI date for construction of coffin, especially in view of 100 yr maximum estimated life-span for sycamore tree. Re-use therefore possible.

2690 ± 50

P-1871. Djedmutesankh, Dynasty XXI ***900 ± 50 BC**

$\delta^{13}C_{vp} = +2.88‰$

Linen wrappings from mummy of Lady Djedmutesankh. *Comment*: short-lived linen sample indicates a late Dynasty XXI-early Dynasty XXII date for actual burial.

2020 ± 50

P-1884. PUM II, Ptolemaic-Roman ***200-170 ± 50 BC**

$\delta^{13}C_{vp} = +13.67‰$

Linen wrappings from Univ Mus mummy PUM II (L-55-15, 21-46-8, Negative nos. 31408, 31409, 73717, and 3481). Of unknown provenance, lent 1934 by Phila Mus Art. Dated to Graeco-Roman period by Henry Fischer, Metropolitan Mus Art, New York. Subm by H N Michael, following mummy's autopsy (Cockburn *et al*, 1975). *Comment*: date consistent with stylistic analysis.

2. Iran

Qabr Sheykheyn series

Samples from small mound of Qabr Sheykheyn, designated KS 168, in alluvial plain 30km SE of Dizful and 20km NW of Shushtar, Iran (32° 15′ N, 48° 45′ E). Coll 1970 and 1971 and subm by Harvey Weiss, Dept Near Eastern Languages & Lit, Yale Univ, New Haven, Connecticut. Ceramic assemblage relatively uniform throughout all periods of occupation and most closely resembles Susiana *d* (Le Breton, 1957). Uncorrected dates expected to be ca 4000-3500 BC (Weiss, 1972).

P-1936. K12, Lot *6*, Str 3, Sample 3 **>38,430**

Submitter's Sample 14, from K12, Lot *6*, Str 3, Sample 3, carbonized reed matting from floor of central rm of Period II house. *Comment*: age quoted represents 2 standard deviations of uncertainty in counting of sample, background, and modern calibration sample. Probably contaminated with bitumen.

P-1937. K12/13, Lot *1*, Str 2, Sample 1 **>37,380**

Submitter's Sample No. 20, from K12/13, Lot *1*, Str 2, 1, charcoal and wood from fill of Period II house, 7 to 10cm below surface. *Comment*: see P-1936, above. Probably contaminated with bitumen.

P-1938. M12, Lot *4* **7810 ± 120**

Submitter's Sample 21, from M12, Lot *4*, charcoal on floor of IIIA occupation, near intrusive Islamic burial. *Comment*: possible bitumen contamination. Date calculated with 5730 half-life, but *not* corrected = 6090 ± 120 BC.

Shahr-i Sokhta series

Shahr-i Sokhta is 59km SSW of Zabol, Sistan prov, Iran (30° 44′ N, 61° 30′ E). Site displays a 4-period sequence (I-IV) distributed into 11

phases (0-10); Period I is oldest period, Phase 10 is oldest phase. Samples coll 1972, subm 1973 by Maurizio Tosi, Inst Itialiano per il Medio ed Estremo Oriente, Rome.

General Comment: basal date for Phase 10 TUNC-61, 4480 ± 100 (unpub) and latest date for Period IV TUNC-63, 3430 ± 70 (unpub). For other dates for Phase 3 see TUNC-21, 4065 ± 65; -22, 3829 ± 61; -23, 4082 ± 66; -24, 3943 ± 70; -25, 4278 ± 58; -26, 4115 ± 72; -27, 3890 ± 90 (R, 1973, v 15, p 593-594). All bot id by R C Koeppen. In sample titles 1st no. represents sec, 2nd no., cut, 3rd no., rm, and last no., layer. Thus XID.2.0.0 is equivalent to Sec XID, Cut 2, Rm, none cited, and Layer, none cited.

4160 ± 60

P-2076. XID.2.0.1-2 ***2910 ± 60 BC**

Sample 89, charcoal (*Pistacea*) in loose soil above Rms XXVII, XXVIII and XXII. *Comments*: NaOH pretreatment. (MT): dates to Period II, Phase 7.

4080 ± 60

P-2076-A. XID.2.0.1-2 ***2820-2700 ± 60 BC**

Portion of P-2076, above. *Comment*: NaOH pretreatment.

4080 ± 60

P-2086. XIG/XIH.XX.0 ***2820-2700 ± 70 BC**

Sample 94, charcoal id as *Tamarix* in reddish soil beneath staircase of E wall. *Comment* (MT): will date foundation of 'House of Stairs'. Dates to Period II, Phase 7.

4270 ± 60

P-2085. RRT.9.CLXXXII.8 ***2990-2970 ± 60 BC**

Charcoal (probably *Tamarix*), in reddish soil from floor of rm. *Comment* (MT): earliest layer with pottery of SS II. Dates to Period II, Phase 7.

4110 ± 60

P-2084. XIM/XIL.7.CCI.0 ***2840 ± 60 BC**

Sample 17, charcoal (*Tamarix*) in loose earth as filling above main floor. *Comments*: NaOH pretreatment. (MT): dates to Period II, Phase 6.

4040 ± 60

P-2083. XIM/XIL.6.CCI.0 ***2680-2630 ± 70 BC**

Sample 15, charcoal (*Tamarix*) in loose earth as filling above main floor. *Comment* (MT): dates to Period II, Phase 6.

4020 ± 70

P-2082. RSP.0.0.7 ***2620 ± 80 BC**

Sample 18b, charcoal (*Tamarix*) in loose, clayish earth above floor. *Comment* (MT): dates to Period II, Phase 6.

4150 ± 70

P-2081-B. RSP.0.0.7 ***2910-2880 ± 70 BC**

Sample 18a, charcoal (*Tamarix*). Stratigraphically identical to P-2082. *Comment*: NaOH pretreatment.

4310 ± 60

P-2081-A. RSP.0.0.7 ***3110-2990 ± 60 BC**

Portion of P-2081-B, above.

4060 ± 70

P-2079. RYL.10-11.CIVI.0 ***2690-2800 ± 80 BC**

Sample 91, charcoal (*Tamarix*) in clayish dust from fireplace in central pit of rm. *Comments*: NaOH pretreatment. (MT): should determine date of bldg phase preceding that of Period IV 'Burnt Building'. Dates to Period II, Phase 5.

4180 ± 70

P-2078. XIA.3.0.2 ***2920 ± 70 BC**

Sample 90b, charcoal (*Tamarix*) at top of filling above, and immediately S of 'House of Foundations'. *Comment* (MT): dates to Period II, Phase 5.

3950 ± 60

P-2077. XIA.3.0.2 ***2560 ± 60 BC**

Sample 90a, charcoal (*Tamarix*) stratigraphically identical to P-2078, above.

3950 ± 60

P-2075. RSP.0.CXXVIII.4 ***2560 ± 60 BC**

Sample 92, charcoal (*Populus*) in destruction layer above floor, found near skeleton of boy. *Comments*: NaOH pretreatment. (MT): should date destruction of bldg. Dates to Period IV, Phase 2.

4220 ± 60

P-2068. 0.0.CXXXVIII.4 ***2950-2930 ± 60 BC**

Sample 71a, charcoal (?) (*Tamarix*) in clayish soil from fireplace, beside burnt skeleton. *Comments*: NaOH pretreatment. (MT): dates to period IV, Phase 1.

3930 ± 60

P-2069. 0.0.CXXXVIII.4 ***2540-2520 ± 70 BC**

Sample 71b (*Populus*). Stratigraphically identical to P-2068, above. *Comment*: NaOH pretreatment.

4070 ± 60

P-2070. RRT.0.0.3 ***2800, 2740-2710, 2690 ± 70 BC**

Sample 78, charcoal (*Populus*) in relatively sterile layer of clayish earth. *Comments*: NaOH pretreatment. (MT): dates to Period IV, Phase 1.

3840 ± 60

P-2073. 0.0.CXXVI.4 ***2440, 2330 ± 60 BC**

Sample 87a, charcoal (*Populus*), in destruction layer of brownish earth representing remains of fallen roof beams. *Comments*: NaOH pretreatment. (MT): dates to Period IV, Phase 1.

3750 ± 60

P-2072. RWE.0.0.2 ***2180 ± 60 BC**

Sample 86b, charcoal (*Populus*) in clay from post-abandonment layer. *Comment* (MT): dates to Period IV, Phase 0.

3970 ± 60

P-2071. RWE.0.0.2 ***2580 ± 60 BC**

Sample 86a, charcoal (*Pistacea*?). Stratigraphically identical to P-2072, above. *Comment* (MT): dates to Period IV, Phase 0.

Tepe Sharafabad series

Tepe Sharafabad is small site in N central sector of Susiana plain 10km S of Dezful, Khusistan, SW Iran (32° 7′ N, 48° 22′ E). It contains important deposits dating to Sukkulmahhu and Transitional phases of Elamite period (ca 1900 to 1300 BC), as well as earlier material indicating relatively continuous occupation ca 5500 to 2800 BC. Subm 1974 by H T Wright, Mus Anthropol, Univ Michigan, Ann Arbor (Schacht, 1975).

4260 ± 330

P-2209. Sample A ***2970 ± 350 BC**

Charred wood from Excavation Unit 305 N, 300 E, Lot 22, Layer 6, a brown silt with charcoal and ash directly on floor. Assoc with ceramics of ca 1400 BC (Elizabeth Carter, pers commun). Seal of approx same date in trash layers immediately overlying brick collapse of this bldg, and tablet fragment of approx same date in fill of overlying small structure (Vallat & Cameron, pers commun). Coll 1971 by Nancy Talbot. *Comments*: sample counted in small counter. (HTW): expected date close to TUNC-34, 3170 ± 130, and -35, 3200 ± 140 (R, 1973, v 15, p 595).

5140 ± 60

P-2210. Samples B, C, E ***3960-3940 ± 60 BC**

Combined sample of charred wood from Excavation Unit 283N 340E, large, rapidly filled pit. Sample B, Lot *14*, Layers 22, 25, brown silt with ash, mud brick fragments, and charcoal, in lower layers of pit (feature 3), ca 2.6m depth. Sample C, Lots *43* and *44*, Layers 17-18, light brown silt with ash, mud brick fragments and charcoal in middle layers of pit, ca 2.2m depth. Sample E, Lo *12*, Layer 14-22, brown silt, charcoal and mud brick fragments, ash and sherds from pit, ca 2.1 to 3m depth. Coll 1971 by Nancy Talbot and Richard Redding. Ceramics from pit represent very end of Middle Uruk period (for ceramic terminology, see Johnson, 1973, p 54-58). Samples combined due to small size. *Comment* (HTW): expected date close to TUNC-32, 4832 ± 55, and -33, 4331 ± 50 (R, 1973, v 15, p 595).

2770 ± 270

P-2281. Sample D ***1010-990, 960 ± 290 BC**

Sample D, charred wood from Excavation Unit 310N 295E, Lot *9*, Layer 9, brown silt and charcoal layer on top of irregular floor at courtyard walls, ca 1.3m depth. Assoc with ceramics of ca 1400 BC (Elizabeth Carter, pers commun). Coll 1971 by William Laubernds. *Comments*: sample counted in small counter. (HTW): expected date close to TUNC-34, 3172 ± 125, and -35, 3200 ± 138 (R, 1973, v 15, p 595).

3. Iraq

Abu Salabikh series

Tell Abu Salabikh is a large mound, last occupied in Early Dynastic III period, ca 20km NW of Nippur, Iraq (31° 00′ N, 42° 30′ E), on ancient course of Euphrates. Samples coll 1965 by Donald Hansen and subm by Robert Biggs, Oriental Inst, Chicago (Biggs, 1966).

4850 ± 50

P-2050. Area E, Level I B ***3670 ± 60 BC**

Field Sample 1, charcoal from Area E, Level I B, fill above Floor 3. Sample from level of earliest stratified cuneiform inscriptions. *Comments*: NaOH pretreatment. (RB): expected date should be mid-3rd millennium BC, early part of Early Dynastic IIIa. Sample tested negative for bitumen.

4100 ± 60

P-2051. Area E, Level I ***2830 ± 60 BC**

Field Sample 2, charcoal from Area E, Level I. *Comments*: NaOH pretreatment. (RB): presumably burned at time of destruction of bldg.

4330 ± 60

P-2052. Area E 31, Level I ***3140-3090, 3050-3030 ± 60 BC**

Field Sample 3, charcoal from Area E 31, Level I, fill. *Comment*: NaOH pretreatment.

4390 ± 60

P-2053. Area E 39, Level I B ***3160 ± 60 BC**

Field Sample 4, charcoal from Area E 39, Level I B, fill above Floor 3, at E wall. *Comment*: NaOH pretreatment.

3480 ± 60

P-1117. Tell al Rimah ***2020-1960 ± 60 BC**

Ash from Tell al Rimah, 12.8km S of Tell 'Afar in Sinjar region of NW Iraq (46° 26′ N, 36° 16′ E). From 1 of 2 ash layers in Level II overlying dado of Site A shrine rm within platform temple on center mound of complex. Coll 1965 by J Reade, subm 1966 by David Crownover, Univ Mus, Univ Penna, Phila. *Comment*: NaOH pretreatment. For another date see P-844, 3291 ± 57 (R, 1965, v 7, p 190).

4. Israel

Ai (et Tell) series

Ai (et Tell), near village of Deir Dibwan, 10km NNE of Jerusalem, Israel, (31° 55′ N, 35° 16′ W), contains stratified remains of Early Bronze age (ca 3100 to 2200 BC) and Iron age remnants. Artifactual correlations at site exist linking EB I-EB III with Thinite to Early Old Kingdom Egypt. Samples subm 1975 by J A Callaway, Southern Baptist Theol Seminary, Louisville, Kentucky, and James Weinstein, Univ Mus, Univ Penna (Callaway, 1972; Callaway & Wagner, 1974).

General Comment: in sample titles, letter after title denotes site, nos. designate area, sub-area, and layer, eg, G VI 500.6 = Site G, Area VI, Sub-area 500, Layer 6).

4170 ± 70

P-2298. G VI 500.6 ***2910 ± 70 BC**

Charred wood from destruction layer of EB IIIB (Phase VIII) house. Coll 1966 by G H Livingston. *Comments*: NaOH pretreatment (JAC): sample should indicate date ca 2450 BC, at beginning of last half of EB IIIB. For another date from same provenance see Tx-1033, 4400 ± 80 (R, 1972, v 14, p 483).

4200 ± 70

P-2299. C I 1.28b ***2940-2920 ± 70 BC**

Charred lentils (preliminary field id by Kermit Schoonover, Perkins School Theol, Dallas, Texas) from destruction layer of house used during EB IIB, Phase V. Coll 1964 by Kermit Schoonover. *Comments*: NaOH pretreatment. (JAC): sample should indicate date for termination of Urban B, or EB IIB, at Ai, assigned to ca 2720 BC (Callaway, 1972, p 199-201). For another date from same provenance, see Tx-1030, 4700 ± 50 (R, 1972, v 14, p 483).

4250 ± 60

P-2300. C I 1.31 ***2970 ± 60 BC**

Charred lentils (see P-2299, above) from destruction layer in house next to Wall C used during EB IC, Phase III. Coll 1964 by Kermit Schoonover. *Comments*: NaOH pretreatment. (JAC): for other dates from same provenance see Tx-1035, 4810 ± 90 (R, 1972, v 14, p 483), and -2371, 4310 ± 130 (unpub).

4270 ± 70

P-2301. C IX 800.10 ***2990-2970 ± 70 BC**

$\delta^{13}C_w = +1.82‰$

Charred lentils (see P-2299, above) from destruction layer of Urban B house. Same location in layer succeeding Urban C phase in which samples P-2299 and -2300 belong. Coll 1966 by Kermit Schoonover. *Comment* (JAC): should indicate date for termination of Urban B, or EB IIB, at Ai, assigned to ca 2720 BC (Callaway, 1972, p 199-201). For other dates from same provenance see GaK-2380, 4160 ± 120 (R, 1973, v 15, p 66) and Tx-1031, 4730 ± 90 (R, 1972, v 14, p 483).

4320 ± 70

P-2302. D IV 300.5 ***3110-3090, 3050-3010 ± 70 BC**

Charred wood (*Quercus calliprinos*) id by Cecil Warren, Ashmolean Mus, Oxford, from Urban C temple-palace complex destruction layer, used during EB IC. Sample contemporary with P-2303 and -2304 (*cf*). Coll 1964 by J A Callaway. *Comments*: NaOH pretreatment. (JAC): should indicate date for beginning of Urban C at Ai, or beginning of EB IC, Phase III. For other dates from same provenance, see GaK-2379, 4980 ± 120; GaK-2381, 5000 ± 120 (R, 1973, v 15, p 66); Tx-1032, 4940 ± 90 (R, 1972, v 14, p 483) and Tx-2372, 4380 ± 80 (unpub).

4550 ± 60

P-2303. L I 1.8 ***3370-3350 ± 60 BC**

Charred wood, presumably evergreen oak as P-2302 (above), from destruction layer of Urban C Tower C, and contemporary with P-2302 and -2304 (*cf*). Coll 1972 by J A Callaway. *Comments*: NaOH pretreatment. (JAC): same as for P-2302.

4360 ± 60

P-2304. L I 2.2 ***3150 ± 60 BC**

Charred wood, presumably evergreen oak as P-2302, from destruction layer of Urban C Tower C, and contemporary with P-2302 and -2303. Coll 1972 by J A Callaway. *Comment* (JAC): same as for P-2302, above.

Arad series

Arad, S Israel (31° 17′ N, 35° 07′ E), site of important Early Bronze age city, and later acropolis town of Iron age. The 4 EB strata (IV, oldest, to I) correspond to late Gerzean-Second Dynasty periods in Egypt (Callaway & Weinstein, ms in preparation). Samples subm 1970, 1972-1975 by Ruth Amiran, Israel Mus, Jerusalem (Amiran, 1965; 1969; 1970). All samples from Arad Strata III or II, which probably coincide with mid-late 1st Dynasty. Previous date for Loc 1240, EB II city, GrN-4704, 4335 ± 65 (R, 1967, v 9, p 139).

General Comment: grain id by Maria Hopf, Mainz, W Germany.

P-1742. Floor of Rm 2326, Stratum II, Area K **4050 ± 50**
***2800-2760, 2720, 2690 ± 50 BC**

Charred barley, no. 5541/91, from floor of Rm 2326, Stratum II, Area K. Coll 1965 by R Brown. *Comment*: NaOH pretreatment.

4910 ± 60

P-2055. Loc 4155-4158, Stratum II ***3720 ± 60 BC**

$\delta^{13}C_w = +3.54‰$

Charred wheat from Loc 4155-4158, Stratum II. Coll 1972 by Ruth Amiran. *Comment*: NaOH pretreatment.

P-2109. Loc 4155-4158, Stratum II, No. 8986 **4070 ± 50**
***2800, 2740-2710, 2690 ± 50 BC**
$\delta^{13}C_w = +2.23‰$

Charred wheat from Loc 4155-4158, Stratum II. Some Loc and collector as P-2055, above. Coll 1972, subm 1974. *Comment* (RA): date agrees with chronology beginning First Dynasty at 2970 BC.

4510 ± 60
P-2054. Loc 4058-4071, Stratum II ***3340-3230 ± 60 BC**
$\delta^{13}C_w = +0.88‰$

Charred barley from Loc 4058-4071, Stratum II. Coll 1971 by Ruth Amiran. *Comment*: NaOH pretreatment.

4230 ± 60
P-2054-A. Loc 4058-4071, Stratum II ***2960-2930 ± 60 BC**
$\delta^{13}C_w = +4.07‰$

Charred barley from Loc 4058-4071, Stratum II. Sample is another portion of P-2054, see above. *Comment*: NaOH pretreatment.

P-2110. Loc 4151, Stratum II, No. 8968 **4310 ± 60**
3110-3070, 3040-3010 ± 60 BC
$\delta^{13}C_w = +3.15‰$

Charred barley from Loc 4151, Stratum II. Coll 1973 by Ruth Amiran.

P-2415. Loc 4610, Stratum III, X-1394/91 **4210 ± 60**
***2940-2920 ± 60 BC**

Carbonized wood (id as *Pistacea atlantica*) from Loc 4610, Stratum III. Coll 1975 by Ruth Amiran. *Comment*: NaOH pretreatment.

5. Jordan

2350 ± 50
P-2207. Tell Siran ***460-440 ± 50 BC**

Uncarbonized grain, contents of sealed Ammonite bronze container, consisting mainly of *Triticum dicoccum*, emmer wheat, *Triticum aestivum*, bread wheat, and *Hordeum vulgare*, hulled six-row barley, id by Hans Helbaek, Natl Mus, Copenhagen (Helbaek, 1974, p 167-168). Inscribed container found in unstratified deposit in one of a complex of subterranean chambers at Tell Siran, NW of Amman, Univ Jordan campus (31° 57′ N, 35° 56′ E). Container inscription dated to ca 600 BC by Frank Cross, Am Schools Oriental Research, Cambridge, Massachusetts. Coll 1972 and subm 1973 by H O Thompson, Am Center Oriental Research, Amman (Thompson, 1973, p 5-13). *Comment* (HOT): radiocarbon analysis should determine whether grain is contemporary with container.

6. Syria

Tell es Sweyhat series

Tell es Sweyhat is substantial settlement mound ca 120km NE of Aleppo, on E bank of Euphrates (36° 19′ N, 38° 10′ E). Samples coll 1974

and subm 1975 by John Dayton and Tom Holland, Inst Archaeol, London. Both samples from same destruction layer, Square IV 0 p 1.4, ca 120cm depth.

General Comment (JD): radiocarbon analysis should determine whether stratigraphy dates to time of Sargon, ca 2400 BC, time of Hammurabi, ca 1800 BC, or to Neo-Assyrian period, ca 800 BC.

3640 ± 70

P-2324. Carbonized grain ***2140-2120 ± 70 BC**

Unid carbonized grain sample from jar beneath roof beam remains. *Comment*: NaOH pretreatment.

3730 ± 70

P-2338. Charcoal ***2180 ± 70 BC**

Charcoal sample from ca 8cm carbonized roof beam of poplar type, overlying P-2324, above.

7. *Turkey*

2630 ± 50

P-1279. Gordion, City Mound ***810 ± 50 BC**

Gordion, on Sangarius R, ca 110km SW of Ankara, Turkey (39° 45′ N, 31° 55′ E), is site of a Phrygian kingdom, destroyed during Cimmerian invasion of early 7th century BC. City Mound contains strata dating from Chalcolithic to Galatian periods. Sample of charred grain (wheat, millet?) from burnt Phrygian house, City Mound, clay cut. Coll 1955 and subm by M J Mellink, Bryn Mawr College, Bryn Mawr, Pennsylvania. For other dates see R, 1959, v 1, p 46-47; R, 1962, v 4, p 146-149; R, 1965, v 7, p 194; R, 1966, v 8, p 352. *Comment*: NaOH pretreatment.

130 ± 80

P-2323. Ergani mine ***AD 1680-1800 ± 80**

Carbonized wood from 30 to 45m below surface in old copper mine opening, now caved in, at Ergani copper mine, 1km S of Maden village, Diyabakir prov, Central Anatolia, Turkey (38° 23′ N, 39° 40′ E). Coll 1962 by Sahap Aybat, Ergani Bakir Ismelleri (Ergani Copper Operations), Etibank, Maden, Turkey. Subm 1975 by C A Wendel, and P S de Jesus, Inst Archaeol, London Univ. *Comment* (PSdeJ): date is satisfactory; supports hypothesis that prehistoric mines have been erased by modern exploitation or that they have already caved in.

P-2285. Ergani Maden (Ergani mine) **>37,590**

Samples (wood) of mine timbers from suspected ancient copper source at Ergani copper mine, Diyabakir prov, Central Anatolia, Turkey (38° 23′ N, 39° 40′ E). Coll 1968 by Theodore Wertime and subm 1975 by Robert Maddin, Lab for Research and Study of Matter, Univ Pennsylvania (Wheeler *et al*, 1975, p 34, 37). *Comment*: age quoted represents 2 standard deviations of uncertainty in counting of sample, background, and modern calibration sample. No explanation for anomalously early date.

4120 ± 70

P-2208. Karataş-Semayük ***2870-2850 ± 70 BC**

Karataş-Semayük is small Early Bronze age site 8km E of Elmali on upland plain of Elmali in interior of ancient Lycia, Antalya, Turkey (36° 45′ N, 30° 00′ E). Mound is 3 to 4m high, 100m diam, lying NE of large necropolis. Sample from Storage Pit 14, S of house courtyard, Level II. Coll 1973 and subm 1974 by M J Mellink, Bryn Mawr Coll, Bryn Mawr, Pennsylvania (Mellink, 1972). For other dates see R, 1966, v 8, p 352-353. Date expected to be not far into 3rd millennium BC. *Comment*: NaOH pretreatment.

1340 ± 50

P-1620. Mount Ararat ***AD 650 ± 50**

Wood sample from tree belonging to white oak group (*Quercus sp*), id by B F Kukachka, Forest Prod Lab, US Dept Agric, Madison, Wisconsin. Found at + 4000m under 30cm ice and moraine, exposed by thawing 10m ice pack, on SW face of Mount Ararat, Turkey (39° 20′ N, 44° 00′ E). Sample coll 1969 and subm by SEARCH Foundation Inc, Washington, DC. For previous date from same site see NPL-61, 1190 ± 90 (R, 1965, v 7, p 161; Navarra, 1956).

C. SW Asia

1. Afghanistan

Deh Morasi Ghundai series

Deh Morasi Ghundai is Chalcolithic site in S-central Afghanistan (31° 35′ N, 65° 30′ E). Samples coll 1951 and subm 1960 by Louis Dupree (1963). For other date from this site see P-1493, 4414 ± 53 (R, 1970, v 12, p 586).

General Comment: all samples except P-2291 counted in small counter.

3780 ± 240

P-2288. 100 to 120cm ***2190 ± 250 BC**

Charcoal from 100 to 120cm depth.

4440 ± 260

P-2289. 220 to 240cm ***3200-3180 ± 270 BC**

Fire-burned earth and some charred wood from 220 to 240cm depth.

4090 ± 220

P-2290. 240 to 260cm ***2700, 2810-2830 ± 230 BC**

Fire-burned earth and some charred wood from 240 to 260cm depth.

4500 ± 70

P-2291. 260 to 280cm ***3330, 3300-3280, 3250-3220 ± 80 BC**

Fire-burned earth and some charred wood from 260 to 280cm depth.

5680 ± 300

P-2292. 290 to 300cm ***4540 ± 310 BC**

Fire-burned earth and some charred wood from 290 to 300cm depth.

Shamshir Ghar series

Shamshir Ghar is historic period cave site ca 100m above Arghanab R, near village of Badwan, Kandahar prov, Afghanistan (31° 35′ N, 65° 30′ E). Samples coll 1950 and subm 1960 by Louis Dupree (1958).

General Comment: samples counted in small counter.

1750 ± 220

P-2286. 40 to 50cm, Trench 2 ***AD 210 ± 230**

Fire-burned earth and some charred wood from Trench 2, 40 to 50cm depth. *Comment*: on typologic grounds, date expected to be AD 100 to 300.

2780 ± 250

P-2287. 50 to 60cm, Trench 2 ***1010 ± 260 BC**

Fire-burned earth and some charred wood from Trench 2, 50 to 60cm depth. *Comment*: on topologic grounds date expected to be AD 100 to 300.

2. Pakistan

Aligrama series

Aligrama is in Swat Valley, Pakistan (34° 37′ N, 72° 22′ E). Samples coll 1973 and subm 1974 by Giorgio Stacul, Inst Storio Antica, Univ Trieste, Italy (Stacul, 1969; 1970).

3090 ± 40

P-2150. Layer 10 ***1460 ± 50 BC**

Carbon from Layer 10, 3.60 to 3.80m depth, assoc with pottery related to early Vth period. For other dates for Period V in Swat Valley see BM-195, 2980 ± 150, BM-196, 2850 ± 150 (R, 1969, v 11, p 292) and R-476, 3150 ± 150 (R, 1970, v 12, p 610).

3010 ± 60

P-2151. Layer 13 ***1360-1300 ± 60 BC**

Carbon from hearth in Layer 13, 5.75m depth, assoc with pottery related to IVth period.

3350 ± 40

P-2151. Layer 13 ***1710-1690 ± 50 BC**

Carbon from hearth in Layer 13, 5.75m depth, assoc with pottery related to IVth period.

Allahadino series

Allahdino is Harappan-period site near Karachi, Pakistan (24° 52′ N, 67° 20′ E). Samples coll 1974 by W A Fairservis, Jr; subm by Gregory Possehl, Univ Mus, Univ Pennsylvania.

General Comment (WAF): samples from high on site. Only P-2296 could qualify as assoc with main bldg period; P-2237 and -2295 from last phase of occupation.

3840 ± 60

P-2237. Sq E 5 ***2410-2340 ± 70 BC**

Charcoal from small burned area in Sq 5 E, 60cm from N balk, 60cm depth. Date expected to be 2000 ± 200 BC.

3760 ± 70

P-2295-A. Building Level I, 40cm depth ***2180 ± 70 BC**

Charcoal from Bldg Level I, 40cm depth. Date expected to be 1900 ± 200 BC. *Comment*: NaOH pretreatment.

3930 ± 50

P-2296. Building Level I, 60cm depth ***2550 ± 50 BC**

Charcoal from Bldg Level I, 60cm depth. Date expected to be 1900 ± 200 BC.

870 ± 50

P-2294. Periano Ghundai ***AD 1090 ± 50**

Charcoal from bottom of Stein's Trench E, at Periano Chundai, a multi-period mound site in Zhob Valley, N Baluchistan, Pakistan (31° 35′ N, 65° 30′ E). Original excavation produced 2 distinct stratigraphic phases with later phase revealed in Trench E (Stein, 1929; Fairservis, 1959, p 329-330). Coll 1950 and subm 1960 by Louis Dupree. *Comment*: NaOH pretreatment.

Rana Ghundai series

Rana Ghundai is 5th to 3rd millennium BC site in Loralai Valley of N Baluchistan, Pakistan (30° 24′ N, 68° 43′ E). Samples coll 1972 and subm by M R Mughal, Dept Archaeol, Govt Pakistan (Mughal, 1972; 1974; Fairservis, 1959).

5580 ± 60

P-2148. Sample 2 ***4470 ± 60 BC**

Charcoal, earth and ash from occupation level in already exposed sec on W edge of site. Sample from 3m below arbitrary datum, in level which may belong to either Rana Ghundai I Period or to occupation preceding Period I.

4600 ± 60

P-2149. Sample 3 ***3380 ± 60 BC**

Burned material and ash from occupation deposit (ca 22cm thick, max) from already exposed sec containing charcoal and carbonized seeds, belonging to Rana Ghundai IIIA period. For comparably dated material from Damb Sadaat II-III, see P-522, 4378 ± 196; P-523, 4029 ± 74 (R, 1963, v 5, p 94) and from Kot Diji, see P-195, 3925 ± 134; P-180, 4083 ± 137; P-179, 4161 ± 151, and P-196, 4421 ± 141 (R, 1959, v 1, p 51).

D. Africa

1. Ethiopia

Aksum series

Aksum, capital of Aksumite Kingdom of 1st millennium AD is on W side of N Ethiopian plateau (14° 8′ N, 38° 48′ E). Samples subm by Neville Chittick, British Inst in E Africa, Nairobi, Kenya (Chittick, 1974).

1960 ± 40

P-2310. XXII A (5a) ***AD 30-50 ± 50**

Sample XXII A (5a), charcoal from pit underlying fill of 2nd extension to earliest structure (Platform A) beneath main group of stelae, ca 2.6m depth. Coll 1974 by John Manley.

1820 ± 50

P-2311. XXII H (5) ***AD 150 ± 50**

Sample XXII H (5), charcoal on steps leading to extended platform beneath main group of stelae, ca 2.4m depth. Coll 1974 by John Manley.

1610 ± 40

P-2312-A. XXII H (5d) ***AD 390 ± 50**

Sample XXII H (5d), charcoal from deposits accumulated next to platforms, ca 2.4m depth. Coll 1974 by John Manley. *Comments*: NaOH pretreatment. (NC): expected date to be slightly later than P-2311, above.

1690 ± 180

P-2313. Sample XII FW (6a) ***AD 270 ± 80**

Charcoal from bottom of pit, ca 6m depth, cut through "platform" deposits probably in Late Aksumite times. Coll 1974 by John Manley. *Comments*: sample counted in small counter. (NC): date expected to be later than P-2310 and -2312-A, above, which would indicate robber activities in Late Aksumite times, but sample may possibly predate pit.

1680 ± 80

P-2314. Sample DA (15) ***AD 280 ± 80**

Charcoal from outer part of left chamber of "Tomb of Brick Arches," against steps, at 8m depth. Coll 1974 by S Munro-Hay. *Comments*: NaOH pretreatment. (NC): sample should date furnishing of tomb, though it is possible that material was left by robbers in antiquity.

1720 ± 220

P-2315. Sample GT II (11) ***AD 230-250 ± 220**

Charcoal from tomb chamber in Gudit stele field. Coll 1974 by W Ball. *Comments*: NaOH pretreatment. Sample counted in small counter. (NC): on basis of grave goods, 3rd to 4th century AD date expected.

1550 ± 50

P-2316. Sample IW II (5) ***AD 440 ± 50**

Charcoal from lowest fill of burned Bldg IW, ca 1.5m depth, assoc with stone bowls. Coll 1974 by W Ball. *Comments*: NaOH pretreatment. (NC): Late Aksumite date expected, which should indicate *terminus post quem* for destruction of bldg.

1890 ± 50

P-2317. Sample IW IA (3) ***AD 90 ± 50**

IW IA (3), charcoal in collapse of burned bldg IW, ca 1m depth. Coll 1974 by W Ball. *Comments*: NaOH pretreatment. (NC): sample is probably part of beam from structure of house. Date expected to be older than P-2316, above.

P-2238. Gobedra Rockshelter **10,110 ± 140**

Gobedra rockshelter is 1 of series of rockshelters at W end of Gobedra ridge, 6km W of Aksum, Tigre, N Ethiopia (14° 10′ N, 38° 45′ E). Coll and subm 1974 by D W Phillipson, British Inst in E Africa, Nairobi, Kenya. Charcoal from Grid-Sq S, Level 7/8 interface, 65 to 75cm depth. Assoc with earliest phase of microlithic "Late Stone Age" industry, overlying industry based on large blades. Later phases of microlithic industry assoc with pottery of previously unknown type (Chittick, 1974, p 194). *Comment*: date calculated with 5730 half-life, but *not* corrected = 8460 ± 140 BC.

E. N America

1. USA

2210 ± 90

P-1809. Nuk, Alaska ***400 ± 100 BC**

Charcoal from hearth in single habitation level of House 285, Nuk, 29km E of Nome, Alaska (64° 30′ N, 166° 00′ W). Coll 1970 by J R Bockstoce, subm by F G Rainey, Univ Mus, Univ Pennsylvania. Comparable date for same site, I-5379, 1970 ± 100 (FGR, personal commun). Other date for same site P-1633, 2284 ± 56 (R, 1971, v 13, p 372). *Comment*: NaOH pretreatment. Sample was processed at Univ Pennsylvania Radiocarbon Lab, but was too small for our counters, therefore counted by Isotopes.

2430 ± 200

P-2440. Fort Hill, Pennsylvania ***660-510 ± 210 BC**

Charcoal from Fort Hill, Somerset Co, SW Pennsylvania (39° 50′ N, 79° 17′ W). Sample from interface of tan-ferrous clay and dense-dry siltstone, at 0.4m depth. Coll and subm 1976 by Jeffrey Kenyon, Univ Mus, Univ Pennsylvania. *Comment*: sample counted in small counter.

F. Caribbean

230 ± 40

P-1402. Cap Haïtien Wreck **AD 1640 ± 40**

Wood from rudder of wreck in area of Cap Haïtien, Haiti (19° 47′ N, 72° 17′ W). Remains located on coral reef at location consistent with presumed site of wreck of Santa Maria, flagship of Christopher Columbus, which sank Dec 1492. Coll and subm 1967 by Fred Dickson, Dimeco Inc, Ocean City, New Jersey. *Comment*: sample taken from outermost growth rings of rudder heavily contaminated with shell casings of marine shipworms. MASCA thermoluminescence date series obtained from pottery sample assoc with wreck produced average value equivalent to AD 1475 ± 100 (P-T-126).

G. Central America

1. Costa Rica

Chahuite Escondido series

Chahuite Escondido is shell midden site in Guanacaste prov on E bank of Rio Murcielago, 1km S of Juantillo Bay on N shore of Santa

Elena Peninsula, Costa Rica (10° 55′ N, 85° 40′ W). B1 cut 1 (B1/1) was in deepest part of midden. Coll 1960 by M D Coe, subm 1974 by J W Sweeney, Dept Anthropol, Univ Pennsylvania (Baudez, 1967; Baudez & Coe, 1962; Coe, 1962; Coe & Baudez, 1961). For another date from this site see Y-816, 840 ± 70 (R, 1961, v 3, p 133).

1070 ± 50

P-2168. B1/1C ***AD 920 ± 50**

Charcoal, Field Cat No. B1/1C, Cut 7, level 0.60 to 0.90m. *Comment*: NaOH pretreatment.

870 ± 40

P-2169. B1/1D ***AD 1090 ± 50**

Charcoal, Field Cat No. B1/1D, Cut 1, level 0.90 to 1.20m. *Comment*: NaOH pretreatment.

1030 ± 50

P-2170. B1/1F ***AD 950 ± 50**

Charcoal, Field Cat No. B1/1F, Cut 1, level 1.50 to 1.80m. *Comment*: NaOH pretreatment.

720 ± 50

P-2171. B1/1G ***AD 1240 ± 50**

Charcoal, Field Cat No. B1/1G, Cut 1, level 1.80 to 2.10m. *Comment*: NaOH pretreatment.

950 ± 40

P-2172. B1/1I ***AD 1020 ± 50**

Charcoal, Field Cat No. B1/1I, Cut 1, level 2.40 to 2.70m. *Comment*: NaOH pretreatment.

880 ± 50

P-2173. B1/1J ***AD 1090 ± 50**

Charcoal, Field Cat No. B1/1J, Cut 1, level 2.70 to 3m. *Comment*: NaOH pretreatment.

1110 ± 40

P-2174. B1/1L ***AD 860-880 ± 40**

Charcoal, Field Cat No. B1/1L, Cut 1, level 3.30 to 3.60m.

1030 ± 50

P-2282. B1/1E ***AD 950 ± 50**

Charcoal, Field Cat No. B1/1E, Cut 1, level 1.20 to 1.50m.

1040 ± 50

P-2283. B1/1H ***AD 940 ± 50**

Charcoal, Field Cat No. B1/1H, Cut 1, level 2.10 to 2.40m.

1120 ± 40

P-2284. B1/1K ***AD 860-880 ± 40**

Charcoal, Field Cat No. B1/1K, Cut 1, level 3 to 3.30m.

Matapalo series

Matapalo (Site G 11) is an extensive village site beginning at modern Matapalo and covering a wide area to ca 1km NW of town, located W of Rio Matapalo, NW of Matapalo Plaza, Guanacaste prov, Costa Rica (10° 20′ N, 85° 50′ W). Site pertains to Zoned Bichrome and Early Polychrome periods. (Baudez & Coe, 1962; Coe, 1962; Coe & Baudez, 1961; Lange, 1971). Coll 1960 by M D Coe and subm 1974 by J W Sweeney. For other dates from this site see Y-810, 1870 ± 200; Y-809, 1530 ± 280; and Y-811, 1395 ± 90 (R, 1961, v 3, p 132).

740 ± 40

P-2175. G11/1C ***AD 1230 ± 50**

Charcoal, Field Cat No. G11/1C, Cut 1, level 0.30 to 0.45m. *Comment*: NaOH pretreatment.

1040 ± 50

P-2176. G11/1D ***AD 940 ± 50**

Charcoal, Field Cat No. G11/1D, Cut 1, level 0.45 to 0.60m. *Comment*: NaOH pretreatment.

1330 ± 50

P-2177. G11/2D and G11/2E ***AD 640 ± 50**

Charcoal, Field Cat Nos. G11/2D, Cut 1, level 0.45 to 0.60m and G11/2E, Cut 1, level 0.60 to 0.75m. *Comment*: 2 samples combined.

Huerta del Aguacate series

Huerta del Aguagate site is one of series of shell mounds within 200m radius near Villareal, Guanacaste prov, on N side of Rio San Andrés ca 2km E of Tamarindo Bay (10° 15′ N, 85° 50′ W). Presumed to be single period site pertaining to Middle Polychrome period (AD 800-1200) but there may be an earlier component (Baudez, 1967; Lange, 1971). Coll 1960 by M D Coe, subm 1974 by J W Sweeney. For another date see Y-815, 990 ± 70 (R, 1961, v 3, p 132-133).

810 ± 40

P-2178. G2/1C ***AD 1180 ± 40**

Charcoal, Field Cat No. G2/1C, Cut 1, level 0.30 to 0.45m. *Comment*: NaOH pretreatment.

930 ± 40

P-2179. G2/1D ***AD 1030 ± 40**

Charcoal, Field Cat No. G2/1D, Cut 2, level 0.45 to 0.60m. *Comment*: NaOH pretreatment.

760 ± 50

P-2180. G2/2F ***AD 1200-1220 ± 50**

Charcoal, Field Cat No. G2/2F, Cut 2, level 0.75 to 0.90m.

1130 ± 40

P-2181. G2/2G ***AD 850 ± 40**

Charcoal, Field Cat No. G2/2G, Cut 2, level 0.90 to 1.05m.

2. Guatemala

San Jeronimo Basin series

All 3 sites in San Jeronimo Basin, Salama Valley, Guatemala (15° 5′ N, 90° 12′ W) (Sedat & Sharer, in press; Sharer & Sedat, 1973; Sedat & Sharer, 1973).

El Porton (Site SV-3)

El Porton is Late Preclassic, ca 300 BC — AD 200, ceremonial center ca 1km W of town of San Jeronimo. Samples coll 1972 by D W Sedat, subm 1973 by R J Sharer, Univ Mus, Univ Pennsylvania.

2260 ± 60
P-2132. EP 1-1.4/10 C.25 ***410 ± 60 BC**

EP 1-1.4/10 C.25, charcoal from under Cache 25 vessel in structure J7-2. *Comments*: NaOH pretreatment. (RJS): cache 25 may be intrusive.

1960 ± 40
P-2133. EP 1-1.4/8 ***AD 30-50 ± 40**

EP 1-1.4/8, charcoal from burned surface in Structure J7-2. *Comment*: NaOH pretreatment.

2300 ± 50
P-2134. EP 1-1.8/10A ***430 ± 50 BC**

EP 1-1.8/10A, charcoal and soil from intrusive trash pit, 330 to 390cm depth, in Structure J7-2. *Comment*: NaOH pretreatment.

2230 ± 60
P-2135. EP 1-1.8/10B ***400 ± 60 BC**

EP 1-1.8/10B, charcoal and soil from intrusive trash pit, 330 to 390cm depth, in Structure J7-2. *Comment*: NaOH pretreatment.

2160 ± 60
P-2136. EP 2-1.3/10 ***380, 330-310, 280-230 ± 60 BC**

EP 2-1.3/10, charcoal and sand from hearth in Structure J7-4, 315 to 335cm depth. *Comment*: NaOH pretreatment. Sample undersized, 85.33%.

2230 ± 60
P-2137. EP 2-1.3/12 ***400 ± 60 BC**

EP 2-1.3/12, charcoal and sand from hearth in Structure J7-4, 360cm depth. *Comment*: NaOH pretreatment.

2320 ± 50
P-2138. EP 2-1.3/7 C.32E ***430 ± 50 BC**

EP 2-1.3/7 C.32E, charcoal and sand from Cache 32E, Structure J7-4. *Comments*: NaOH pretreatment. (RJS): Cache 32E may be intrusive.

Las Tunas (Site SV-15)

Samples from early Middle Preclassic, 900 to 500 BC, ceremonial platform at Las Tunas, ca 4km W of San Jeronimo. Coll 1973 by D W Sedat; subm 1974 by R J Sharer.

2140 ± 70

P-2219. LT 3-2.1/4B ***370-330, 210 ± 70 BC**

LT 3-2.1/4B, charcoal from midden over stairs and plaza surface. Expected date later than P-2220. *Comment*: NaOH pretreatment.

2180 ± 60

P-2220. LT 3-2.1/3B ***390, 290-270 ± 60 BC**

LT 3-2.1/3B, charcoal from fill of stairs, sealed by stairs' construction. Date expected to be earliest in series. *Comment*: NaOH pretreatment.

2020 ± 60

P-2221. LT 1-1.3/5 ***100-60, 40-10 ± 60 BC**

LT 1-1.3/5, charcoal from burned debris on floor. Should date use or abandonment of construction. Date expected to be latest in series. *Comment*: NaOH pretreatment.

2300 ± 50

P-2222. LT 1-1.3/4 ***430 ± 50 BC**

LT 1-1.3/4, charcoal from construction fill, 190 to 200cm depth. *Comment*: NaOH pretreatment.

Los Mangales (Site SV-13)

Samples from Middle Preclassic, ca 900 to 300 BC, burial mound at Los Mangales, ca 1km N of town of San Jeronimo. Coll 1972 by D W Sedat; subm 1973 by R J Sharer.

2290 ± 50

P-2139. LM 5-1/11A and B ***420 ± 50 BC**

LM 5-1/11A and B, charcoal and soil from inside oven, 160 to 200cm depth. *Comment*: NaOH pretreatment.

360 ± 40

P-2140. LM 1-1/3A ***AD 1460-1500 ± 40**

LM 1-1/3A, bone (organic and inorganic fractions) from Burial 6, sealed tumulus.

H. S Pacific

Malo Is, New Hebrides

970 ± 50

P-2087. Batuniurunga ***AD 1010 ± 50**

Charcoal and charred bone from Batuniurunga, Malo Is (15° 45′ S, 167° 10′ E), Location C, NHMa-101-C 1A, Feature 1, a hearth on living floor of house on shell midden. Coll 1973 and subm by J D Hedrick, Dept Anthropol, Univ Pennsylvania. Expected date, AD 1200 (Hedrick, 1971). *Comment*: NaOH pretreatment.

190 ± 30

P-2089. Avunamatala rock shelter ***AD 1650 ± 40**

Charcoal from hearth in Avunamatala rock shelter, Malo Is, NHMa-9, Test Pit A, 0 to 15cm, Feature 1, a hearth at 15cm depth. Site is a dry rock shelter cave. Sample dates end of ceramic sequence at site. Coll

1972 and subm by J D Hedrick. Expected date AD 1200 (Hedrick, 1971). *Comment*: NaOH pretreatment.

I. Far East

Indonesia

Tianko Panjang Cave series

Samples from Tianko Panjang Cave, Sungai Manau kecamatan, Sarko kabupaten, Jambi Province, Sumatra, Indonesia (2° 05′ S, 101° 58′ E). Coll 1973 and subm by Bennet Bronson, Field Mus Nat Hist, Chicago (Bronson *et al,* 1973).

General Comment (BB): all samples except No. 15 from Stratum B, very thick and internally undifferentiated pre-pottery levels underlying sherd-containing Stratum A. Expected dates post-Pleistocene and pre-Metal age.

P-2284. 5 and 6 combined **8940 ± 120**

Sample 5, charcoal from Trench B, Stratum B, Lot 6, 179.5 to 183cm below datum. Sample 6, charcoal from Trench B, Stratum B, Lot 7, 186 to 203cm below datum. *Comment*: date calculated with 5730 half-life, but *not* corrected = 7260 ± 130 BC.

P-2249. 7, 9, and 11 combined **9300 ± 120**

Sample 7, charcoal from Trench B, Stratum B, Lot 8, 206.5 to 210cm below datum. Sample 9, charcoal from Trench B, Stratum B, Lot 8, 208 to 208cm below datum. Sample 11, charcoal from Trench B, Stratum B, Lot 9, 215 to 217cm below datum. *Comment*: date calculated with 5730 half-life, but *not* corrected = 7630 ± 130 BC.

P-2250. 13, 14, and 15 combined **9950 ± 130**

Sample 13, charcoal from Trench B, Stratum B, Lot 10, 222 to 227cm below datum. Sample 14, charcoal from Trench B, Stratum B, Lot 10, 222 to 232cm below datum. Sample 15, charcoal from Trench B, Stratum C, Lot 11, 235 to 248cm below datum. Stratum C should be older than Stratum B. Date for P-2250 expected to be older than P-2249. *Comment*: date calculated with 5730 half-life, but *not* corrected = 8300 ± 140 BC.

J. N Europe

Ireland

Dun Ailinne series

Samples of old sod from Don Ailinne, Knockaulin Townland, Kilcullen, Co Kildare, Ireland (53° 13′ N, 6° 35′ W), Iron age ceremonial site overlying Neolithic remains. Coll 1975 by Bernard Wailes, subm by Kathleen Ryan, Univ Mus, Univ Pennsylvania (Wailes, 1974). For other dates from this site see R, 1973, v 15, p 399-400. For thermoluminescence date from this site, see Carpenter & Ryan (1975).

P-2410. Old sod under small bank at entrance **3490 ± 60**
***2020-2000 ± 60 BC**

Sample 1, Grid Ref 65100 51750, Cutting 64-50, old sod layer covered by small bank at original entrance through bank and ditch enclosing site.

2410 ± 60
P-2411. Old sod under main bank ***640-500 ± 60 BC**

Sample 2, gray soil and iron pan from old sod layer covered by bank enclosing site.

Narraghmore series

Samples from rescue excavation of quarried-out ringfort at Narraghmore, Co Kildare, Ireland (53° 03′ N, 6° 50′ W). Samples from old ground level buried by construction or surrounding bank and ditch, and should pre-date occupation of site. Excavation produced no closely datable finds. Coll 1975 by Thomas Fanning; subm by Kathleen Ryan (Fanning, 1972).

1580 ± 170
P-2412. Old sod below bank ***AD 400 ± 180**

Field Sample 4, soil and charcoal from old sod layer buried by construction of bank and ditch. *Comment*: sample counted in small counter.

1945 ± 60
P-2413. Old sod below bank ***AD 110-130 ± 60**

Field Samples 8 and 9, soil and charcoal from old sod layer buried by construction of bank and ditch.

II. GEOLOGIC SAMPLES

A. N America

1. Canada

Beaufort Sea series

Sediment samples from 2 cores taken in Beaufort Sea > 200km from shore. Core 809 (71° 31′ N, 138° 11′ W). Core 810 (71° 00′ N, 138° 15′ W). Coll 1970 and subm 1975 by G Vilks, Atlantic Geosci Centre, Geol Survey of Canada, Bedford Inst Oceanog.

General Comment: measurements in cm indicate depth below sediment-water interface.

P-2370. Core 810, 1000 to 1075cm **>40,220**

Submitter's Sample H69-050. *Comment*: sample given 7 counts of 1000 mins each. Age limit quoted represents 2 standard deviations of the uncertainties of sample, background and modern calibration sample.

P-2371. Core 809, 675 to 750cm **30,960 $^{+1830}_{-1490}$**

Submitter's Sample H69-809.

P-2372. Core 810, 371 to 460cm **30,280 $^{+1860}_{-1520}$**

Submitter's Sample H69-810.

P-2373. Core 809, 250 to 350cm **33,950 $^{+2340}_{-1810}$**

No sample no. given.

P-2141. Griffith I. **6040 ± 60**
***5000 ± 60 BC**
$\delta^{13}C_w = 10.57‰$

Sample III, collagen extracted from whale bones on raised beach, SH Griffith I., Dist of Franklin, NW Terr, Canada, 22km S of Cornwallis I. (74° 33′ N, 95° 30′ W). Coll 1973 by J G Bockheim and T M Ballard; subm by J G Bockheim, Dept Geol, Univ Pennsylvania.

P-2142. Intrepid Bay **8350 ± 80**
$\delta^{13}C_w = +26.39‰$

Sample I, unid shells from Cornwallis I., Dist Franklin, NW Terr, Canada, 0.5km W of Coal Lakes and 50km N of Resolute (75° 02′ N, 96° 02′ W). Contained in silt and clay, overlying quartzose sand and coal-bearing strata. Sediments have recently been ascribed to late Cretaceous — early Tertiary Eureka Sound formation (Thorsteinsson & Kerr, 1967). Coll 1973 by J G Bockheim and T M Ballard, subm by J G Bockheim. *Comment*: date calculated with 5730 half-life but not corrected = 6650 ± 80 BC.

2. Iceland

P-2367. Icelandic Highlands **>41,900**

Sample of wood buried by volcanic debris from Icelandic Highlands, NW Iceland (66° 10′ N, 23° 22′ W). Subm by Charles Price, Dept Chemistry, Univ Pennsylvania and J D Hallahan.

3. U S A

P-1360. La Porte, Texas **>39,800**

Wood encountered at depth of ca 77m during excavation of water well at La Porte, Texas, plant of I E Dupont Co (29° 42′ N, 95° 02′ W). Coll 1967 by H D Failing, subm 1967 by W Hageman and Froelich Rainey, Univ Mus, Univ Pennsylvania. *Comment*: age limit quoted represents 2 standard deviations of the uncertainties of sample, background and modern calibration sample.

B. Europe

1. Azores

P-2165. San Miguel **4760 ± 60**
***3610 ± 60 BC**

Azores charcoal No. 1 (a), carbonized wood from trees engulfed by latest pumiceous tuff in area, Agua de Pau volcano, San Miguel, Azores (37° 43′ N, 25° 28′ W). Coll 1973 and subm 1974 by J M Ade-Hall,

Dept Geol, Dalhousie Univ (Ade-Hall *et al,* 1974). *Comment*: NaOH pretreatment.

2. Spain

P-2408. Cave of Canet, Majorca **9170 $^{+570}_{-500}$**

Charcoal layer in Trench 1 at 3.10m depth in Cave of Canet, Esporles, Majorca, Spain, 100m S of Palma-Esporles rd at km 14 (39° 36′ N, 6° 18′ E). Sample stratigraphically assoc with travertine layer in Test Trench 4, overlying polarity reversal episode in palaeomagnetic log of that trench. Sample coll 1975 and subm by J S Kopper, C W Post College, Long Island Univ, New York. *Comment* (JSK): date appropriate for Gothenburg polarity reversal episode, 12,000 BP. *Comment*: date calculated with 5730 half-life, but *not* corrected = 7500 +590, −510 BC.

Correction

R, 1975, v 17, p 205: P-2029, *MASCA* corrected date should be 4380 ± 90 BC.

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PHYSICAL RESEARCH LABORATORY RADIOCARBON DATE LIST II

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Presented below are dates from some important archaeologic and Quaternary sites. For the first time, a large number of dates have been reported here on the eustatic changes on the Eastern Indian coast. All dates are based on $\tau_{1/2} = 5568$ yr; to convert the radiocarbon dates for archaeological samples into AD/BC scale, 1950 has been used as base year as per resolution passed at the Ninth International Radiocarbon Conference, San Diego, 1976. The dates are not corrected for ^{13}C fractionation.

Samples were converted to methane for measuring ^{14}C activity in gas proportional counters. Detailed techniques were described earlier (R, 1971, v 13, p 442-449). All archaeologic samples were given NaOH pretreatment.

General Comment: 3 dates from Rajpura Dariba indicate that copper mines were being exploited even before the 1st millennium BC (PRL-208-210). PRL-220 and -221 confirm that the Jorwe culture extended up to the 1st millennium BC. Early dates from Koldihawa (PRL-224) and Bateshwar (PRL-200) probably indicate some unknown basal cultures in these regions.

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SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

PRL-186. Aligrama, Pakistan, Swat Protohistoric Vth period **3070 ± 230**

Charcoal from Aligrama (34° 49′ N, 72° 19′ E), Dist Swat, Loc Tr E, Layer 5b, depth 3.4m; subm by G Stacul, Trieste Univ, Italy.

Amaravati series, Andhra Pradesh

Amaravati (16° 34′ N, 80° 17′ E), a Buddhist site, Dist Guntur; subm by Dir Gen Archaeol, New Delhi.

PRL-157. Northern Black Polished Ware (NBP) deposits (?) **1700 ± 100**

Charcoal, Loc Tr YA-1/3, Layer 10A, depth 4.2m.

PRL-158. NBP deposits (?) **1880 ± 100**

Charcoal, Loc Tr YA-4/3, Layer 12, depth 3.7m.

PRL-165. Habitational layer coeval with early level of the Maha Stupa **1820 ± 130**
Charcoal, Loc Tr YA-3/3, Layer 10, depth 4.2m.

PRL-160. Early phase of Stupa complex **1900 ± 100**
Charcoal, Loc Tr YA-3/2, Layer 10, depth 3.6m.

PRL-162. Early level of the stupa **1950 ± 130**
Charcoal, Loc Tr YA-1/2, Layer 11, depth 4.1m.

PRL-53. Ambamata, India, old copper working **2050 ± 200**
Timber from ancient mine near Ambamata (24° 20′ N, 72° 51′ E), Dist Banaskantha, depth 70m. Coll by N C Shekar; subm by Dir, Min Expl Corp Ltd, Ambaji.

Banawali Sottar series, Haryana

Banawali Sottar, Dist Hissar, a Harappan site; subm by Dir Archaeol, Haryana, Chandigarh.

PRL-207. Harappa culture **3100 ± 100**
Charred grains, Loc Tr ZC2, Layer 6, depth .5 to .6m.

PRL-204. Harappa culture **3260 ± 120**
Charcoal, Loc Tr. ZB1, Layer 10, depth 1.1 to 1.3m.

PRL-203. Harappa culture **3800 ± 150**
Charcoal, Loc Tr ZB1, Layer 12, depth 1.3 to 1.6m.

PRL-205. Harappa culture **3810 ± 180**
Charcoal, Loc Tr ZB1, Layer 14, depth 1.7m.

Bateshwar series, Uttar Pradesh

Bateshwar, Dist Agra, subm by Dir Gen Archaeol, New Delhi. *Comment*: dates show an erratic scatter indicative of stratigraphic disturbance.

PRL-197. Sunga levels **2410 ± 100**
Charcoal, Loc Tr BTR1 A1 Qd 1, Layer 14, depth 4.7m, Field BTR 1/3.

PRL-199. Mauryan levels **590 ± 130**
Charcoal, Loc Tr BTR2 A2, Qd 4, Layer 7A, depth 3m, Field BTR 2/6.

PRL-198. Black and Red Ware (BRW) and Painted Grey Ware (PGW) levels **2490 ± 90**
Charcoal, Loc Tr BTR1 A2, Qd 3, Layer 19, depth 6.6m, Field BTR 1/5.

PRL-200. Transitional phase **5130 ± 240**
Charcoal, Loc Tr BTR2 AW, Qd 4, Layer 8, depth 3.1m, Field BTR 2/7.

PRL-201. Sunga levels **2520 ± 160**

Charcoal, Loc Tr BTR1 A2, Qd 1, Layer 11, depth 4.2m, Field BTR 1/2.

Bharatpur series, West Bengal

Bharatpur (23° 24′ N, 87° 27′ E), Dist Burdwan; subm by Dir Gen, Archaeol, New Delhi. Samples date Chalcolithic levels.

PRL-187. Chalcolithic culture **3040 ± 150**

Charcoal, Loc Tr BRP-1/74 F3, Qd 3, Layer 6, depth 1.9m.

PRL-188A. Chalcolithic culture **2770 ± 140**

Charcoal, Loc Tr BRP-1/74 B3 Qd 1, hearth sealed by Layer 9, depth 2.4m.

Jodhpura series, Rajasthan

Jodhpura (27° 31′ N, 76° 5′ E), Dist Jaipur. Coll by Vijai Kumar, subm by Dir Archaeol and Mus, Rajasthan, Jaipur. Samples date BRW and PGW deposits.

PRL-212. BRW and PGW deposits **2270 ± 100**

Charcoal, Tr D, Layer 9, depth 2.6m.

PRL-213. PGW deposits **2210 ± 110**

Charcoal, Tr E, Layer 7, depth 3.5m.

Khed series, Maharashtra

Khed (18° 20′ N, 74° 50′ E), Dist Ahmednagar, a Jorwe culture site, coll by P Narayana Babu, subm by Dir Deccan College, Poona.

PRL-220. Jorwe culture **2900 ± 160**

Charcoal, Tr KHD-1, Layer 18, depth 2.2m.

PRL-221. Jorwe culture **3040 ± 90**

Charcoal, Tr KHD-1, Layer 7A, depth .9m.

Koldihawa series, Uttar Pradesh

Koldihawa (24° 54′ N, 82° 2′ E), Dist Allahabad; subm by G R Sharma, Allahabad Univ, Allahabad.

PRL-223. Transitional phase from Neolithic to Chalcolithic **3300 ± 120**

Charcoal, Loc Tr KDW-II/Z1, Layers 3 and 4, depth .6 to .9m, Field AU/ALD/KDW-II(DGT)/75-15.

PRL-224. Iron age deposits (?) **8280 ± 210**

Charcoal, Loc Tr KDW-II/Z1, Layer Z1/KM, debris sealed by 1, depth .2 to .4m, Field AU/ALD/KDW-II(DGT)/75-16. *Comment*: sample perhaps represents an earlier phase, compare PRL-100 and -101.

PRL-227. Iron age deposits **2050 ± 110**

Charcoal, Loc Tr KDW-I/E3, Layer E3/KM-VII, Depth .48 to .6m, Field AU/ALD/KDW-I(DGT)/75-20.

Rajpura Dariba series, Rajasthan

Rajpura Dariba (24° 57′ N, 74° 8′ E), ancient mining area, Dist Udaipur; subm by U S Khamesra, Hind Zinc Ltd, Dariba.

PRL-208a. Wood **2140 ± 100**

Wood from E Lode old working, depth 4 to 5m.

PRL-209. Wood **1790 ± 120**

Wood from E Lode old working, depth 263m.

PRL-210. Wood **3040 ± 150**

Wood from Main Lode old working, depth 100m.

PRL-190. Sanghao cave, Pakistan, cave deposits **210 ± 140**

Charcoal from Sanghao cave (34° 28′ N, 72° 12′ E), Loc Tr 1963 E sec, Layer 9, depth 3.6m; subm by Mohmmad Salim, Inst Archaeol, London. *Comment*: sample may merely represent a recent shepherd's fire.

Ulu Leang 1 Cave series, Indonesia

Ulu Leang 1 cave (5° S, 119° 40″ E) a Late Stone age site, Dist Maros; subm by I C Glover, Inst Archaeol, London.

PRL-230. Late Toalian culture **3550 ± 130**

Charcoal, Tr C2, Layer 2, depth .1 to .2m.

PRL-231. Late Toalian culture **4390 ± 110**

Charcoal, Tr C2, Layer 3, depth .2 to .3m.

II. QUATERNARY SAMPLES

PRL-147. Ankleshwar, India, R terrace deposit **68.68 ± 2.05 % modern**

Lime caliche from upper terrace on R Narmada W of Ankleshwar, Dist Broach, coll by N Bedi; subm by Dir Geol, Ahmedabad. *Comment*: caliche is not a well understood material for dating, hence expressed as % modern.

PRL-136. Antisara, India, fluvial deposit **2890 ± 120**

Wood from a pile of channel-fill sediment at Antisara quarry (23° 49′ N, 88° 1′ E), Dist Hooghly, depth 9m; subm by Dir Geochron Isotope Geol Div, Calcutta.

PRL-88. Badalpur, India, oyster bed **24,300 $^{+1700}_{-1400}$**

Shells from Oyster bed along old channel of R Saraswati near Badalpur (20° 53′ N, 70° 29′ E), alt +8.43m, Dist Junagadh; subm by S N

Rajaguru, Deccan College, Poona. *Comment*: sample measured to date eustatic changes in the area.

PRL-44. Browns Creek, Australia, coastal sediments **a) 560 ± 95** **b) 300 ± 120**

Aragonite shells from boulder bed rising 1m above the beach NE side of mouth of Browns Creek, Otway Hills, Victoria, Sample 13/1972. Subm by E D Gill, Nat Mus Victoria, Melbourne. *Comment*: fraction a is CO_2 evolved from outer shell and fraction b from core.

Coastal sediment series, India

Samples coll by A V N Sharma, Temple Univ, Philadelphia; subm by Dir Gen, Archaeol, New Delhi.

General Comment: samples were measured to date sea-level changes on E coast of India between Madras and Cape Comorin.

PRL-58. Cape Comorin, coastal sediments **33,300 $^{+2500}_{-1900}$**

Corals from Cape Comorin (8° 4′ N, 77° 32′ E), Dist Kanyakumari, alt +6m.

PRL-115. Illankalanvadi, coastal sediments **4200 ± 100**

Lagoon shells from Illankalanvadi (8° 5′ N, 77° 32′ E), Dist Kanyakumari, alt +5m.

PRL-118. Chinna Nattathi, coastal sediments **>40,000**

Lagoon shells from Chinna Nattathi (8° 38′ N, 78° 1′ E), Dist. Tirunelveli, alt +11m.

PRL-119. Pandiya Tivu, coastal sediments **1020 ± 80**

Coral from Pandiya Tivu (old Hare's I.) (8° 45′ N, 78° 13′ E), alt +3m.

PRL-121. Tuticorin Harbour, coastal sediments **28,400 $^{+2600}_{-1900}$**

Marine shells from Tuticorin New Harbour (8° 44′ N, 78° 13′ E), Dist Tirunelveli, Borehole Z, alt −11.6m.

PRL-122. Tuticorin Harbour, coastal sediments **>40,000**

Lime stone with shells from Borehole L, alt −12.7m.

PRL-123. Tuticorin Harbour, coastal sediments **32,100 $^{+2100}_{-1700}$**

Calcareous material from Borehole B, alt −11.4m.

PRL-124. Dubash Chetti, coastal sediments **5310 ± 110**

Marine shells from Dubash Chetti (8° 50′ N, 78° 8′ E), Dist Tirunelveli, 4km inland and 5.6km N of Tuticorin, alt +6m.

PRL-125. Dubash Chetti, coastal sediments **5550 ± 280**

Marine shells alt +3m.

PRL-126. Kamarajapuram, coastal sediments **2710 ± 150**

Lagoon shells from Kamarajapuram (8° 41′ N, 78° 6′ E), Dist Tirunelveli, 4km inland, alt +6m.

PRL-127. Surangadu, coastal sediments **420 ± 140**

Shells from Surangadu (8° 42′ N, 78° 7′ E), Dist Tirunelveli, alt +3m.

PRL-128. Korkai, coastal sediments **3710 ± 100**

Shells from Korkai (8° 38′ N, 78° 4′ E), Dist Tirunelveli, 8km inland, alt +6.5m.

PRL-129. Ayyaniruppu, coastal sediments **22,100 $^{+1100}_{-1000}$**

Shells from Ayyaniruppu (8° 46′ N, 78° 5′ E), Dist Tirunelveli, 9km inland, alt +7m.

PRL-130. Pudukkottai, coastal sediments **29,050 $^{+3500}_{-2400}$**

Lagoon shells from Pudukkottai tank (8° 44′ N, 78° 4′ E), a swampy edge on Sawayerpuram rd, Dist Tirunelveli, 16km inland, alt +14m.

Continental shelf series, W India

Corals from continental shelf off Bombay; subm by R R Nair, Nat Inst Oceanog (NIO), Panaji. *Comment*: samples measured to date sea-level changes on W continental shelf.

PRL-153. Continental shelf sediments **8700 ± 190**

Oolitic limestone from continental shelf floor obtained by dredging off Bombay (19° 30′ N, 70° 34′ E), water depth 82m, sender's Sample 49-08.

PRL-154. Continental shelf sediments **11,010 ± 240**

Oolite concentrate from continental shelf floor obtained by grabbing off Bombay (19° N, 70° 15′ E), water depth 80m, sender's Sample 51-10.

PRL-155. Continental shelf sediments **10,100 ± 230**

Oolite concentrate from continental shelf floor obtained by grabbing off Kathiawar (24° N, 69° 41′ E), water depth 65m, sender's Sample 43-04.

PRL-156. Continental shelf sediments **9670 ± 160**

Oolite concentrate from continental shelf floor obtained by grabbing off Kathiawar (19° 58′ N, 70° 46′ E), water depth 80m, sender's Sample 47-08.

PRL-75. Dahanu, India, raised beach **3540 ± 120**

Shells from raised beach, alt +5 to +6m near Dahanu (19° 59′ N, 72° 44′ E), Maharashtra; subm by Bridget Allchin, Cambridge, UK to study sea-level changes in W India.

PRL-143. Dhamner, India, R sediment **10,130 ± 250**

Shells from Dhamner, Dist Satara, 7 to 10m above bed level of R Krishna, Field No. 1; subm by S N Rajaguru, Deccan College, Poona. *Comment*: sample measured to study Late Quaternary fluvial activity of R Krishna. Deposit yielded few rolled chalcedony Middle Palaeolithic flakes.

PRL-86. Deoghat, India, cemented gravel III **$25{,}070^{+810}_{-730}$**

Shells from cemented gravel III near Deoghat on R Belan (24° 54′ N, 82° 2′ E), Dist Allahabad; subm by G R Sharma, Allahabad Univ, Allahabad.

Geneva Lake series, lake sediments

Samples from drill core, 1.44m length, subm by V N Nijampurkar, PRL, Ahmedabad to study sedimentation rate in Geneva Lake, Switzerland.

Sample	Core depth (m)	Date
PRL-31	.3	12,120 ± 215
PRL-32	.3 to .56	13,330 ± 230
PRL-33	.56 to .9	7,010 ± 110
PRL-34	.9 to 1.2	15,440 ± 265
PRL-35	1.2 to 1.44	13,240 ± 195

PRL-79. Kaldevanhalli, India, pebble conglomerate **1560 ± 120**

Shells from a pebbly conglomerate bed exposed along nullah cliff sec near Kaldevanhalli (16° 29′ N, 76° 33′ E), Dist. Gulbarga, depth 3 to 4m. Coll by K Paddayya, subm by Dir Deccan Coll, Poona. Conglomerate yielded Middle Stone age artifacts.

PRL-152. Katral Hill, India, Miliolite deposit **$24{,}600^{+3200}_{-2500}$**

Miliolite shells from Katral Hill, Dist Kutch, 13km from Bhuj Mandvi Rd, alt +137m, Field No. 11/94, depth 15m; subm by S K Biswas, Oil Nat Gas Comm, Baroda. *Comment*: date indicates Late Pleistocene origin of miliolite rocks.

Kavaratti Atoll series, India

Kavaratti Atoll (10° 33′ N, 72° 36′ E), Laccadive I., coll by V N Sankaranarayanan; subm by R R Nair, Nat Inst Oceanog, Goa. *Comment*: samples measured to date atoll formation.

PRL-71. Atoll formation **2585 ± 110**

Algal and coral limestone from atoll formation, alt +5m.

PRL-72. Atoll formation **2130 ± 130**

Algal and coral limestone from atoll formation, alt +5m.

PRL-73. Atoll formation **2740 ± 130**

Algal and coral limestone from atoll formation, alt +5m.

PRL-74. Atoll formation **1830 ± 140**

Algal and coral limestone from atoll formation, alt +5m.

PRL-218. Khimeshwar Temple, India, oyster bed **37,400 $^{+11800}_{-4600}$**

Lamellibranch shells from oyster bed, 1.5km N 75° E of temple of Kunchhidi (21° 40′ N, 69° 33′ E), Dist Junagadh, alt +2m, underlies 1m thick recent R clays; subm by U B Mathur. *Comment*: sample dated to study eustatic rise in sea level.

PRL-238. Kolara, India, R Terrace **1660 ± 110**

Peaty clay from R Terrace near Kolara (22° 30′ N, 88° 30′ E), Dist Howrah, depth 2.6m; subm by H P Gupta, Birbal Sahni Inst Palaeobot, Lucknow. *Comment*: samples were dated to study possible subsidence of forest in Bengal basin.

PRL-217. Odador, India, marine deposit **>40,000**

Coralline limestone 3km SE of Odador (21° 34′ N, 69° 40′ E), Dist, Junagadh, alt +3m, overlain by 4m thick aeolinite deposit, subm by U B Mathur, Geol Survey India, Jaipur. *Comment*: sample dated to study strand line.

PRL-148. Pardi, India, R terrace **50.2 ± 0.7 % modern**

Caliche from upper terrace on R Narmada at Pardi, Dist Broach, Field No. GSI/NB/5, depth 2.5m; subm by N Bedi, Geol Survey, Ahmedabad.

PRL-60. Vembanad, India, lake sediment **8385 ± 135**

Decayed wood from Vembanad Lake, Dist Kottayam, depth 25.9m below lake bed, Field 278, subm by P S N Murty. NaOH pretreatment. *Comment*: sample measured to compute sedimentation rate in lake.

PRL-21. Vishakapatanam, India, continental shelf **13,690 $^{+300}_{-330}$**

$CaCO_3$ from 1m drill core off Vishakapatanam (17° 2′ N, 83° 3′ E), water depth 206m, Field 452; subm by P S N Murty. *Comment*: sample measured to date terrigenous sediment deposition on slope region.

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[RADIOCARBON, VOL. 19, No. 2, 1977, P. 237-244]

QUEENS COLLEGE RADIOCARBON MEASUREMENTS II

R PARDI

Radiocarbon Laboratory, Queens College, City University of New York
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This list contains all analysis completed since the first list (R, 1975, v 18, p 205).

Synthesis and counting are essentially the same as before except that the computer programs now employed reject sample counting intervals that fall $> 2.5\sigma$ from the mean.

Samples submitted for analysis are reviewed by a Committee consisting of W DeBoer, P Tolstoy, Anthropology, L Marcus, Biology, W S Newman, Earth and Environmental Sciences, and R Pardi, Radiocarbon Laboratory.

All results are based on the conventional half-life for ^{14}C, *ie*, 5568 ± 30 years. Results are reported in years before 1950. Errors are 1 σ, based on the combined statistical counting error of the sample, background and standard. $^{13}C/^{12}C$ measurements and corrections have not been made for these samples.

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Sue Coughlin, Don Haarmann, and Linda Kaplan assisted in sample preparation and compiling this list. The continued support and encouragement of David H Speidel is greatly appreciated. I am indebted to L Marcus for his assistance with the computer programming.

I. GEOLOGIC SAMPLES

QC-122. USAF Montauk 1 — 12,290 ± 115

Peaty clay from modern bluff, US Air Force Stat, Montauk Point, New York (41° 03′ N, 71° 52′ W), alt ca 1m MHW. Coll and subm by W S Newman, Queens Coll, CUNY, Flushing, New York. Date on acid-washed organic fragments of > 40 mesh. *Comment* (WSN): proglacial (?) lacustrine deposit above Montauk till and near base of overlying stratified drift. Top of sec includes some till lenses believed to be Late Wisconsin in age. Previous date on log from nearby locality, RL-318: 38,800 +5600/−3200.

Great Bear Swamp series

Peat from Great Bear swamp, central Albany Co, New York (42° 28′ N, 74° 03′ W) alt ca 366m (*cf*, Connally and Sirkin, 1971). Coll and subm by R J Dineen, New York State Geol Survey, Albany, New York. HCl pretreatment only.

General Comment (RJD): upland swamp, dammed by glacial debris.

QC-148. 1, 150 to 170cm — 4000 ± 100

Comment (RJD): dates middle or early Pine Zone development in this area. Sample was pooled from 2 cores at layer 150 to 170cm. Possible contamination by root penetration.

QC-149. 2, 316 to 340cm **11,590 ± 265**

Sample diluted with "dead" benzene. *Comment* (RJD): dates postglacial lake that occupied Great Bear Swamp depression after ice retreated N to lowlands. Sample pooled from 2 cores at layer 326 to 340cm. Possible contamination by root penetration.

QC-153. Norfolk 5d **11,230 ± 200**

Shells of small pelycepod from glacial Champlain Sea, St Lawrence Lowland, Winnowed Till Sec, NE of Norfolk, New York (44° 51′ N, 74° 52′ W), alt 88m, depth 1.5m. Coll and subm by D R Coates, Dept Geol Sci, SUNY at Binghamton, New York. *Comment* (DRC): from beach and strandline-type deposits with sandy matrix. Previous dates on Champlain Sea samples from Brock: 10,340 ± 130, 11,000 ± 150 and 12,000 ± 200.

QC-154. Gay Head **23,900 ± 450**

Wood-charcoal from Gay Head—central S-side, mouth of Devil's den, Martha's Vineyard, Massachusetts (41° 21′ N, 70° 51′ W). Coll and subm by C Kaye, US Geol Survey, 80 Broad St, Boston, Massachusetts. *Comments* (CK): lignitized wood or fusain from shear plane in Cretaceous white clayey sand. (RRP): previous date on material from same locality coll by RRP, GX-3000: 23,900 +2200/—1700.

QC-159. Cape Cod 1 **1) >44,000** **2) >43,000**

Wood from just NE of Highland Light, N Thuro quad, Massachusetts (40° 2′ 30″ N, 70° 3′ 40″ W), approx alt 11m ASL, depth ca 26m below surface. Coll and subm by J H Hartshorn, Dept Geol/Geog, Univ Massachusetts, Amherst, Massachusetts. *Comments*: sample treated with 5% NaOH. (JHH): wood is not *in situ*. Estimated age at least 35,000 yr BP, based on previous dates in area and stratigraphic considerations.

QC-162. Mal 28-70 **3400 ± 125**

Shell from esker resting on till, Malaspina glacier (59° 47′ N, 140° 10′ W), ca 23m ASL. *Comment* (JHH): in 1951 the esker was just beginning to emerge from beneath ice. Shells date from ice recession when sea was far N of present limits. Readvance incorporated shells first in till and then in meltwater stream gravels.

Deep sea core series

Carbonate fraction of deep sea cores V30-97 (41° 00′ N, 32° 55.5′ W), V22-82 (00° 32.5′ S, 17° 16′ W), subm by A McIntyre, Lamont-Doherty Geol Observatory, Palisades, New York. All samples were diluted with "dead" benzene.

QC-198. V30-97, 63.5 to 71.5cm **16,360 ± 220**

Ca 53% $CaCO_3$.

QC-215. V22-182, 85 to 89cm **21,000 ± 770**

Ca 95% $CaCO_3$.

QC-216. V22-182, 45 to 49cm **12,710 ± 190**

Ca 82% $CaCO_3$.

Pt Peron series

QC-191.A Pt Peron **4115 ± 105**

QC-191.C Pt Peron **3910 ± 125**

Mixed gastropods and fragments from Pt Peron, W Australia (32° S, 116° E), alt 4.5m above LWL. Coll and subm by R Fairbridge, Columbia Univ, New York. A: whole shell and fragments of whelk and cone gastropods, C: 3 large horn gastropods.

Leit's Beach, Victoria series

Shells from Leit's Beach, Victoria (38° S, 148° E). Coll by R Ward and R Fairbridge. Subm by R Fairbridge.

QC-192. Seacombe 2 **100.4 ± 1.0%**

Modern beach shells.

QC-193. Leit's Beach 3 **475 ± 90**

Pelycepod shells from midden 4.5 to 6m above beach.

QC-194. Dune Causeway 4 **1750 ± 130**

Shell midden from inner margin of fore dunes. Same pelycepod species as QC-192 & -193.

QC-195. Lagoon 6 **5980 ± 165**

Snail and clam shells from outcrop at high tide level.

Champlain Sea series

Shells from glacial Champlain Sea, NE New York State. Coll and subm by T M Cronin, Mus Comparative Zool, Harvard Univ, Cambridge, Massachusetts.

General Comment (TMC): both species could inhabit brackish water down to 5ppt.

QC-199. T C 92 **10,300 ± 180**

Mya arenaria shell, Beekmantown, New York (44° 47′ N, 73° 6′ W), alt 40m ASL. *Comment* (TMC): date indicates deposition near end of Late Pleistocene from sea (see Hillaire-Marcel, 1974, for a list of Canadian dates). Youngest date yet recorded for New York State (*cf,* W-1109: 10,560 ± 350, Ives *et al,* 1964) and 2nd youngest date from Champlain Valley (*cf* I-4695: 9620 ± 350, from West Bridgport, Vermont, Wasner, 1972). Most significantly, date demonstrates existence of *Mya arenaria* phase (Elson, 1969) of the sea of New York and also that *Mya* phase deposits are correlative, based on alt ASL and fauna, with deposits in Quebec that yield similar faunas and late Champlain Sea ages (*cf,* Elson, 1962, GrN-2032: 10,450 ± 80, GrN-2031: 10,870 ± 100, GrN-2034: 10,590 ± 100, all

Mya phase ages). Alt, in addition to shell date, indicates deposition at very end of Champlain Sea, just before water level regressed to present level of Lake Champlain (29m ASL). The foraminiferan, ostracode and molluscan faunas suggest brackish, subfrigid to cold temperate water conditions.

QC-200. T C 26 **11,665 ± 175**

Shell *Macoma balthica,* Plattsburgh, New York (44° 40′ N, 73° 26′ W), alt 78 to 81m ASL. *Comment* (TMC): oldest date yet obtained for Champlain Sea in USA and indicates deposition early in marine episode. Other US Champlain Sea dates are QC-153: 11,225 ± 200, Wasner, 1972, W-2311: 11,420 ± 350, I-3647: 11,230 ± 170. These date early stages of sea. Older shell dates from Canada are Gadd *et al,* 1972, GSC-1533: 12,400 ± 160, MacDonald, 1968, GSC-936: 12,000 ± 200, Lowdon *et al,* 1967, GSC-505: 11,880 ± 180. This date, along with 2 others from New York, suggest the following history for sea in Champlain Valley: rapid inundation almost immediately reaching maximum extent, gradual regression due to isostatic crustal rebound, eventual termination of marine episode as connection to marine water source closed. Three dates, all from samples located only a few km from one another but at different alts, document this history: QC-200: 11,665 ±175, alt 79m ASL, W-1109: 10,560 ± 350, alt 55m ASL, QC-199: 10,300 ± 180, alt 40m ASL.

II. ARCHAEOLOGIC SAMPLES

Hudson River series

Charcoals from Hudson River Archaic sites, subm by L A Brennan, Briarcliff College, Ossining, New York.

5325 ± 110

QC-111. #11 **3375 BC**

Firepit #4, Pear tree loc, Haverstraw quad (41° 10′ N, 73° 52′ W), alt ca 12m, depth ca 90cm. Coll by LAB. *Comment* (LAB): dates early use of this loc where middens are extensive (*cf,* QC-109-110, R, 1976, 18, p 205-209).

4425 ± 110

QC-115. Kemey's Cove **2475 BC**

Hearth, Kemey's Cove, Haverstraw quad (41° 08′ N, 73° 52′ W), alt ca 3m, depth ca 55cm. Coll by R Wingerson. *Comment* (LAB): sample from salvage dig, hearth was below shell midden, Taconic points were found at this level.

605 ± 90

QC-132. Shantok Cove site **AD 1395**

Charcoal from hearth-pit (41° 28′ 50″ N, 72° 04′ 38″ W), alt ca 6m, depth 51 to 69cm below surface. Coll and subm by J Vetter, Dept Anthropol, Adelphi Univ, Garden City, New York. *Comment* (JV): hearth-pit was located in a "living area" adjacent to a small midden. Previous

dates from site from Isotopes, 845 ± 125, 1035 ± 150, 1110 ± 95, 1190 ± 115.

Indian Canyon 35WHB(IC-2) series

Wood charcoal and scorched wood from Indian Canyon, NW Wheeler Co., Oregon (44′ 56′ 12″ N, 120° 24′ 05″ W). Coll and subm by B L Gannon, Portland State Univ, Dept Earth Sci, Portland, Oregon.

General Comment (BLG): samples from fluvial terrace of E-facing canyon cliff. Should date occupational horizon of a "campsite" (food and tool preparation site) as well as truncation of fluvial strata.

QC-135. /rc-3 **1460 ± 100 AD 490**

Alt ca 7m, depth 1.1m. *Comment* (BLG): sample was expected to be older than IC-2/rc-2 from adjacent occupational area with vague stratigraphic relations dated Gak-3866: 570 ± 80.

QC-137. /rc-4 **1545 ± 100 AD 405**

Alt ca 6.9 to 7m, depth 1.6 to 1.75m. *Comment* (BLG): age should approx IC-2/rc-3.

Jones Canyon 35WH21(IC-2) series

Wood choarcoal from Jones Canyon, NW Wheeler Co, Oregon (44° 55′ 10″ N, 120° 14′ 30″ W). Coll and subm by B L Gannon. *Comment* (BLG): samples define limits of occupational horizon in House Pits #1 and 2 in alluvial fan truncated by a now-epemeral stream.

QC-134. /rc-2 House Pit #2 **875 ± 115 AD 1075**

Comment (BLG): previous date from neighboring House Pit #1 Gak-3867: 360 ± 80. Artifact difference suggests different age.

QC-138. /rc-3 House Pit #2 **390 ± 65 AD 1560**

QC-136. /rc-4 House Pit #1 **300 ± 75 AD 1650**

QC-163. 15 **2920 ± 115 970 BC**

Charcoal from Feature Pit 23 site of Coapexco, Edo de Mexico, Mexico (19° 7′ 32″ N, 98° 46′ 45″ W) alt 2600m, depth 0.85m below surface. Coll and subm by P Tolstoy. *Comment* (PT): estimated age ca 1150 BC, date later within Ixtapalucas phase (1200 BC-950 BC radiocarbon age) than expected. Date acceptable and interpretable as occupation of Coapexco lasted beyond time interval defined, EH-2 (Tolstoy, in press; 1975). EH-2 contemporaneous with Ayotla sub-phase at site Ayotla-Tlapacoya (Tolstoy & Paradis, 1970). Samples between 2nd and 3rd trampled floors near F Pit 23 were dated 1180 ± 160 BC in 1972 within EH-2.

West Northumberland Canyon series

Charcoal from Triple T Shelter, W Northumberland Canyon, Nye Co, Nevada (39° 00′ N, 116° 55′ W) alt 2073m. Coll and subm by D H Thomas, Am Mus Nat Hist, Dept Anthropol, New York, New York. *General Comment* (DHT): similar silt/living floor sequence as Gatecliff Shelter, central Nevada.

QC-167. 427 — **920 ± 105** / **AD 1030**

Unit D5, depth 10 to 20cm. *Comment* (DHT): estimated age later than AD 1300, based on cultural assoc.

QC-168. 432 — **1) 4320 ± 90** / **2370 BC** / **2) 4880 ± 120** / **2930 BC**

Unit C5, depth 170 to 180cm. *Comment* (DHT): estimated age older than 1500 BC, based on cultural assoc.

QC-169. 415 — **5000 ± 170** / **3050 BC**

Unit B4, depth 200 to 210cm. *Comment* (DHT): estimated age older than 1500 BC, based on cultural assoc.

QC-170. 443 — **6340 ± 160** / **4390 BC**

Unit B5, depth 360 to 370cm. Sample diluted with "dead" benzene. *Comment* (DHT): estimated age should be oldest date in series based on stratigraphy.

QC-171. 422 — **3720 ± 95** / **1770 BC**

Unit C5, depth 110 to 120cm. *Comment* (DHT): estimated age ca 1500 BC, based on cultural assoc.

QC-172. 431 — **1) 2700 ± 105** / **750 BC** / **2) 3030 ± 110** / **1080 BC**

Unit C4, depth 100 to 110cm. *Comment* (DHT): estimated age 100 BC to AD 500, based on cultural assoc.

QC-173. Calvary Cemetery — **180 ± 130** / **AD 1770**

Shell fragments (*Ostrea virginica* and *Venus mercenaria*) from Woodside, New York (40° 44′ N, 74° 56′ W). Coll and subm by S Coughlin, Dept Earth & Environmental Sci, Queens Coll, Flushing, New York. *Comment* (SPC): sample possibly from a Colonial period midden exposed during excavation.

Ostego County series

Hearth charcoal from Russ site, Ostego Co, New York (42° 21′ 57″ N, 75° 15′ 7″ W), alt 319m, depth 25cm. Coll and subm by R E Funk, New York State Mus & Sci Service, Albany, New York.

General Comment (REF): flood plain of upper Susquehanna R, base of plow zone, intrusive into silt.

QC-176. B **4350 ± 170**
2400 BC

From Feature 30, Sec Eos39, Loc 2. *Comment* (REF): estimated age 1800 to 1900 BC, based on assocs on other upper Susquehanna sites.

QC-177. C **4050 ± 190**
2100 BC

From Feature 1, Sec E953, Loc 1. Sample diluted with "dead" benzene. *Comment* (REF): estimated age 3000 to 4000 BC.

Hansanlu Tepe series

Charcoal from Iron age site (37° 01′ N, 45° 28′ E), Azerbaigan, NW Iran, near town of Nazadeh. Samples from roofbeam of collapsed Iron age buildings of Period IVB. Coll and subm by L Winter, Dept Art, Queens Coll.

QC-183. 18A **2965 ± 165**
Bldg IVE **1015 BC**

QC-184. 44A **1) 2965 ± 105**
Bldg IVV **1015 BC**
2) 2950 ± 90
1000 BC

QC-185. 60A **3050 ± 110**
Bldg V **1100 BC**

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[RADIOCARBON, VOL. 19, No. 2, 1977, P. 245-262]

RADIOCARBON, LTD NATURAL RADIOCARBON MEASUREMENTS II

CHARLES S TUCEK

Radiocarbon, Ltd, Lampasas, Texas 76550

Radiocarbon, Ltd moved its laboratory facilities from Spring Valley, New York to Lampasas, Texas in the summer of 1974. This date list represents all results obtained at the Spring Valley location for which sample data have been received, and which have not been reported previously.

Sample preparation techniques and CO_2 counting procedures remain as previously reported (R, 1971, v 13, p 74). In July 1972 we began benzene counting as well as CO_2 counting. CO_2 is converted to benzene following the procedure of Noakes *et al* (1966) and scintillation counting is done with a Picker Nuclear Liquimat, optimized for low-level counting. Many samples were counted both as CO_2 and as benzene, while the benzene synthesis technique was being perfected. The data obtained (Table 1) indicate good agreement between the 2 methods.

Samples are listed in chronologic order of preparation; relatively poor data for the 1st 10 samples are a reflection of the learning process in synthesizing benzene. It is interesting that good concordance in the 2nd group of samples is achieved even though % benzene yield is quite variable, and relatively low at times. Following these cross-check samples, 57 samples were run strictly as benzene, the average yield being 76 ± 4%.

All samples described below report dates by CO_2 counting, except for RL-221, -222, -223, -298, -300, -302, -310, -318, and -322, which were obtained by benzene counting.

Age calculations are based on ^{14}C half-life of 5570 years, using 0.95 NBS oxalic acid as the modern value. Errors are based on counting statistics, and for finite ages are quoted to ± 1σ; for samples approaching the modern or background value, 2σ limits are used.

ACKNOWLEDGMENTS

We are grateful to John Noakes, University of Georgia, and to Don Kearns, Applied Science Technology, Inc, for their help in setting up the benzene operation. We also acknowledge cooperation of our clients who have supplied the sample descriptions and authorized their use, together with the results.

SAMPLE DESCRIPTIONS

I. ARCHAEOLOGIC SAMPLES

A. Alaska

RL-402. Ester Creek, Alaska **>35,500**

Ivory from mammoth tusk from Ester Creek; 16km W of Fairbanks, Alaska (ca 65° N, 145° W), from base of ca 32m frozen, wind-deposited loess, atop 10m alluvial gravels, assoc with many Pleistocene remains.

TABLE 1
CO_2–Benzene Cross-Check Samples

Sample no.	CO_2 date	Benzene date	Results overlap within	Benzene yield (%)
RL-174	4540 ± 110	4700 ± 250	1 σ	—
RL-168	10,140 ± 170	9720 ± 720	1 σ	—
RL-161	480 ± 100	990 ± 290	2 σ	—
RL-173	200 ± 90	740 ± 260	2 σ	—
RL-175	1490 ± 100	1860 ± 180	2 σ	—
RL-176	< 310	220 ± 110	1 σ	62
RL-172	< 230	~ 200	1 σ	52
*RL-164	1310 ± 110	1790 ± 120	3 σ	54
*RL-171	11,400 ± 850	8600 ± 2250	1 σ	25
RL-154	9700 ± 620	6340 ± 1600	2 σ	32
*RL-177	6150 ± 120	6150 ± 150	1 σ	62
*RL-178	400 ± 100	490 ± 100	1 σ	62
*RL-179	550 ± 105	450 ± 120	1 σ	51
*RL-180	1330 ± 105	1330 ± 115	1 σ	75
*RL-181	1410 ± 105	1410 ± 115	1 σ	58
RL-185	6470 ± 140	6200 ± 150	1 σ	50
RL-142	> 31,400	> 32,300	1 σ	55
RL-182	6490 ± 130	6840 ± 150	2 σ	—
RL-183	11,950 ± 280	11,700 ± 300	1 σ	68
RL-187	330 ± 90	290 ± 90	1 σ	72
RL-152	8320 ± 220	7620 ± 520	1 σ	29
RL-196	340 ± 90	320 ± 130	1 σ	71
RL-185a	6470 ± 140	6450 ± 130	1 σ	84
RL-192	380 ± 80	440 ± 100	1 σ	—
*RL-224	560 ± 120	580 ± 100	1 σ	78
RL-255	1710 ± 110	1910 ± 100	1 σ	71
RL-217	1120 ± 100	1220 ± 90	1 σ	76

* Descriptions for these samples appear below, results based on CO_2 counting.

Coll 1955 by Nick Glumac; subm by Edward Felien, Morgan Park High School, Duluth, Minnesota. *Comment*: sample was check on another portion of tusk, by high school students Cheryl Doherty and Mary Richardson.

B. Western United States

RL-149. Birch Bay, Washington **1580 ± 120 AD 370**

Charcoal from Site 45-WH-24, on 10m terrace at W margin of Birch Bay (48° 56′ N, 122° 47′ 25″ W). Sample came from hearth feature at depth 21 to 40cm, containing finely broken shell and bits of mammal bone. Coll 1969 by C E Larsen and James Edris; subm by G F Grabert,

Western Washington State Coll, Bellingham, Washington. *Comment* (GFG): many cobble tools found, typologically different from and assumed to antedate artifacts from shell midden site, 45-WH-11, 400m E on presently forming sand spit beach. Cobble and flake tools are rare in latter site, which yields bone, antler, and ground stone artifacts of typically Marpole through Whalen and more recent aspect. Age of this hearth is probably similar to present and largest midden, but not assoc with cobble implement component.

2630 ± 240
680 BC

RL-272. Strait of Georgia, Washington

Charcoal from Site 45-WH-1, on wave-cut terrace, at ca 3m level, approx N limit of San Juan Is., Washington (48° 05′ 45″ N, 122° W). Sample from base of short trench at depth 160 to 175cm, from shallow firepit. Coll 1971 by John Prager; subm by G F Grabert. *Comment* (GFG): sample should date early use of Cherry Point site for human habitation (Grabert & Larsen, 1973).

Ferndale series, Washington

Samples from Site 45-WH-34, at NE city limit of Ferndale, Washington, right bank of Nooksack R (48° 51′ 30″ N, 122° 35′ W). Subm by G F Grabert (Grabert & Larsen, 1973).

4180 ± 120
2230 BC

RL-273. No. 249

Charcoal from intrusive firepit > 1m deep, at depth 117cm of pit containing abundant shell remains. Coll 1972 by Jean Bosch. *Comment* (GFG): although 11km from salt water, molluscan remains were marine species. Preliminary stratigraphic analysis places intrusive firepit in chronologic relationship with Fraser Delta Marpole phase. Artifacts are similar; many chipped stone projectile points of lanceolate and stemmed forms occur in shell zones and some in non-shell horizons. RL-273 and -274, below, possibly bracket early soil formation and mid-occupation period.

1030 ± 100
AD 920

RL-274. No. 511

Charcoal (bark and wood) from charred log lying on and in paleosol formed on alluvial sand of Nooksack R. Coll 1972 by L K Strickland. *Comment* (GFG): log was with a few scattered basalt flake tools and 1 well-formed basalt triangular scraper. Several thin strata of charcoal and dark-stained earth contained a few other artifacts indicating series of brief occupations. Should date early occupation of small remnant levee ridge along small former channel of Nooksack R.

1210 ± 100
AD 740

RL-275. No. 586

Charcoal from area of RL-274, from sloping edge of intrusive depression, vertically and horizontally distinct from firepit with shell that yielded RL-273. Coll 1972 by L K Strickland. *Comment* (GFG): should

date what may be a large semisubterranean dwelling, relatively rare in region.

General Comment (GFG): all 3 samples in series came from trench 20m l x 2m w. Its E end yielded RL-273 in deep and presumably late prehistoric pit; RL-275 came from 2nd depression extending from ca 8 to 18.5m W of ref. RL-274 lay outside depression, and seems stratigraphically earlier. Samples should determine construction chronology, occupation date of depression, and relationship to cultural phases of Fraser Delta, and Gulf Is. Assoc antler sedges, projectile points, and many small bone implements in fill suggest woodworking and fishing activities.

Clover Valley Wash series, Nevada

Clover Valley Wash is ca 26km ESE of Caliente (37° 31′ N, 114° 16′ W), at alt ca 1630m. Samples coll 1970 by D B Madsen, Univ Missouri, Columbia and P J Mehringer, Jr; subm by D D Fowler, Desert Research Inst, Univ Nevada, Reno.

RL-104. Fright Midden No. 2 **250 ± 90 AD 1700**

Juniper twigs (*Juniperus osteoperma*) from consolidated fossil woodrat midden from small cliff alcove overlooking Clover Valley Wash.

RL-105. Fright Midden No. 1 **4390 ± 110 2440 BC**

Woodrat dung from consolidated fossil woodrat midden from small cliff alcove overlooking Clover Valley Wash.

Meadow Valley Wash series, Nevada

Samples from various sites S of Caliente, Nevada. 1st group of 8 coll 1971 by D B Madsen and P J Mehringer, Jr; subm by D D Fowler.

RL-126. No. 1 **2070 ± 150 120 BC**

Charcoal from Stein Canyon Rock Shelter, Rocksprings Canyon; ca 24km S of Caliente (37° 28′ N, 114° 36′ W). Scattered charcoal from lowest 15cm of basal cultural unit at rock shelter; 4 to 4.15m below surface.

RL-127. No. 2 **890 ± 150 AD 1060**

Charcoal, 100m S of ranch pump pond, ca 11km S of Caliente (37° 34′ N, 114° 34′ W). Scattered charcoal from base of fill of channel cut in Meadow Valley Wash alluvium. *Comment*: NaOH pretreatment to remove humic acids.

RL-128. No. 3 **<280**

Charcoal, 100m N of mouth of Picnic Canyon, ca 13km S of Caliente (37° 33′ N, 114° 36′ W). Scattered charcoal from base of fill of higher of the 2 channel cuts in Meadow Valley Wash alluvium. *Comment*: NaOH pretreatment to remove humic acids.

400 ± 150

RL-129. No. 4 **AD 1550**

Charcoal, ca 100m N of Etna, Nevada (37° 35′ N, 114° 35′ W). Scattered charcoal from lowest peat band in series of pond deposits in Meadow Valley Wash alluvium. *Comment*: NaOH pretreatment to remove humic acids.

1670 ± 130

RL-130. No. 5 **AD 280**

Seeds (*Cyperaceae* sp) 200m N of S boundary of Conway Ranch; ca .8km NE of Etna, Nevada (37° 35′ N, 114° 34′ W). Scattered sedge seeds from lowest peat band in pond sediments in Meadow Valley Wash alluvium. *Comment*: NaOH pretreatment to remove humic acids.

1240 ± 150

RL-165. No. 6 **AD 710**

Charcoal from same site as RL-130. Scattered charcoal from lower 25cm of pinkish-gray sand stratum overlying peat bands at Loc I, Meadow Valley Wash.

420 ± 190

RL-166. No. 7 **AD 1530**

Charcoal from same site as RL-128. Scattered charcoal from base of fill of lower of the 2 channel cuts in Meadow Valley Wash alluvium.

510 ± 220

RL-167. No. 8 **AD 1440**

Charcoal, .8km N of trestle; ca 20.6km S of Caliente (37° 27′ N, 114° 34′ W). Scattered charcoal from lowest (10cm) peat bands in Meadow Valley Wash alluvium at Loc IV. Second group of 5 samples coll 1972 and subm by D B Madsen.

3190 ± 140

RL-219. No. 9 **1240 BC**

Charcoal from E arroyo wall; ca 8.2km S of Caliente (37° 33′ 20″ N, 114° 33′ 50″ W). Scattered charcoal throughout Unit B at Loc VII in Meadow Valley Wash. Unit B is stratigraphically 2nd depositional unit in Meadow Valley Wash alluvium.

2430 ± 130

RL-220. No. 10 **480 BC**

Charcoal from same site as RL-219. Scattered charcoal throughout Unit D_2 at Loc VII in Meadow Valley Wash. Unit D_2 is contained wholly within Unit D, stratigraphically 4th depositional unit in Meadow Valley Wash alluvium.

20,000 ± 400

RL-221. Etna Midden No. 1 **18,050 BC**

Pine needles (*Pinus aristata, Pinus flexilis*) from cliff alcove ca 100m up E canyon wall; ca 9km S of Caliente (37° 33′ 30″ N, 114° 34′ 10″ W).

Needles are from fossil woodrat midden in a rock crevice overlooking Meadow Valley Wash.

RL-222. Stine Midden No. 1 **14,980 ± 250 / 13,030 BC**

Dung (*Neotoma* sp) from cliff alcove ca 150m up NW canyon wall in Stine canyon. Stine canyon is Meadow Valley Wash tributary which meets wash ca 17.4km S of Caliente. Site is ca 1.6km upstream from confluence (37° 27′ 50″ N, 114° 36′ 40″ W). Dung is from fossil woodrat midden in rock crevice overlooking Stine canyon (Madsen, 1973).

RL-223. Stine Midden No. 3 **1770 ± 90 / AD 180**

Dung (*Neotoma* sp) from fossil woodrat midden under rock overhang ca 125m up NW canyon wall in Stine canyon. Coll site is same as for RL-222.

RL-276. Split-twig Figurine, Etna Cave, Nevada **3750 ± 330 / 1800 BC**

Wood, probably willow (*Salix* sp) from Etna Cave, Lincoln Co, Nevada (37° 35′ N, 114° 37′ W). Sample above "3rd Floor" level (Wheeler, 1942). Coll 1935 by S M Wheeler; subm by D D Fowler. *Comment* (DDF): designated BP-3987 (Wheeler, 1942); accession No. 3336, Natl Park Service Visitors Center, Boulder City, Nevada, figurine was reportedly found stratigraphically *below* "Pleistocene age" horse dung in same level as Gypsum series projectile points. ^{14}C date agrees with dates on similar figurines from N Arizona.

Joe's Valley Alcove series, Utah

Wood charcoal from Joe's Valley Alcove, Emery Co, Utah (39° 17′ N, 111° 16′ 30″ W). Coll 1972 and subm by E I DuBloois, U S Forest Service, Ogden, Utah. *Comment* (EID): discussion of samples in unpub preliminary repts, USDA Forest Service, Intermountain Region, Ogden, Utah.

RL-352. No. 1 **6760 ± 180 / 4810 BC**

Single piece of wood charcoal from Bed I, Level 2b, 228cm above datum, 25cm N of 4S line (375cm S of datum), 201cm E of base line.

RL-353. No. 2 **6200 ± 190 / 4250 BC**

Scattered charcoal coll over several sq cm of Bed I, Level 3, at 265cm above datum and 300 to 350cm S of datum.

RL-354. No. 13 **7770 ± 230 / 5820 BC**

Charcoal from contact of Bed I, Level 1 and shelter floor, 180cm above datum, 400cm S of datum.

7670 ± 210
RL-355. No. 16 **5720 BC**

Charcoal from Bed I, Level 1 at 165cm above datum, 580cm S of datum, and 196cm E of base line.

8210 ± 220
RL-356. No. 17 **6260 BC**

Charcoal from Bed I, Level O, at 160cm above datum, 535cm S of datum, and 176cm E of base line.

1260 ± 160
RL-413. Hogup Cave, Utah **AD 690**

Phragmites arrow shaft fragment from S end of Hogup Mts, W of Great Salt Lake. Area is unmapped; closest approx is SW¼, T8N, R12W. Sample, (#24, Fs #554-55), from Stratum 9, Hogup Cave (Aikens, 1970). Coll 1968 by C M Aikens; subm by D B Madsen, Div State History, Salt Lake City, Utah.

Snowbird Bog series, Utah

Unid. wood samples from possible forest floor mat at Snowbird, Little Cottonwood Canyon, Utah (40° 30′ N, 111° 39′ 15″ W). Coll 1974 and subm by D B Madsen.

5600 ± 190
RL-414. Snowbird Bog #2 **3650 BC**

Sample from Unit IV-D.

7920 ± 210
RL-415. Snowbird Bog #3 **5970 BC**

Sample from Unit II.

Grand Canyon 671 series, Arizona

Charcoal from structural timber, Grand Canyon Nat Monument, Mohave Co, Arizona (36° 14′ N, 113° 09′ W). Coll 1969, 1970 and subm by Richard Thompson, Southern Utah State Coll, Cedar City, Utah.

720 ± 100
RL-50. GC 671 No. 2 **AD 1230**

Sample .3m deep under collapsed wall of basalt, Structure 1.

630 ± 100
RL-78. GC 671 No. 10 **AD 1320**

Sample .3m deep under collapsed wall of basalt, Structure 3.

780 ± 105
RL-79. GC 671 No. 19 **AD 1170**

Sample .5m deep under collapsed wall of basalt, Structure 3.

840 ± 110
RL-80. GC 671 No. 21 **AD 1110**

Sample .5m deep under collapsed wall of basalt, Structure 3. *General Comment* (RT): RL-80 age agrees with accepted occupation of area by

Virgin Branch of Kayenta Anasazi; RL-50 and -79 ages suggest possibility of later occupation, while RL-78 age is considerably later than accepted date for end of occupation of area by Virgin Branch of Kayenta Anasazi.

RL-224. Pinal County, Arizona **580 ± 100 AD 1370**

Post from prehistoric ramada-like structure, likely Ironwood (*Olneya tesota*) but could possibly be Mesquite (*Prosopis juliflora*), from S 2.4km of Pinal Co, Sec 36, T10S, R4E, USGS Silver Reef Mts 15′ quad, Arizona. Sample, No. 9, from SE posthole of Feature 1, AZ AA:5:4 (ASU) (Goodyear & Dittert, 1973). Coll 1972 by A C Goodyear and Mark Raab; subm by A C Goodyear, Arizona State Univ, Tempe. *Comment* (ACG): date seems consistent with a late plain ware assoc with Sells phase and with structure dated by this sample. It is architecturally similar to other nearby Sells phase ramada-type houses.

RL-397. Westwing site, Arizona **1090 ± 90 AD 860**

Charcoal from W bank of Agua Fria R in central Arizona, Maricopa Co (33° 42′ 22″ N, 112° 18′ 18″ W), within shallow pit oven 40 to 50cm below present land surface (Weaver, 1974). Coll 1973 and subm by D E Weaver, Jr, Arizona State Univ, Tempe. *Comment* (DEW): sample probably represents beginning of occupation of Westwing site, a small Sedentary period Hohokam settlement.

C. Central United States

Helb series, South Dakota

Charcoal from Helb site, Campbell Co, South Dakota (45° 47′ 09″ N, 100° 20′ 55″ W). Subm by C R Falk, Midwest Archeol Center, Lincoln, Nebraska (Falk & Calabrese, 1973).

RL-298. 39CA208-104 **940 ± 90 AD 1010**

Wood charcoal from Feature 1, Level 7; extramural trash-filled pit adjacent to House 3 (705/710NW600). Coll 1972 by C R Falk. *Comment* (CRF): date consistent with NWU-38, -39, and -40 (unpub) and suggests early Extended Middle Missouri Variant in S portion of Cannonball Region of Middle Missouri Subarea.

RL-299. 39CA208-360 **430 ± 90 AD 1520**

Wood charcoal (*Prunus* sp) from Feature 12, House 8; central hearth (220NW585). Coll 1973 by R K Nickel. *Comment* (CRF): date suggests use/occupation during late 15th or early 16th centuries AD and contrasts with dates of samples cited in comment, RL-298.

Lower Grand (Davis) series, South Dakota

Wood and charcoal from Lower Grand (Davis) site, Corson Co, South Dakota (45° 34′ 30″ N, 100° 29′ W). Subm by C R Falk.

590 ± 90

RL-300. 39CO14-1068 **AD 1360**

Wood charcoal (*Salix/Populus* spp) from Feature 102; extramural trash-filled pit adjacent to House 12 (640NW290). Coll 1969 by C R Falk.

650 ± 120

RL-301. 39CO14-1706 **AD 1300**

Wood from Feature 402; wall post, House 12 (640NW350). Coll 1969 by S A Ahler.

490 ± 90

RL-302. 39CO14-1983 **AD 1460**

Wood charcoal (*Salix/Populus* spp) from Feature 582, Level 3; extramural trash-filled pit adjacent to House 6 (450NW130). Coll 1969 by C R Falk.

600 ± 90

RL-303. 39CO14-2196 **AD 1350**

Wood charcoal (*Salix/Populus* spp) from Test 6, adjacent to N fortification, Level 3. Coll 1969 by Steven Gentzler.

General Comment (CRF): samples suggest occupation of site during mid- to late-14th century AD, 2 centuries earlier than Lehmer's assignment of site to Extended Coalescent Variant of Middle Missouri tradition.

Walth Bay series, South Dakota

Charcoal and bone from Walth Bay site, Walworth Co, South Dakota (45° 24′ 45″ N, 100° 16′ 30″ W). Subm by C R Falk.

450 ± 90

RL-304. 39WW203-859 **AD 1500**

Wood charcoal (*Salix/Populus* spp) from Feature 116, burned structural (roof) debris; House 19 (670NW880), cultural Zone D. Coll 1971 by S A Ahler.

450 ± 90

RL-305. 39WW203-1437/1477 **AD 1500**

Wood charcoal (*Salix/Populus* spp) from Feature 257, combined Levels 5 and 6; intramural trash-filled pit assoc with House 9, cultural Zone D. Coll 1971 by S A Ahler.

380 ± 90

RL-306. 39WW203-2207 **AD 1570**

Wood charcoal (*Salix/Populus* spp) from Test 15, Feature 593, Level 7; extramural trash-filled pit adjacent to House 15, cultural Zone D. Coll 1971 by K A Lippencott.

310 ± 90

RL-307. 39WW203-2329/2340 **AD 1640**

Wood charcoal (*Salix/Populus* spp) from Test 16, Feature 741, combined Levels 4 and 6; extramural trash-filled pit adjacent to House 12, cultural Zone D. Coll 1971 by L G Madison.

General Comment (SAA): 1st 4 samples in this series suggest a true age of mid- to late-15th century AD for Extended Coalescent Variant, cultural Zone D, occupation of site.

8030 ± 1100

RL-308. 39WW203-2577 **6080 BC**

Bone (*Bison* sp) from Sq 600NW990, 1.7m, cultural Zone B (Ahler *et al,* 1974). Coll 1972 by Danny Clinger. *Comment* (SAA): sample assoc with buried soil horizon, IIA_{1B}/IIA_{3B}, containing Middle period cultural remains. Sample very small; age based on bone collagen.

7010 ± 210

RL-309. 39WW203-970 **5060 BC**

Bone (*Bison* sp) adjacent to Test 10, 1.5 to 1.6m, cultural Zone A (Ahler *et al,* 1974). Coll 1971 by S A Ahler. *Comment* (SAA): sample assoc with buried soil horizon, $IIIA_{3B}$, containing Late Paleo-Indian or early Archaic cultural materials. Age based on bone collagen.

D. Eastern United States

Goddard site series, Maine

Charcoal from area of Brooklin, Maine (44° 13′ 30″ N, 68° 31′ 30″ W). Subm by B J Bourque, Maine State Mus, Augusta.

3700 ± 130

RL-368. No. 1 **1750 BC**

Charcoal in pit, assoc with ground slate point. Coll 1971 by Guy Mellgren.

2300 ± 120

RL-369. No. 3 **350 BC**

Charcoal in pit, assoc with 2 chipped and ground stone celts. Coll 1973 by Guy Mellgren.

6150 ± 120

RL-177. Hudson River, New York **4200 BC**

Shell (*Crasestrea virginica* valve) from E bank, Hudson R opposite Pollepel I., 5km S of Beacon, New York (41° 27′ 18″ N, 73° 58′ 42″ W). Sample from Stratum 3 at 38 to 51cm, underlying clayey sand, Stratum 2, and overlying a hearth at 114cm, base of Stratum 3 (Ritchie, 1958). Coll ca 1951 by W A Ritchie; subm by W S Newman, Queens Coll, CUNY. *Comment* (WSN): charcoal from hearth below shells was dated, 4480 ± 300 (M-287; Science, 1958, v 127, p 1100). The nearly 2000-yr discrepancy between dates suggests hearth is either intrusive, or one of dates is wrong. Yet this is, by several hundred yrs, the oldest Hudson Oyster Shell Midden date known.

1240 ± 90

RL-310. Hughes Farm site, West Virginia **AD 710**

Charcoal, No. 971, from Hughes Farm site, 46-Oh-9, Feature 13; Ohio Co, West Virginia (40° 08′ 46″ N, 80° 38′ 00″ W) (Dunnell, 1962). Coll 1959 and subm by R C Dunnell, Univ Washington, Seattle. *Com-*

ment (RCD): Feature 13, from which sample was taken, is part of late Watson/early Monogahela hamlet representing deepest part of occupation at 46-Oh-9. Assoc ceramics include ca 12% of shell-tempered, previously assumed much later when compared chronologically with other areas.

Deep Shelter series, Kentucky

Carbonized wood from Deep Shelter rock shelter, S Rowan Co, Kentucky, at edge of and slightly into E Mts (38° 03′ N, 83° 27′ 30″ W) (Dorwin & Warholic, 1970). Coll 1969 by J T Dorwin and D T Warholic; subm by J T Dorwin, Univ Kentucky, Lexington.

RL-67. KY Ro 34, 1119 **7240 ± 550**
5290 BC

Small pieces of carbonized wood, scattered throughout fill of small pit, Feature 4, which was at edge of drip line of shelter at depth 1.32m below datum to 1.63m. Pit is above and slightly SE of area from which RL-68 was obtained. *Comment* (JTD): date is for a general horizon of pit. Horizon included LeCroy Bifurcated Base points. RL-67 and -68 agree and fit well within chronology and projectile point sequence of St Albans, West Virginia site (Broyles, pers commun).

RL-68. KY Ro 34, 1120 **8520 ± 470**
6570 BC

Small pieces of carbonized wood from upper level of a remnant living floor of shelter, which contained 4 separate superimposed layers consisting of ashy sandy soil, bone and chert debitage. Sufficient charcoal for dating from lower levels was unavailable. Sample is from ca 40cm below top of pit containing RL-67, and slightly NW. *Comment* (JTD): date is in keeping with stratigraphy at Deep Shelter and artifact sequence established at St Albans site, West Virginia. General horizon of date contained Charleston Corner Notched points, dated slightly earlier by Broyles (pers commun).

Mayo series, Kentucky

Samples from Mayo site, 15-Jo-14, on T^2 of Paint Creek, ca 1.6km from its confluence with Levisa Fork on Big Sandy R W of Paintsville, Johnson Co, Kentucky (37° 49′ 27″ N, 82° 48′ 05″ W). Coll 1939 by J C Greenacre; subm by R C Dunnell.

RL-311. 15-Jo-14/51 **800 ± 100**
AD 1150

Charcoal from Level II, sheet midden O-O. *Comment* (RCD): should date early middle Woodside phase occupation of Levisa Fork Valley and is comparable to dates for early Fort Ancient in Ohio.

RL-322. 15-Jo-14 "B" **1060 ± 90**
AD 890

Animal scrap bone, (mostly *Odocoileus viriginianus*) from Feature 13, a sheet midden, probably surface deposit aboriginally, which is an

integral part of Woodside component of site. *Comment* (RCD): should be relatively close to RL-311, as they both are part of same Woodside occupation; they reasonably agree, in that 15-Jo-14 is relatively early Woodside phase, suggested by stylistic analysis.

RL-77. Peace Camp site, Florida **3050 ± 140 / 1100 BC**

Shell (*Strombus gigas*) from Peace Camp site, Broward Co, Florida (26° N, 80° 10′ W). In stratigraphic excavation; Sq N-18, Stratum 6, 1.3m below datum, and just below deepest Norwood Plain and St Johns Incised pottery. Coll 1969 by Wilma Williams; subm by R P Bullen, Florida State Mus, Gainesville. *Comment* (RPB): dates 1st occupancy of site (Wilma Williams, ms in preparation, Broward Co Arch Soc).

E. Canada

Lanoraie series, Quebec

Charcoal from Lanoraie, Berthier Co, Quebec (45° 58′ N, 73° 13′ W). Coll 1970 and subm by Georges Barré, Min Affaires culturelles, Quebec.

RL-178. La-6 **580 ± 90 / AD 1370**

From base of pit containing charcoal, potsherds, and carbonized corn kernels.

RL-179. La-9 **550 ± 105 / AD 1400**

From base of pit containing charcoal and potsherds.

General Comment (HT): based on body treatment and decorative techniques, Lanoraie site initially was assigned to early stage of Iroquois Prehistory (MacNeish, 1952; Wright, pers commun). These 2 dates indicate that chronologic significance of such attributes should be re-evaluated in central St Lawrence Valley area.

Cap-Chat series, Quebec

Charcoal from Cap-Chat site, Gaspé Nord Co, Quebec (49° 10′ N, 66° 40′ W). Subm by Georges Barré.

RL-180. DgDq-1 **1330 ± 105 / AD 620**

Sample from S sec of lowest cultural layer of site. Coll 1971 by Georges Barré.

RL-181. DgDq I:43.1 **1410 ± 105 / AD 540**

Sample from N sec of lowest cultural layer of site. Coll 1971 by Hughette Trudeau.

RL-343. Restigouche River, New Brunswick **2030 ± 130 / 80 BC**

Charcoal, C1Dq-1:C11, from S shore of Restigouche R, Old Church Point, near Atholville, Restigouche Co, New Brunswick (47° 59′ 35″ N, 66° 44′ 20″ W), from pit dug into sterile gravels, assoc with pottery

fragments, stemmed projectile point, and fire-cracked rock. Coll 1972 by K Crandall; subm by C J Turnbull, Hist Resources Admin, Prov New Brunswick. *Comment* (CJT): site may be multi-component occupation, most recently, 18th century. Sample may date earliest settlement.

2330 ± 110

RL-344. Northumberland County, New Brunswick 380 BC

Charcoal, CfDw-2:1, from junction of Little Southwest Miramichi R and Northwest Miramichi R, near Red Bank, Northumberland Co, New Brunswick (46° 51′ 00″ N, 67° 50′ 00″ W), assoc with burials in probable burial mound 12m across, 1.2m high. Subm by C J Turnbull. *Comment* (CJT): site is a problem: burial mound, and some artifacts indicate early Woodland assoc; exceptional preservation of wood, bark cloth, and bones indicate much more recent date. Because site was dug by an amateur, assocs are still tentative. Only ½ sample was submitted.

RL-345. Old MacDonald Farm, New Brunswick < 420

Charcoal, CgDi-1:334, from Old MacDonald Farm, W side of Bartibog R, .6km downriver from bridge (47° 05′ 40″ N, 65° 21′ 15″ W). Sample from hearth, beneath plough zone. Coll 1972 and subm by C J Turnbull. *Comment* (CJT): only sample from an aceramic component.

F. West Indies

Grenadines series, West Indies

Samples coll 1970 and subm by R P Bullen, Florida State Mus, Gainesville (Bullen & Bullen, 1972).

1470 ± 110

RL-70. FSM-BF No. 8 AD 480

Shell (*Strombus gigas*) from Chatham Bay, Union I., Grenadines (12° 35′ 56″ N, 61° 27′ 08″ W), from narrow zone ca 20cm below surface; a 1-period deposit. *Comment* (RPB): dates a Modified Saladoid ceramic complex including Troumassee Decorated Cylinders.

530 ± 110

RL-71. FSM-BF No. 9 AD 1420

Shell (*Strombus gigas*) from Banana Bay, Belliceaux I. (12° 57′ N, 61° 09′ 05″ W), from top of midden in eroded face of site. *Comment* (RPB): this is a check on RL-27 (R, 1971, v 13, p 76), from middle part of midden, dated, AD 1230 ± 100. Range is reasonable. Clearly, site is prehistoric, at least for midden.

St Vincent series, West Indies

Samples coll by Earle Kirby and (RL-73) R P Bullen; subm by R P Bullen (Bullen & Bullen, 1972).

370 ± 110

RL-72. FSM-BF No. 10 AD 1580

West Indian Top shells (*Pica*) from Indian Bay, SE St Vincent (13° 08′ 10″ N, 61° 12′ 45″ W), from below pottery-producing midden. *Com-*

ment (RPB): shells below midden did not represent preceramic occupation. Midden bleongs to proto-historic Suazey complex and shells date midden occupation.

1670 ± 160

RL-73. FSM-BF No. 11 **AD 280**

Charcoal from Lower Buccament Valley in front of cave (13° 10′ N, 61° 16′ W), from test at depth 1.2m. *Comment* (RPB): dates early Modified Saladoid ceramics of area.

930 ± 110

RL-74. FSM-BF No. 12 **AD 1020**

Charcoal from Fitz Hughes site, NW St Vincent (15° 17′ 10″ N, 61° 14′ W), from deep pit leading down from occupation zone. Overburden and top of midden removed by bulldozer. *Comment* (RPB): dates a mixed Suazey-Caliviny ceramic complex.

1540 ± 110

RL-75. FSM-BF No. 13 **AD 410**

Charcoal from Arnos Vale (swamp) near airport, SE St Vincent (13° 08′ 20″ N, 61° 13′ 00″ W), from lower artifact-producing zone under ca 2.4m water and volcanic deposited material. *Comment* (RPB): dates spectacular Modified Saladoid pottery from this low zone. Pottery seems younger than that from Kingstown Post Office site, RL-28 (R, 1971, v 13, p 76), dated, AD 160 ± 100. Indicates typologic changes during Modified Saladoid period.

550 ± 110

RL-76. Savanne Suazey site, Grenada **AD 1400**

Shell (*Strombus gigas*), FSM-BF No. 14, from Savanne Suazey site, NE Grenada (12° 10′ N, 61° 37′ W), from burial area with Suazey series pottery, iron fragments, and 2 Spanish Olive jar sherds. Burials were in shallow midden deposit, 0 to 38cm from surface to base of deposit (Bullen, 1964). Coll 1970 and subm by R P Bullen. *Comment* (RPB): indicates burials are proto-historic and Suazey ceramic complex lasted until, if not into, Post-Columbian times.

780 ± 100

RL-155. Couronue site, West Indies **AD 1170**

Shell (*Strombus gigas*) from E coast of Guadeloupe (12° 30′ N, 61° 30′ W), just below surface in a 1-period site. Coll 1971 and subm by R P Bullen. *Comment* (RPB): site produced Suazey ceramics, correlated with Carib occupancy. Date is consistent, possibly a bit early.

1730 ± 110

RL-156. Vivé, Martinique **AD 220**

Charcoal from NE coast of Martinique, French West Indies (14° 51′ N, 61° 05′ W), from lower cultural zone below sterile volcanic tuff. Coll 1971 and subm by R P Bullen. *Comment* (RPB): dates a very late phase of Insular Saladoid ceramic tradition (or perhaps very early phase of Modified Saladoid tradition). Date is consistent with others: S-85 (unpub)

from volcanic tuff was dated, AD 295 ± 150; UGA-113 (unpub) from upper cultural zone overlying volcanic tuff was dated, AD 420 ± 75.

II. GEOLOGIC SAMPLES

A. North America

RL-171. Utah Lake, Utah **11,400 ± 850**

Peat from Utah Lake, Utah Co (40° 15′ N, 111° 45′ W), from ca 1.6m W of shoreline adjacent to Geneva steel mills, at depth 490 to 500cm. Coll 1970 and subm by R F Bolland, Univ of Utah, Salt Lake City. *Comment* (RFB): cores were taken for study on diatoms of Utah Lake.

RL-157. Orbach Mall, New York **13,470 ± 850**

Peat and silt from foundation excavation for Orbach Queens Fashion Mall on Queens Blvd near Long Island Expwy, Rego Park, Queens, New York (40° 44′ 00″ N, 73° 52′ 24″ W), at depth ca 7m, near top of stratified and laminated silt of glacial Lake Flushing, overlain by .3 to 1.5m till, probably Sirkin's "upper till", his Roslyn Till equivalent, the latest evidence of glacial advance to Long I. (Sirkin, 1971). Coll 1971 by M I Esrig; subm by W S Newman, Queens Coll, CUNY. *Comment* (WSN): 1st intertill date from Long I. and surprisingly young. Sirkin believed minimum age of Roslyn Till > 17,000 yr.

RL-318. Montauk Point, New York **38,000 $^{+5600}_{-3200}$**

Wood from 1.6km SW of Montauk Point in S shore bluff, Long I., New York (41° 03′ 12″ N, 71° 52′ W), from clayey silt lenses containing peat and wood, lying between 2 layers of till, upper ca 3m thick and lower 1.2m thick (Perlmutter & De Luca, 1963). Coll 1972 by R E Matarese; subm by W S Newman. *Comment* (WSN): pollen analyses suggest tundra/Boreal forest/tundra sequence. Pollen data plus old age of sample indicate a Wisconsin Interstadial.

RL-245. Gross Bog, Connecticut **12,750 ± 230**

Gyttja peat from bog at 330m alt, NW flank of Housatonic Highlands, NW Connecticut (41° 48′ N, 73° 29′ 26″ W), from 6m beneath bog surface at gyttja-clay interface (Kelley, ms in preparation). Coll 1972 by G C Kelley; subm by W S Newman. *Comment* (WSN): dates T (for tundra) Zone of Gross Bog.

B. South America

RL-113. Puerto Varas, Chile **16,270 ± 360**

Wood from bank on S side of rd leading W from Puerto Varas to Panamerican Hwy, under rr bridge (41° 18′ S, 72° 59′ W); 160cm gyttja covered with peat lenses and fragments of wood, overlying gravel; sample 20cm above base of gyttja. This organic sequence is covered by 14m lake sediment; uppermost peat is thus in similar stratigraphic posi-

tion to peat exposed in Calle Rosa, Puerto Varas, dated (uppermost peat) at 14,820 ± 230 (I-5033, unpub) (Mercer, 1972). Coll 1971 and subm by J H Mercer, Inst Polar Studies, Ohio State Univ, Columbus. *Comment* (JHM): deposition of gyttja began at start of low-water phase of Lago Llanquihue, when glacial recession opened outlet to tidewater Seno Reloncavi at E end of lake. Sample age is, thus, minimum for start of Varas Interstadial. It is consistent with age of I-5033, and similar to date of early part of the Erie Interstadial in North America.

RL-116. Frutillar End Moraine, Chile **20,100 ± 550**

Peat from gravel pit on S side of rd from Frutillar Alto to Frutillar Bajo, Prov Llanquihue, Chile (41° 07′ S, 73° 03′ W), from stratified drift below thin compact till that extends ca 25m W of site. This marks outer limit of maximum stand of Lago Llanquihue glacier (Mercer, 1972). Coll 1971 and subm by J H Mercer. *Comment* (JHM): peat was fibrous and unhumified, probably derived from near surface of bog overridden by ice, near its maximum stand. Date agrees well with I-5679: 19,450 ± 400 (unpub) at surface of bog beneath end moraine at adjacent Lago Rupanco.

RL-120. Lago Llanquihue, Chile **17,370 ± 670**

Peat, 3km N of Puerto Octay, Prov Osorno, Chile; 50m W of Rte U-55-V crossing of Río Chan-Chan (40° 57′ S, 72° 50′ W), from 3m depth in old outlet of Lago Llanquihue, now ca 100m above lake level. Obtained by Hiller borer from contact with material thought to be cobbles (Mercer, 1972). Coll 1971 by C J Heusser; subm by J H Mercer. *Comment* (JHM): outlet drained ice-marginal lake when Lago Llanquihue glacier reached lake shore moraines further S. Date agrees with RL-116, above, and I-5679 (unpub) which suggest a glacial maximum ca 19,400 BP. Outlet apparently cuts through moraines of earlier, greater advance of last major glaciation.

RL-119. Moreno Glacier, Argentina **9510 ± 210**

Peat (mainly *Juncus*) from depression from head of Bahía Catalán of Lago Rico, and Lago Argentino, Prov Santa Cruz, Argentina (50° 29′ S, 73° 02′ W). Long narrow bog, surface 42m above Lago Argentino, occupies depression. Sample is basal peat from bog. Coll 1971 and subm by J H Mercer. *Comment* (JHM): sample invalidates conclusions drawn from data of I-2201: 3830 ± 115 (Mercer, 1968), which was misidentified as basal peat for this same section of bog. Site is 800m from present ice front; date is minimum for shrinkage of Moreno Glacier close to its present dimensions; this agrees with age of basal peat in ancient outlet of Lago Rico: 10,000 ± 140, I-2209 (Mercer, 1968).

C. Europe

RL-164. Helice site, Greece **1310 ± 110**

Assorted shells, urchins near Aigion, Greece, 24km E, at supposed site of ancient Helice; W of mouth of Selinous R, Bay of Corinth in 44m

water, offshore from cement markers at Volimeka (38° 17′ 18″ N, 22° 08′ 42″ E). Sample from sediments in lower 20cm of core; 5cm diam, 2m long (Marinatos, 1960; 1970). Coll 1971 by S N Marinatos, H E Edgerton, and Peter Throckmorton; subm by H E Edgerton, Massachusetts Inst Technol, Cambridge. *Comment* (HEE): date implies material from 2m below base was deposited after earthquake of 325 BC; other disturbances occurred since then. More radiocarbon dates from greater depths will establish geologic sequence of sediments.

III. OCEANOGRAPHIC SAMPLES

Core V29-183K series, North Atlantic

Deep sea sediment samples containing planktonic forams from a core under 3492m water, North Atlantic Ocean (49° 08′ N, 25° 30′ W). Coll 1972 and subm by Andrew McIntyre, Lamont-Doherty Geol Observatory, Palisades, New York.

RL-212. V29-183K **3860 ± 130**

From 7 to 8cm depth.

RL-213. V29-183K **5440 ± 130**

From 14.5 to 15.5cm depth.

RL-214. V29-183K **8950 ± 220**

From 20.5 to 21.5cm depth.

RL-215. V29-183K **15,950 ± 620**

From 25 to 26cm depth.

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GEOLOGICAL SURVEY OF FINLAND RADIOCARBON MEASUREMENTS VII

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This list of measurements includes most of the geologic samples dated in this laboratory since the publication of our last list (R, 1974, v 16, p 252-268).

The age calculations are based on 95% of the isotopically corrected activity of the NBS oxalic acid standard and on a halflife of 5568 yr. The results are reported in years before 1950. Most of the samples have been corrected for deviations from the normal $^{13}C/^{12}C$ ratios ($\delta^{13}C = -25‰$ in the PDB scale). The $\delta^{13}C$ values quoted are relative to the PDB standard.

We measured the ^{14}C activity of the CO_2 gas in proportional counters, as described by Heikkinen *et al,* 1974. Each sample was counted at least twice for a period of not less than 2400 min. When measured activity was low, alternating counting sample/background was applied to the sample.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

Finland

Marrasjärvi series, Rovaniemi, N Finland

Four samples from lowermost part of till bed underlain by sorted sediments. Humus content 0.8%, Marrasjärvi, Raumo sand pit (66° 53′ N, 25° 10′ E), surface alt 125m, depth 2.5m. Coll and subm May 1973 by Aulis Heikkinen and Raimo Kujansuu. The fibrous matter, which may have been of postglacial age, was picked out of samples in the lab.

Su-236. Marrasjärvi **>42,300**
$\delta^{13}C = -28.5‰$

Sample, 1430g, boiled 1 N HCl. Organic material in till analyzed (10 2-day counts).

Su-237. Marrasjärvi **>48,000**
$\delta^{13}C = -24.7‰$

Sample weight 1300g, subjected to non-chemical processing (10 2-day counts).

Su-263. Marrasjärvi **>54,000**

$\delta^{13}C = -26.5‰$

Sample weight 3290g. Humic acids analyzed. Preparation: 1 N NaOH dissolution, filtrate + HCl = humic acids (4 2-day counts).

Su-264. Marrasjärvi **26,300 ± 250**

$\delta^{13}C = -26.5‰$

Same as Su-263. Residue boiled in 1 N HCl, residue of organic material in till analyzed (4 2-day counts).

Su-265. Marrasjärvi **>49,000**

$\delta^{13}C = -28.0‰$

Sample weight 2990g. Humic acids analyzed. Preparation: 0.5 N NaOH dissolution, filtrate + HCl = humic acids (3 2-day counts).

Su-266. Marrasjärvi **>40,700**

$\delta^{13}C = -27.7‰$

Same as Su-265. Residue of organic material in till analyzed (3 2-day counts. *Comments*: 1) because ^{14}C activity in samples may be caused by contamination, estimated age of organic substances transported by glacial ice is >55,000 yr (Heikkinen, 1975). 2) according to stratigraphy, glacial flow directions and pollen content of basal till layer, the esker at Marrasjärvi was deposited during Early-Weichselian deglaciation and covered with till during Late-Weichselian glaciation (Kujansuu, 1975).

Su-289. Savukoski, N Finland **9300 ± 160**

Peat and clayey silt from lower part of postglacial peat deposit, depth 1.3 to 1.45m, surface alt 219m, Sokli (67° 49′ N, 29° 24′ E). Coll 1972 and subm 1973 by E Ilvonen.

Su-503. Savukoski, N Finland **>16,700**

Diatomaceous earth deposited in fresh water, depth 1.1 to 1.2m, surface alt 252m, Sokli (67° 48′ N, 29° 20′ E). Coll 1973 and subm 1975 by E Ilvonen. *Comment*: sample derives from a diatomaceous earth deposit between 2 till beds. Microfossil composition suggests that sample is interglacial in age.

Su-290. Artjärvi, S Finland **960 ± 50**

$\delta^{13}C = -28.1‰$

Gyttja clay taken with piston corer. Sample depth 0.6 to 0.7m, water depth 65m, from lake Pyhäjärvi (60° 40′ N, 26° 02′ E). Coll and subm 1973 by E Kukkonen and R Tynni. *Comment*: increase in Secale pollen in Artjärvi area. Oldest Secale pollen, according to annual microvarves, AD 750, at level −1.3m (Kukkonen & Tynni, 1970).

Pieni Kankaanlampi series, Kemijärvi, N Finland

Samples from various levels of waterside bog at Lake Pieni Kankaanlampi (66° 43′ N, 27° 56′ E), surface alt 160.5m. Coll 1972 with piston sampler and subm 1973 by E Lappalainen.

Su-292. Pieni Kankaanlampi **8940 ± 100**
$\delta^{13}C = -34.4‰$

Ooze taken from 5.60 to 5.68m below bog surface. *Comment*: pollen analysis shows transition from Betula to Pinus maximum.

Su-293. Pieni Kankaanlampi **10,470 ± 100**
$\delta^{13}C = -36.5‰$

Ooze, depth 6.22 to 6.29m. *Comment*: pollen analyses, Betula maximum.

Su-294. Pieni Kankaanlampi **11,400 ± 200**

Ooze, depth 6.32 to 6.40m. *Comment*: Betula maximum.

Su-300. Laukaa, Central Finland **6630 ± 110**
$\delta^{13}C = -27.5‰$

From peat above sand, taken with piston sampler at depth 1.66 to 1.70m, surface alt 134m, Suojärvenneva bog (62° 37′ N, 25° 58′ E). Coll 1973 by A Leino and subm 1973 by V E Valovirta.

Su-301. Laukaa, Central Finland **8900 ± 100**
$\delta^{13}C = -27.7‰$

From peat above sand, taken with piston sampler, depth 2.76 to 2.80m, surface alt 148.3m, Kilpisuo bog (62° 25′ N, 26° 09′ E). Coll 1973 by A Leino and subm 1973 by V E Valovirta.

Su-302. Äänekoski, Central Finland **8300 ± 100**
$\delta^{13}C = -25.9‰$

From pine wood above sand, taken with piston sampler, depth 6.77 to 6.80m, surface alt 113.8m, Kaikkarsuo bog (62° 39′ N, 25° 30′ E). Coll 1973 by A Leino and subm 1973 by V E Valovirta.

Su-308. Äänekoski, Central Finland **7380 ± 80**
$\delta^{13}C = -29.2‰$

Same site as Su-302, peat, depth 6.77 to 6.80m, taken with piston sampler. Coll 1973 by A Leino and subm by V E Valovirta.

Su-303. Äänekoski, Central Finland **4390 ± 60**
$\delta^{13}C = -29.3‰$

Shore peat above silt, taken with piston sampler, depth 3.12 to 3.16m, surface alt 89m, Orissuo bog (62° 30′ N, 26° 03′ E). Coll 1973 by A Leino and subm 1973 by V E Valovirta.

Su-304. Äänekoski, Central Finland **8980 ± 100**
$\delta^{13}C = -29.0‰$

Peat above silt, taken with piston sampler, depth 4.16 to 4.20m, surface alt 178.4m, Isosuo bog (62° 34′ N, 25° 31′ E). Coll 1973 by A Leino and subm 1973 by V E Valovirta.

Su-305. Perniö, S Finland **5960 ± 90**

$\delta^{13}C = -26.5‰$

Wood and peat above gyttja (detritus) taken with piston sampler, depth 3.97 to 4m, surface alt 43m (threshold), Melassuo bog (60° 12′ N, 23° 09′ E). Coll 1973 by A Leino and subm 1973 by V E Valovirta.

Su-306. Perniö, S Finland **6290 ± 80**

$\delta^{13}C = -29.2‰$

Peat and wood above sand, taken with piston sampler, depth 4.61 to 4.65m, surface alt 40.5m, Träskmossan bog (60° 05′ N, 23° 02′ E). Coll 1973 by A Leino and subm by V E Valovirta.

Su-307. Perniö, S Finland **6290 ± 60**

$\delta^{13}C = -29.2‰$

Peat taken with piston sampler, depth 3.71 to 3.75m, surface alt 43.15m, Lakiassuo bog (60° 12′ N, 23° 57′ E). Coll 1973 by A Leino and subm by V E Valovirta.

Su-311. Sodankylä, N Finland **>55,000**

$\delta^{13}C = -26.0‰$

Peat (CB) taken with piston sampler, depth 3.6 to 3.8m, surface alt 347m, Pyssyselkä (67° 53′ N, 26° 08′ E). Coll and subm 1973 by H Tanskanen (5 2-day counts) (Tanskanen, 1975).

Su-312. Sodankylä, N Finland **>55,000**

Same site as Su-311. Peat (CB), depth 3.8 to 4.05m. Coll and subm 1973 by H Tanskanen (4 2-day counts) (Tanskanen, 1975).

Su-313. Inari, N Finland **6370 ± 100**

Wood from peat layer between sand in erosion bank of river Ivalojoki Törmänen (68° 36.7′ N, 27° 28.6′ E), surface alt 122m, depth 1.7m. Coll and subm 1973 by A T Lahtinen. *Comment* (ATL): Analysis of Su-314 was made of peat layer mentioned below. Possibly drift wood transported by flood.

Su-314. Inari, N Finland **1270 ± 90**

$\delta^{13}C = -24.2‰$

Peat between sand layers in erosion bank of Ivalojoki at village of Törmänen. Sample was taken from peat layer mentioned in Su-313 at depth of 1.65 to 1.75m. Coll and subm 1973 by A T Lahtinen. *Comment* (ATL): peat was formed when old meander channel grew into a bog, after which river action buried peat layer under ca 1.5m alluvial sand. Thickness of peat layer varies from 10 to 30cm.

Su-315. Inari, N Finland **970 ± 60**

$\delta^{13}C = -24.5‰$

Peat under sand from hand-dug section, near village of Akujärvi (68° 40.9′ N, 27° 39.4′ E), surface alt 122m, depth 0.55 to 0.63m. Coll and subm 1973 by A T Lahtinen. *Comment* (ATL): peat layer ca 20cm

thick was formed when delta channel grew into a bog, after which it was buried under ca 0.5m sand.

Su-316. Multia, Central Finland **5060 ± 100**
$\delta^{13}C = -26.0‰$

Subfossil hazelnuts (*Corylus avellana*) from hand-dug sec, depth 0.8 to 1.1m, village of Isojärvi, Heposuo bog (62° 20′ N, 24° 57′ E). Coll 1973 by L O Ervi and subm 1973 by V E Valovirta.

Su-317. Multia, Central Finland **4985 ± 100**
$\delta^{13}C = -22.4‰$

Subfossil hazelnuts (*Corylus avellana*) from hand-dug sec of bog earth pit, depth 0.8 to 1.1m, village of Sahrajärvi, Uusi Ilomäki (62° 28′ N, 25° 05′ E). Coll 1973 by L O Ervi and subm 1973 by V E Valovirta.

Jukolansuo bog series, Kytäjä, S Finland

Peat, gyttja and silt samples from hand-dug sec, surface alt 121m, Jukolansuo bog (60° 35′ N, 24° 36′ E). Coll 1973 by A Leino and V E Valovirta and subm 1974 by V E Valovirta (*cf* Heikkinen 1971, p 434).

Su-377. Jukolansuo **Modern**
$\Delta^{14}C = +43‰$
$\delta^{13}C = -26.4‰$

Peat, depth 0.08 to 0.1m. *Comment*: pollen analysis shows end of Sub-Atlantic period and rise of *Picea*.

Su-378. Jukolansuo **110 ± 40**
$\delta^{13}C = -25.5‰$

Peat, depth 0.18 to 0.2m. *Comment*: pollen analysis shows Sub-Atlantic period and *Picea* minimum.

Su-379. Jukolansuo **870 ± 30**
$\delta^{13}C = -25.8‰$

Peat, depth 0.28 to 0.3m. *Comment*: pollen analysis shows Sub-Atlantic period and *Picea* minimum.

Su-380. Jukolansuo **1330 ± 50**
$\delta^{13}C = -26.1‰$

Peat, depth 0.38 to 0.4m. *Comment*: pollen analysis shows Sub-Atlantic period.

Su-381. Jukolansuo **2050 ± 40**
$\delta^{13}C = -25.8‰$

Peat, depth 0.48 to 0.5m. *Comment*: pollen analysis shows Sub-Atlantic period.

Su-382. Jukolansuo **2740 ± 40**
$\delta^{13}C = -26.7‰$

Peat, depth 0.58 to 0.6m. *Comment*: pollen analysis shows rise of *Picea* pollen and transition from Sub-Boreal to Sub-Atlantic period.

Su-383. Jukolansuo **5250 ± 50**

$\delta^{13}C = -26.7‰$

Peat, depth 0.68 to 0.7m. *Comment*: pollen analysis shows end of Atlantic period.

Su-384. Jukolansuo **6520 ± 100**

$\delta^{13}C = -26.7‰$

Wood peat, depth 0.78 to 0.8m. *Comment*: pollen analysis shows Atlantic period.

Su-385. Jukolansuo **6740 ± 40**

$\delta^{13}C = -27.3‰$

Wood peat, depth 0.88 to 0.9m. *Comment*: pollen analysis shows Atlantic period.

Su-386. Jukolansuo **7090 ± 90**

$\delta^{13}C = -27.0‰$

Wood peat, depth 0.98 to 1m. *Comment*: pollen analysis shows Atlantic period.

Su-387. Jukolansuo **7460 ± 80**

Peat, depth 1.08 to 1.1m. *Comment*: pollen analysis shows Atlantic period.

Su-388. Jukolansuo **7900 ± 100**

Peat, depth 1.18 to 1.2m. *Comment*: pollen analysis shows end of Boreal period.

Su-389. Jukolansuo **8410 ± 80**

Peat, depth 1.28 to 1.3m. *Comment*: pollen analysis shows transition from Pre-Boreal to Boreal period.

Su-390. Jukolansuo **8640 ± 90**

Gyttja (detritus), depth 1.38 to 1.4m. *Comment*: pollen analysis shows Pre-Boreal period.

Su-391. Jukolansuo **8890 ± 160**

Gyttja (detritus), depth 1.48 to 1.5m. *Comment*: pollen analysis shows Pre-Boreal period.

Su-392. Jukolansuo **9490 ± 140**

Gyttja silt, depth 1.58 to 1.6m. *Comment*: pollen analysis shows Pre-Boreal period.

Su-393. Lammi, S Finland **8810 ± 100**

Clay gyttja with moss remnants (mostly *Drepanocladus fluitans*), "Silmisuo" (NW part of Kaurastensuo bog) (61° 02′ N, 24° 59′ E), surface alt 152m, depth 5.78 to 5.82m. Coll 1973 and subm 1974 by K Tolonen. *Comment* (KT): according to pollen, diatom and cladoceran

analyses sample represents the 1st organic sedimentation after deglaciation. If result is compared with Su-394 and with the standard pollen diagrams by Tolonen & Ruuhijärvi (1976), age seems to be ca 1000 yr "too young".

Su-394. Lammi, S Finland **9040 ± 80**

Same site as Su-393. Gyttja (detritus) at depth 5.67 to 5.68m. Coll 1973 and subm 1974 by K Tolonen. *Comment*: sample represents transition *Betula/Pinus* in Lammi area. Result consistent with radiocarbon chronology of pollen zones in Lammi area (Tolonen & Ruuhijärvi, 1976).

Su-395. Vaala, N Finland **8120 ± 80**

Peat (BC) overlying gyttja (detritus), depth 3.85 to 3.9m, surface alt 122.5m, Oulujärvi (64° 27′ N, 27° 10′ E). Coll 1974 with piston sampler and subm 1974 by J Häikiö. *Comment*: pollen analysis shows transition from Boreal to Atlantic period.

Bastuberg series, Porvoo, S Finland

Peat and gyttja, taken with piston sampler, Bastuberg bog (60° 21′ N, 25° 47′ E), surface alt 28.5m. Coll 1974 by A Leino and V E Valovirta and subm 1975 by V E Valovirta.

Su-474. Bastuberg, Core A **120 ± 120**
$\delta^{13}C = -25.0‰$

Peat (LSC), depth 0.2 to 0.24m.

Su-475. Bastuberg, Core A **1160 ± 60**
$\delta^{13}C = -26.5‰$

Peat (LSC), depth 0.4 to 0.44m.

Su-476. Bastuberg, Core A **5180 ± 65**

Peat (LSC), depth 0.8 to 0.84m. *Comment*: pollen analysis shows Atlantic period.

Su-477. Bastuberg, Core A **5890 ± 70**

Gyttja (detritus), depth 1 to 1.04m. *Comment*: pollen analysis shows Atlantic period.

Su-478. Bastuberg, Core A **7440 ± 90**

Gyttja (detritus), depth 1.45 to 1.49m. *Comment*: pollen analysis shows beginning of Atlantic period.

Su-479. Bastuberg, Core A **7850 ± 90**

Gyttja (detritus), depth 1.96 to 2m. *Comment*: pollen analysis shows beginning of Atlantic period.

Su-480. Bastuberg, Core A **8480 ± 100**

Gyttja (detritus), depth 2.2 to 2.25m. *Comment*: pollen analysis shows Boreal period.

Su-481. Bastuberg, Core A **9150 ± 200**

Gyttja (detritus), depth 2.4 to 2.45m. *Comment*: pollen analysis shows Pre-Boreal period.

Su-482. Bastuberg, Core B **Modern**
$\delta^{14}C = -2 \pm 6‰$

Peat (S), depth 0.18 to 0.22m.

Su-483. Bastuberg, Core B **220 ± 30**
$\delta^{13}C = -26.2‰$

Peat (S), depth 0.38 to 0.42m.

Su-484. Bastuberg, Core B **3650 ± 80**
$\delta^{13}C = -26.6‰$

Peat (LS), depth 0.78 to 0.82m. *Comment*: pollen analysis shows Sub-Boreal period.

Su-485. Bastuberg, Core B **5350 ± 100**

Peat (LS), depth 0.98 to 1.02m. *Comment*: pollen analysis shows transition from Atlantic to Sub-Boreal period.

Kerkkolankangas series, Jämsänkoski, Central Finland

Till samples containing organic matter from gravel pit at Kerkkolankangas (61° 55′ N, 25° 09′ E). Till bed is in proximal part of a marginal formation, between glaciofluvial deposits, at depth ca 6 to 7m. Surface alt 140m. Coll 1974 with spade by T Ruohomäki and M Putkinen and subm 1975 by P Lahermo and H Rainio (Rainio & Lahermo, 1976).

Su-492. Kerkkolankangas B **>45,000**

Sample from middle layer of 3-layer till bed. *Comment*: analysis based on humic acids, sample 9kg, 0.5N NaOH leach, HCl precipitation (2 2-day counts).

Su-504. Kerkkolankangas B **>45,000**

Same site as Su-492. *Comment*: analysis from 3kg till without chemical treatment (2 2-day counts).

Su-493. Kerkkolankangas C **>37,000**

Sample from lowermost layer of 3-layer till bed. *Comment*: analysis based on humic acids, sample 19.2kg (2 2-day counts).

Honkalanmäki series, Kuru, Central Finland

Till samples containing organic matter from road-cut at Honkalanmäki (61° 45′ N, 26° 36′ E) from basal till on lee side of rock hummock overlain by sand, silt and till 4m thick. Surface alt 120m. Coll 1974 with spade by T Ruohomäki and M Putkinen and subm 1975 by P Lahermo and H Rainio (Rainio & Lahermo, 1976).

Su-494. Honkalanmäki B **>37,000**

Sample from topmost layer of 3-layer till bed. *Comment*: analysis from humic acids, sample 18.6kg, 0.5N NaOH leach, HCl precipitation (2 2-day counts).

Su-495. Honkalanmäki C **>45,000**

Sample from middle layer of 3-layer till bed. *Comment*: analysis from humic acids, sample 18kg (2 2-day counts).

Osuuspankki series, Kuopio, Central Finland

Samples from ancient bog covered by sand deposits, from foundation pit excavated for Osuuspankki bldg (62° 53.5′ N, 27° 41′ E). Coll 1975 by L Timgren and subm 1975 by V E Valovirta (Kotilainen, 1953).

Su-496. Osuuspankki, Sample 1 **7760 ± 100**

Peat from lowermost part of peat, 0.4m thick, between 2 sand beds, depth 3.1m, surface alt 95.6m.

Su-497. Osuuspankki, Sample 3 **8170 ± 100**

Wood, same site as Su-496.

Su-498. Osuuspankki, Sample 4 **700 ± 100**

Mud and peat, depth 1m, surface alt 97.7m.

Kurujoki series, Sodankylä, N Finland

Samples from various levels of till deposit covered by postglacial peat bog near Kurujoki brook (67° 58′ N, 27° 18′ E), surface alt 244m. Coll with piston sampler (and jackhammer piston sampler) 1975 by E Magga and subm 1975 by R Kujansuu and S Leskelä.

Su-507. Kurujoki **9060 ± 100**

Peat from bottom of postglacial peat layer at depth of 1.45 to 1.52m.

Su-508. Kurujoki **>50,000**

Peat layer sandwiched in flood-plain sediments overlain by till and postglacial peat, depth 4.3 to 4.5m (Hirvas *et al,* 1976) (5 2-day counts).

Su-509. Kurujoki **>50,000**

Peat layer sandwiched in flood-plain sediments overlain by till and postglacial peat, depth 6.86 to 7.78m (Hirvas *et al,* 1976) (3 2-day counts).

Su-510. Kittilä, N Finland **>50,000**

Peat overlain by till, depth 5.93 to 6.50m, surface alt ca 200m, Naakenavaara (67° 42′ N, 24° 7.1′ E). Coll 1975 with jackhammer piston sampler by E Magga and subm 1975 by R Kujansuu and S Leskelä (4 2-day counts).

Su-511. Sodankylä, N Finland **7140 ± 120**

Peat from bottom of postglacial peat layer, depth 2.7 to 2.9m, surface alt ca 208m, Ilmakkiselkä (67° 43′ N, 26° 38′ E). Coll 1975 with jack-

hammer piston sampler by E Magga and subm 1975 by R Kujansuu and S Leskelä.

Su-512. Sodankylä, N Finland **9130 ± 150**

Peat from bottom of postglacial peat layer, depth 3.8 to 4.02m, surface alt ca 207m, Postoaapa (67° 38.5′ N, 26° 36.4 E). Coll 1975 with piston sampler by E Magga and subm 1975 by R Kujansuu and S Leskelä.

Su-513. Sodankylä, N Finland **>50,000**

Same site as Su-512. Gyttja overlain by till deposits, depth 6 to 6.5m. Coll with jackhammer piston sampler by E Magga and subm 1975 by R Kujansuu and S Leskelä (4 2-day counts).

Su-514. Kristiinankaupunki, W Finland **520 ± 50**

Till-covered silty sand with root remnants in gravel pit, depth 1.5m, surface alt 57m, Risåsen (62° 12.5′ N, 21° 38′ E). Coll and subm 1975 by J Niemelä and R Tynni.

Mieslahti series, Paltamo, E Finland

Samples from various levels in bog near Mieslahti (64° 22′ N, 28° 00′ E), surface alt 122.5m. Coll 1975 with piston sampler and subm 1975 by J Häikiö.

Su-515. Mieslahti **3750 ± 100**

Peat (EqC) from immediately below silty gyttja, depth 4.05 to 4.1m. Bog was flooded by water of Lake Oulujärvi.

Su-516. Mieslahti **6430 ± 60**

Peat (EqSC) overlying silty gyttja, depth 5.4 to 5.5m. *Comment*: end of flood or transgression that caused silt layer.

Su-517. Mieslahti **8000 ± 100**

Peat (EqC) mixed with detritus underlying gyttja and silt, depth 6 to 6.1m. *Comment*: pollen analysis shows transition from Boreal to Atlantic period.

Su-541. Kristiinankaupunki, W Finland **>37,000**

Sand containing charcoal in gravel pit, depth 1.5m, surface alt 57m, Risåsen (62° 12.5′ N, 21° 38′ E). Coll 1975 by R Tynni and K Hokkanen and subm 1975 by J Niemelä and R Tynni (1975). *Comment*: stratigraphic and microfossil determinations indicate that carboniferous layer was deposited during previous interstadial or interglacial period. *Cf* Su-573 (2 2-day counts).

Su-573. Kristiinankaupunki, W Finland **>50,000**

Till-covered esker, charcoal in sand in gravel pit, depth 3m, surface alt 45m, Risåsen (62° 13′ N, 21° 37.8′ E), 600m N from site of Su-541. Coll by R Tynni and K Hokkanen and subm 1975 by J Niemelä and R Tynni (4 2-day counts).

Su-542. Vaala, N Finland **300 ± 30**

Stump, exposed from below a beach ridge, surface alt 122.5m, Kuostonsaari (64° 27′ N, 27° 10′ E). Coll and subm 1975 by J Häikiö.

Sammaljoensuo bog series, Ylitornio, N Finland

Samples from various sites and levels in Sammaljoensuo bog (66° 26′ N, 23° 51′ E), surface alt 105m. Coll 1975 with piston sampler by P Lahermo and V E Valovirta (Lahermo *et al,* 1977).

Su-543. Sammaljoensuo, C-D, 105m **6230 ± 60**

Wood, depth 3.72 to 3.83m. *Comment*: dates beginning of paludification.

Su-544. Sammaljoensuo, C-D, 205m **6830 ± 120**

Peat (LSB), depth 4.2 to 4.24 m. *Comment*: dates beginning of paludification.

Su-545. Sammaljoensuo, A-B, 105m **7150 ± 50**

Peat (LSB), depth 4.35 to 4.41m. *Comment*: pollen analysis shows beginning of Atlantic period.

Su-546. Sammaljoensuo, A-B, 105m **7900 ± 150**

Peat (LSB), depth 4.58 to 4.64m. *Comment*: pollen analysis shows Boreal period.

Värttiövaara series, Kittilä, N Finland

Samples from various sites and levels in Värttiövaara bog (67° 33′ N, 25° 45′ E), surface alt 214m. Coll 1975 with piston sampler by P Lahermo, A Leino and M Putkinen and subm 1975 by P Lahermo and V E Valovirta (Lahermo *et al,* 1977).

Su-547. Värttiövaara, A-B, 0m **4660 ± 40**

Peat (BSC), depth 0.95 to 1m. *Comment*: pollen analysis shows Sub-Boreal period.

Su-548. Värttiövaara, A-B, 7m **8810 ± 50**

Peat (BSC), depth 1.9 to 1.95m. *Comment*: pollen analysis shows Pre-Boreal period.

Säynäjäjärvi series, Kittilä, N Finland

Samples from various sites and levels in Säynäjäjärvi bog (67° 21′ N, 25° 24′ E), surface alt 215m. Coll 1975 with piston sampler by P Lahermo, A Leino and M Putkinen and subm 1975 by P Lahermo and V E Valovirta (Lahermo *et al,* 1977).

Su-549. Säynäjäjärvi, A-B, 20m **4530 ± 40**

Peat (BS), depth 1.95 to 2m. *Comment*: pollen analysis shows Atlantic period.

Su-550. Säynäjäjärvi, A, 32m **7920 ± 70**

Peat (BS), depth 2.76 to 2.8m. *Comment*: pollen analysis shows beginning of Atlantic period.

Tuorenaakiselkä series, Sodankylä, N Finland

Samples from various levels and sites in Tuorenaakiselkä bog (67° 46′ N, 25° 58′ E), surface alt 296m. Coll 1975 with piston sampler by P Lahermo, A Leino and M Putkinen and subm 1975 by P Lahermo and V E Valovirta (Lahermo *et al,* 1977).

Su-551. Tuorenaakiselkä, A-B, 10m **8640 ± 120**

Peat (LSB), depth 2.06 to 2.11m. *Comment*: pollen analysis shows Pre-Boreal period.

Su-552. Tuorenaakiselkä, C-D, 14m **7910 ± 60**

Peat (LSB), depth 1.95 to 2m. *Comment*: pollen analysis shows beginning of Atlantic period.

Su-553. Tuorenaakiselkä, C-D, 29m **8790 ± 70**

Peat (CB), depth 2.76 to 2.8m. *Comment*: pollen analysis shows Pre-Boreal period.

Hattuvaara series, Suomussalmi, E Finland

Samples from various levels of Hattuvaara bog (65° 06′ N, 28° 39′ E), surface alt 262m. Coll 1975 with piston sampler by A Leino and subm 1975 by V E Valovirta.

Su-556. Hattuvaara **160 ± 50**

Peat (S), depth 0.2 to 0.23m. *Comment*: pollen analysis shows Sub-Atlantic period.

Su-557. Hattuvaara **1990 ± 90**

Peat (ErS), depth 0.4 to 0.43m. *Comment*: pollen analysis shows Sub-Boreal period.

Su-558. Hattuvaara **3640 ± 60**

Peat (ErS), depth 0.6 to 0.63m. *Comment*: pollen analysis shows Sub-Boreal period.

Su-559. Hattuvaara **4710 ± 30**

Peat (CS), depth 0.8 to 0.83m. *Comment*: rise of *Picea* pollen curve starts at this level.

Su-560. Hattuvaara **5950 ± 50**

Peat (CS), depth 1 to 1.03m. *Comment*: pollen analysis shows transition from Atlantic to Sub-Boreal period.

Su-561. Hattuvaara **6830 ± 70**

Peat (SC), depth 1.2 to 1.23m. *Comment*: pollen analysis shows Atlantic period.

Su-562. Hattuvaara **6920 ± 90**

Peat (SC), depth 1.4 to 1.43m. *Comment*: pollen analysis shows Atlantic period.

Su-563. Hattuvaara **7010 ± 110**

Peat (SC), depth 1.6 to 1.63m. *Comment*: pollen analysis shows Atlantic period.

Su-564. Hattuvaara **7210 ± 80**

Peat (SC), depth 1.7 to 1.72m. *Comment*: pollen analysis shows Atlantic period.

Su-565. Hattuvaara **7590 ± 90**

Peat (SC), depth 1.8 to 1.82m. *Comment*: pollen analysis shows transition from Boreal to Atlantic period.

Su-566. Hattuvaara **7900 ± 50**

Peat (BC), depth 1.89 to 1.92m. *Comment*: pollen analysis shows end of Boreal period.

Su-567. Hattuvaara **8040 ± 80**

Peat (EqC), depth 1.94 to 1.97m. *Comment*: pollen analysis shows Boreal period.

Su-568. Hattuvaara **8380 ± 90**

Gyttja, depth 2.02 to 2.05m. *Comment*: pollen analysis shows Boreal period.

Su-569. Hattuvaara **8790 ± 90**

Gyttja, depth 2.1 to 2.13m. *Comment*: pollen analysis shows beginning of Boreal period.

Su-570. Hattuvaara **8810 ± 150**

Gyttja, depth 2.18 to 2.21m. *Comment*: pollen analysis shows transition from Pre-Boreal to Boreal period.

Su-571. Hattuvaara **8830 ± 140**

Gyttja, depth 2.26 to 2.27m. *Comment*: pollen analysis shows end of Pre-Boreal period.

Su-572. Kuopio, Central Finland **6250 ± 100**

Wood and peat sample from peat layer in sand, Savilahti (62° 54.5′ N, 27° 37.8′ E), surface alt 90m, depth 3m. Coll 1975 by H Rainio and T Ruohomäki and subm 1975 by H Rainio.

Su-574. Bothnian Sea **6600 ± 180**

Gyttja-banded clay, Bothnian Sea (61° 40′ N, 20° 50′ E), depth ca 3m, water depth ca 85m, sample taken 0 to 5cm above Litorina/Ancylus boundary. Coll 1974 with piston corer by E Kukkonen and subm 1975 by H Ignatius. *Comment*: sample subjected to non-chemical processing.

Su-575. Bothnian Sea **8470 ± 100**

Homogeneous clay containing some organic matter, same site as Su-574, sample taken 0 to 10cm below Litorina/Ancylus boundary. Coll 1974 with piston corer by E Kukkonen and subm 1975 by H Ignatius. *Comment*: sample subjected to non-chemical processing.

II. ARCHAEOLOGIC SAMPLES

Finland

Early agricultural history in SW Finland

Su-428. Tenhola, SW Finland **1240 ± 50**

Dark humus-rich gyttja clay, Bonästräsket (60° 03′ N, 23° 22′ E), surface alt 1m, depth 1 to 1.05m, water depth ca 10m. Coll 1974 by K Tolonen and A Siiriäinen and subm 1974 by K Tolonen. *Comment*: according to land-uplift chronology from diatoms, horizon would date to ca AD 1400, *ie,* radiocarbon age is ca 700 yr "too old". Old fossil organic carbon in sediment obviously originates from "field erosion" in catchment area of basin owing to beginning of intensive rye cultivation (Tolonen & Ruuhijärvi, 1976; Tolonen, Siiriäinen & Hirviluoto, 1977).

Läppträsket series, Karjaa, SW Finland

Samples from various sites and levels, Lake Läppträsket (60° 03′ N, 23° 44′ E), surface alt 5.2m. Coll 1974 by A Siiriäinen and K Tolonen and subm 1974 by K Tolonen.

General Comment: results from Läppträsket cores agree with each other and with land-uplift chronology as well as with corresponding dates obtained from Espoo area (Tolonen *et al,* 1975a;b).

Su-429. Läppträsket, Core A **2240 ± 90**

Fine detritus gyttja, depth 2.55 to 2.65m. *Comment*: horizon represents 1st occurrence of rye in pollen diagram (Tolonen & Ruuhijärvi, 1976; Tolonen, Siiriäinen & Hirviluoto, 1977).

Su-430. Läppträsket, Core A **940 ± 100**

Dark coarse detritus gyttja from 1.8 to 1.85m. *Comment*: start of "upper occurrence" of wheat and rye (*op cit, above*).

Su-432. Läppträsket, Core D **2380 ± 70**

Dark organic gyttja clay from 2.45 to 2.55m. *Comment*: 1st occurrence of rye in pollen diagram at end of brackish water stage (*op cit, above*).

Su-433. Läppträsket, Core D **1030 ± 50**

Dark coarse detritus gyttja from 1.85 to 1.95m. *Comment*: upper occurrence of cereals after gap ca AD 600 to 900. Result agrees with history of settlement (*op cit, above*).

Su-434. Vöyri, SW Finland **990 ± 90**

Sphagnum fuscum peat from hand-dug sec from raised bog Lintunemossen (63° 07′ 30″ N, 22° 10′ E), surface alt 17.5m, depth 0.8 to 0.82m. Coll 1973 by A Siiriäinen and K Tolonen and subm 1974 by K Tolonen. *Comment*: "upper occurrence" of cultural pollen grains and cereals. Age agrees with growth-rate curve of bog obtained by means of isolation niveau at depth 1.6m, ca 1800 BP, dating Hel-705: 750 ± 100 BP, at depth 0.6 to 0.63m, and natural bog surface (*op cit, above*).

Su-435. Laitila "II", SW Finland **1210 ± 50**

Forest peat from hand-dug sec from raised bog Isorahka (60° 54′ N, 21° 38′ E), surface alt 15m, depth from 1.61 to 1.71m. Coll 1973 and subm 1974 by K Tolonen. *Comment*: date agrees with other dates from same profile as well as those from beginning of rye pollen curve in latter half of Iron age in Laitila area (*op cit, above*).

Su-436. Laitila "II", SW Finland **1780 ± 70**

Forest peat from same place as Su-435, depth from 2.4 to 2.49m. *Comment*: date agrees with land uplift chronology as well as with other dates from beginning of cerealia curve in Early Roman Iron age in Laitila area (*op cit, above*).

Su-437. Laitila "IX", SW Finland **2310 ± 50**

Gyttja from isolation niveau in basin of raised bog Pärkönsuo (60° 51′ N, 21° 40′ E), surface alt 12.5m, depth from 1.9 to 2m. Coll 1973 with large peat sampler made in USSR and subm 1974 by K Tolonen. *Comment*: 1st cerealia pollen grains occur in dated horizon, age is ca 400 to 500 yr "too old" when compared with land-uplift chronology based on diatoms (*op cit, above*).

Turkey

Su-295. Kozlu, Erbaa **4750 ± 30**

$\delta^{13}C = -23.6‰$

Wood, Kozlu (40° 36′ N, 36° 25′ E), from depth 6m in hand-dug pit; coll May 1973 by E P Kuijpers and subm 1973 by J Huhta (Giles & Kuijpers, 1974).

III. PALEOZOOLOGIC SAMPLES

Su-554. Isojoki, SW Finland **5720 ± 50**

Wood with clear marks of gnawing by beaver (Castor fiber L), from bog Todiston neva (62° 02′ N, 21° 52′ E), surface alt 79m, depth 1.5m. Museum sample. Subm 1975 by E Lappalainen (Lappalainen & Lahti, 1972; 1973).

Su-555. Kirkkonummi, S Finland **2510 ± 30**

Wood, sent to Zool Mus of Helsinki. Sample bears possible gnawing marks by beaver. Subm 1975 by E Lappalainen.

IV. GEOCHEMICAL SAMPLES

Leaves from birch trees and annual plants from Pitkälampi bog (60° 43′ N, 24° 12′ E), Loppi, S Finland, alt +110m. Samples grew on paludifying shore of oligotrophic pond. They were cleaned and washed with distilled water; coll July 1973, Aug 1974, and June 1975 by Aulis Heikkinen (Heikkinen *et al,* 1974).

Su-296. Loppi, 1-1973

$\delta^{14}C = +472 \pm 9‰$
$\Delta^{14}C = +463 \pm 9‰$
$\delta^{13}C = -21.8‰$

Leaves (*Carex lasiocarpa*), coll July 5, 1973.

Su-297. Loppi, 2-1973

$\delta^{14}C = +464 \pm 5‰$
$\Delta^{14}C = +453 \pm 5‰$
$\delta^{13}C = -21.3‰$

Leaves (*Carex vesicaria*), coll July 5, 1973.

Su-298. Loppi, 3-1973

$\delta^{14}C = +472 \pm 5‰$
$\Delta^{14}C = +460 \pm 5‰$
$\delta^{13}C = -20.9‰$

Leaves (*Phragmites communis*), coll July 4, 1973.

Su-299. Loppi, 4-1973

$\delta^{14}C = +455 \pm 4‰$
$\Delta^{14}C = +454 \pm 4‰$
$\delta^{13}C = -24.4‰$

Leaves (*Betula odorata*), coll July 4, 1973.

Su-438. Loppi, 1-1974

$\delta^{14}C = +417 \pm 5‰$
$\Delta^{14}C = +419 \pm 5‰$
$\delta^{13}C = -27.2‰$

Leaves (*Carex lasiocarpa*), coll Aug 10, 1974.

Su-439. Loppi, 2-1974

$\delta^{14}C = +423 \pm 5‰$
$\Delta^{14}C = +426 \pm 5‰$
$\delta^{13}C = -28.4‰$

Leaves (*Carex vesicaria*), coll Aug 10, 1974.

Su-440. Loppi, 3-1974

$\delta^{14}C = +429 \pm 3‰$
$\Delta^{14}C = +429 \pm 3‰$
$\delta^{13}C = -25.0‰$

Leaves (*Phragmites communis*), coll Aug 10, 1974.

Su-441. Loppi, 4-1974

$\delta^{14}C = +422 \pm 2‰$
$\Delta^{14}C = +426 \pm 2‰$
$\delta^{13}C = -28.8‰$

Leaves (*Betula odorata*), coll Aug 10, 1974.

Su-518. Loppi, 1-1975

$\delta^{14}C = +403 \pm 12‰$
$\Delta^{14}C = +404 \pm 12‰$
$\delta^{13}C = -26.7‰$

Leaves (*Carex lasiocarpa*), coll July 10, 1975.

Su-519. Loppi, 2-1975

$\delta^{14}C = +422 \pm 10‰$
$\Delta^{14}C = +425 \pm 10‰$
$\delta^{13}C = -28.2‰$

Leaves (*Carex vesicaria*), coll July 10, 1975.

Su-520. Loppi, 3-1975

$\delta^{14}C = +417 \pm 8‰$
$\Delta^{14}C = +417 \pm 8‰$
$\delta^{13}C = -25.3‰$

Leaves (*Phragmites communis*), coll July 10, 1975.

Su-521. Loppi, 4-1975

$\delta^{14}C = +398 \pm 5‰$
$\Delta^{14}C = +400 \pm 5‰$
$\delta^{13}C = -27.4‰$

Leaves (*Betula odorata*), coll July 10, 1975.

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UNIVERSITY OF TEXAS AT AUSTIN RADIOCARBON DATES XI

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The University of Texas at Austin

This list reports ^{14}C measurements completed between August 1973 and November 1975. Other projects completed in that period will be reported later. Age calculations are based on ^{14}C half-life of 5568 yr and modern standard of 95% NBS oxalic acid, supplemented by tree rings of pre-industrial wood from a log cut in the 1850's (Tx-540; R, 1970, v 12, p 249). Deviations reported are based on counting statistics of sample, background, and modern, and are $\pm 1\sigma$, except that when sample count approaches either modern or background, 2σ limits are reported. Unless noted, $^{12}C/^{13}C$ measurements were not made and results are not corrected for ^{13}C fractionation. The laboratory uses liquid scintillation counting of benzene, with Li_2C_2 and vanadium-activated catalyst in preparation; chemical yields range between 95% and 99%. Three counters are employed: a Packard Tri-Carb Model 3002, and 2 Beckman LS-230 spectrometers obtained through a grant from the National Science Foundation.

We acknowledge with gratitude the assistance of Carolyn Good in preparing the date list, and the administrative support and assistance of W W Newcomb and Saralind Mings of the Texas Memorial Museum.

I. GEOLOGIC, OCEANOGRAPHIC, AND PALEONTOLOGIC SAMPLES

Lower Gulf Coast, Texas

Samples from cores taken along lower Gulf Coast of Texas. Coll 1970-1971 and subm by E W Behrens, Univ Texas Marine Sci Inst, Port Aransas, Texas. In titles, no. after core no. is distance in cm below top of core.

Tx-1362. Baffin Bay, several cores **1590 ± 100**

Marl from several cores in different locations in Baffin Bay, 50 to 100cm below top of cores. Should date algal mat sequence found in many of the cores.

Baffin Bay Core 6 series

Samples from Core 6, 1.7km S of Marker 68, 2.8km S of Kleberg point in Baffin Bay (27° 15′ 30″ N, 97° 37′ 18″ W). Coll 1970 by Behrens.

Tx-1363. Baffin Bay 6, 486 to 497 **3550 ± 80**

Dolomite.

Tx-1364. Baffin Bay 6, 556 to 558 **4000 ± 90**

Calcium carbonate mud, shell, and dolomite.

Tx-1365. Baffin Bay 6, 608 to 617 **4010 ± 90**
Dolomite.

Baffin Bay Core 27 series

Samples from Core 27, 2.4km SW of E Kleberg Point in Baffin Bay (27° 15′ 24″ N, 97° 31′ 24″ W). Coll 1971 by Behrens.

Tx-1384. Baffin Bay 27, 655 to 657 **3910 ± 90**
Dolomite.

Tx-1385. Baffin Bay 27, 608 to 613 **3790 ± 90**
Dolomite.

Tx-1386. Baffin Bay 27, 696 to 697 **3960 ± 100**
Dolomite.

Tx-1387. Baffin Bay 27, 436 to 438 **3220 ± 80**
Dolomite.

Tx-1389. Baffin Bay 27, 45 to 65 **1920 ± 90**
Core mud.

Laguna Salada Core 8 series

Samples from Core 8, 1.9km S of Riviera Beach in Laguna Salada (27° 16′ 12″ N, 97° 40′ 30″ W). Coll 1971 by Behrens.

Tx-1366. Laguna Salada 8, 185 to 205 **3290 ± 80**
Anomalocardia cuniemeris shell hash.

Tx-1367. Laguna Salada 8, 205 to 235 **3960 ± 90**
Anomalocardia cuniemeris shell hash.

Laguna Salada Core 10 series

Samples from Core 10, 3km SE of Williamson's Boat Basin in Laguna Salada (27° 16′ 30″ N, 97° 40′ 42″ W). Coll 1971 by Behrens.

Tx-1368. Laguna Salada 10, 415 **4030 ± 90**
Blebby carbonate mud.

Tx-1369A. Laguna Salada 10, 425(a) **3880 ± 90**
Dolomite. Portion selected from larger sample.

Tx-1369B. Laguna Salada 10, 425(b) **4390 ± 80**
As with Tx-1369A, but large sample mixed thoroughly before removal of smaller sample for dating. *Comment* (EWB): average of Tx-1369A and -1369B gives most reasonable result.

Tx-1370. Laguna Salada 10, 498 to 517 **4500 ± 90**
Taxonomically diverse shell hash.

Tx-1371. Laguna Salada 10, 525 to 550 **5500 ± 90**
Taxonomically diverse shell hash.

Tx-1372. Laguna Salada 10, 555 to 575 **5760 ± 80**
Taxonomically diverse shell hash.

Tx-1373. Laguna Salada 10, 590 to 606 **6600 ± 120**
Taxonomically diverse shell hash.

Cayo del Grullo Core 20 series

Samples from Core 20, 2.2km SE of T-head pier at Loyola Beach in Cayo del Grullo (27° 19′ 18″ N, 97° 40′ 36″ W). Coll 1971 by Behrens.

Tx-1374. Cayo del Grullo 20, 45 to 55 **2390 ± 90**
Anomalocardia cuniemeris shell hash.

Tx-1375. Cayo del Grullo 20, 85 to 100 **3410 ± 70**
Anomalocardia cuniemeris shell hash.

Tx-1376. Cayo del Grullo 20, 125 to 150 **3880 ± 90**
Anomalocardia cuniemeris shell hash-carbonate rock.

Tx-1377A. Cayo del Grullo 20, 225 to 238(a) **7520 ± 130**
Core mud; portion selected from large sample without mixing.

Tx-1377B. Cayo del Grullo 20, 225 to 238(b) **10,030 ± 140**
As with Tx-1377A, but large sample first completely mixed before removal of portion for dating.

Tx-1378A. Cayo del Grullo 20, 305 to 317 **7300 ± 130**
Core mud; portion selected from large sample without mixing.

Tx-1378B. Cayo del Grullo 20, 305 to 317 **10,816 ± 120**
As with Tx-1378A, but large sample completely mixed before removal of portion for dating.

Tx-1379. Cayo del Grullo 20, 265 to 280 **5340 ± 100**
Taxonomically diverse shell hash.

Tx-1380. Cayo del Grullo 20, 365 to 380 **5670 ± 110**
Taxonomically diverse shell hash.

Tx-1401. Cayo del Grullo 20, 362 to 365 **5560 ± 100**
Taxonomically diverse shell hash.

Cayo del Grullo Core 21 series

Samples from Core 21, 2.2km SE of T-head pier at Loyola Beach (27° 19′ 42″ N, 97° 40′ 18″ W). Coll 1971 by Behrens.

Tx-1381. Cayo del Grullo 21, 608 to 644 **6560 ± 120**
Taxonomically diverse shell hash.

Tx-1382. Cayo del Grullo 21, 542 to 600 **5520 ± 100**
Taxonomically diverse shell hash.

Tx-1383. Cayo del Grullo 21, 492 to 542 **5580 ± 100**
Taxonomically diverse shell hash; carbonate rock.

Tx-1388. Cayo del Grullo 21, 400 to 450 **5050 ± 100**
Taxonomically diverse shell hash.

Tx-1392. Cayo del Grullo 21, 145 to 155 **2870 ± 80**
Anomalocardia cuniemeris shell hash; carbonate rock.

Tx-1393. Cayo del Grullo 21, 233 to 265 **3960 ± 90**
Anomalocardia cuniemeris shell hash.

Tx-1394. Cayo del Grullo 21, 115 to 137 **2560 ± 80**
Anomalocardia cuniemeris shell hash.

Tx-1402. Cayo del Grullo 21, 63 to 94 **1900 ± 70**
Anomalocardia cuniemeris shell hash.

General Comment (EWB): dates establish compatibility of varied carbonate materials for dating. Age increases with depth irrespective of material; exception is $CaCO_3$ mud finely disseminated through cores, which apparently has significant amount of detrital dead C, giving anomalously great ages (eg Tx-1377, -1378).

Dates indicate that to determine sedimentation rates, age separation of 2 samples need not be greater than combined 1σ values of the 2 dates, but should be no smaller than 1σ of either date. All pairs of samples separated by at least 100 yr give sedimentation rates comparing well (within 2σ) with rates calculated from all pairs with age separation greater than combined 1σ values of the pair.

Period of dolomite deposition from 2300 to 4300 BP, previously determined (Behrens & Land, 1972), is supported by present data. Present dates Tx-1363-1365, -1369, -1384-1387 suggest more active deposition in 1st half of this period.

Transition from open marine to closed hypersaline environment, previously dated 3500 to 5000 BP (Rusnak, 1960), is indicated by change from taxonomically diverse shell assemblage to restricted assemblage strongly dominated by *Anomalocardia cuniemeris*. Dolomite beds could probably form only after restriction began. Present dates indicate major change was between 4400 and 3600 BP; essentially modern conditions have prevailed since ca 4000 BP.

Other Gulf Coast, Texas, Samples

Packery Channel series

Samples from area of Packery Channel, Newport Channel, and Corpus Christi Channel, Mustang I., E of Corpus Christi, lower Texas Gulf Coast. Coll 1972 (except as noted) and subm by J H McGowen, Bur Econ Geol, Univ Texas, Austin. Nos. after sample title denote depth in ft below surface.

Tx-1616. Packery Channel Hole 4, 15 to 17.5 4470 ± 110

Anomalocardia cuneimeris from drill hole, depth 4.6 to 5.3m, ca 10m from E bank of Packery Channel, in bare flat, ca 700m W of Gulf beach and 1.5km N of Nueces Co Park #1 (27° 36′ 50″ N, 97° 12′ 17″ W). Holocene bay margin, grass flat sediment.

Tx-1617. Packery Channel Hole 2, 7.5 to 10 730 ± 90

Plant debris from drill hole, depth 2.3 to 3m, ca 10m S of Newport Channel, ca 550m W of Gulf beach and 2km N of Nueces Co Park #1 (27° 36′ 50″ N, 97° 12′ 45″ W), in edge of vegetated barrier flat. Holocene barrier sediment. Adjacent to recent storm channel; materials may be mixed.

Tx-1619. Packery Channel Hole 2, 10 to 12.5 1100 ± 60

Wood fragments, as with Tx-1617, depth 3.0 to 3.7m.

Tx-1618. Packery Channel Hole 2, 45 to 50 1670 ± 120

Wood fragments, as with Tx-1617, depth 13.7 to 15.2m. Sample was well below any existing recent channel and should represent initial valley-fill assoc with stillstand.

Tx-1685. Packery Channel #7, 17.5 to 20 1690 ± 50

Shell (*Donax*) from beach, depth 5.3 to 6.1m, 600m NE of Corpus Christi Channel (27° 35′ 40″ N, 97° 12′ 50″ W).

Tx-1686. Packery Channel #8, 17.5 to 20 990 ± 240

Wood fragments from beach, depth 5.3 to 6.1m, 600m NE of Corpus Christi Channel (27° 36′ 30″ N, 97° 12′ 25″ W).

Tx-1687. Packery Channel #9, 20 to 22.5 310 ± 70

Wood fragments from beach, depth 6.1 to 6.8m, 750m SW of Packery Channel (27° 36′ 25″ N, 97° 12′ 20″ W).

Tx-1688. Packery Channel #10W, 15 to 17.5 1250 ± 380

Wood fragments from beach in mouth of Packery Channel (27° 36′ 40″ N, 97° 12′ 15″ W), depth 4.6 to 5.3m.

Tx-1689. Packery Channel #11, 20 to 22.5 2880 ± 170

Wood fragments, depth 6.1 to 6.8m, 600m NW of beach midway between Packery and Corpus Christi Channels (27° 36′ 30″ N, 97° 12′ 40″ W).

Tx-1690. Packery Channel #12, 10 to 12.5 1000 ± 170

Wood fragments from 360m NW of beach, depth 3.0 to 3.8m, midway between Packery and Corpus Christi Channels (27° 36′ 20″ N, 97° 12′ 40″ W).

Tx-1691. Packery Channel #13W, 12.5 to 15 1780 ± 120

Wood chips from beach midway between Packery and Corpus Christi Channels (27° 36′ 20″ N, 97° 12′ 25″ W), depth 3.8 to 4.6m.

Tx-1692. Packery Channel #15A, 15 to 17.5 5400 ± 80

Shell (*Anomalocardia*), from 900m N of beach, depth 4.6 to 5.3m, directly up Corpus Christi Channel (27° 36′ 15″ N, 97° 12′ 55″ W).

Tx-1693. Packery Channel #15M, 15 to 17.5 5410 ± 240

Shell (*Malinia*), depth 4.6 to 5.3m, same location as Tx-1692, above.

Tx-1694. Packery Channel #13E, 12.5 to 15 2530 ± 70

Shell and mostly echinoid debris, depth 3.8 to 4.6m, same location as Tx-1691, above.

Tx-1695. Packery Channel #10M, 15 to 17.5 2580 ± 150

Shell (*Malinia*), depth 4.6 to 5.3m, same area as Tx-1688, above.

Tx-1696. Packery Channel #10D, 15 to 17.5 950 ± 90

Shell (*Donax*), depth 4.6 to 5.3m, same site as Tx-1688, above.

Tx-1697. Packery Channel #5, 17.5 to 20 2400 ± 70

Mostly echinoid shell debris, depth 5.3 to 6.1m, 300m NW of beach in Corpus Christi Channel (27° 36′ 05″ N, 97° 12′ 45″ W).

Tx-1737. Packery Channel #17, 25 to 27 850 ± 170

Wood fragment from middle of storm channel, depth 7.6 to 7.9m, 3.5km N of Bob Hall Pier, ca 30m from swash zone (27° 36′ 48″ N, 97° 12′ 07″ W). Coll 1973.

Tx-1738. Packery Channel #10, 16 to 17 3520 ± 250

Washed wood from right bank of present storm channel, depth 4.9 to 5.2m, Newport Channel, 3.3km N of Bob Hall Pier, ca 30m from swash zone on backbeach (27° 36′ 40″ N, 97° 12′ 13″ W). Coll 1973.

Tx-1739. Packery Channel #18A, 24 to 27 1320 ± 80

Washed shell (*Donax*) from left bank of storm channel, depth 7.3 to 8.2km N of Bob Hall Pier, 30m from swash zone (27° 37′ N, 97° 12′ 03″ W). Coll 1973.

Tx-1740. Packery Channel #18B, 24 to 27 2450 ± 100

Washed shell (*Mulinia*), depth 7.3 to 8.2m, same core as Tx-1739, above.

Tx-1741. Packery Channel #17, 20 to 21 1200 ± 90

Washed shell (*Donax*), depth 6.1 to 6.4m, coll 1973.

General Comment (JHMcG): dates provide chronology of development of N part of Padre I. and evolution of tidal channel between Mustang and Padre Is. These dates aided Texas State Land Office in settling a legal dispute, permitting the state to retain ownership of this segment of coastal lands.

Lavaca Bay series

Wood and plant debris samples from Sites L-55 (28° 35′ 40″ N, 96° 30′ 35″ W) and L-57 (28° 34′ 55″ N, 96° 30′ 10″ W) in Lavaca Bay,

Central Gulf coast of Texas. Dated to estimate age of aggradation of Lavaca R and oldest age of bay mud. Coll 1973 by B Wilkinson and J R Byrne and subm by Byrne, Dept Geol Sci, Univ Texas, Austin. In sample titles, figures refer to depth in meters below present sea level. Comments by Byrne.

Tx-1805. Lavaca Bay, L-55, 22.8 to 24.3 **9580 ± 760**

Comment: start of marine inundation of Lavaca-Navidad Estuary 9430 ± 100 BP.

Tx-1806. Lavaca Bay, L-55, 22.5 **8300 ± 180**

Comment: all mud is recent.

Tx-1808. Lavaca Bay, L-55, 25.8 to 27.4 **10,120 ± 3500**

Comment: ages and depths agree with pub sea level curves for Holocene.

Tx-1980. Lavaca Bay, L-57, 25.8 **9430 ± 100**

Tx-1982. Lavaca Bay, L-55, 2.4 to 3.3 **2190 ± 60**

Comment: ages from deltaic (Holocene) beds decrease in age landward. Lavaca-Navidad fluvial-deltaic complex migrated upvalley in response to rising sea level.

Matagorda, Cunningham series

Samples of oyster shell from area of Matagorda Peninsula, Holocene barrier i. on Texas gulf coast SW of Houston. Coll 1971 and subm by J D Cunningham, Bur Econ Geol, Univ Texas at Austin, unless otherwise stated.

Tx-1287. Matagorda 35/X **28,490 ± 1210**

From Pleistocene oyster reef (alt not known) on E side of Texas Hwy 35, Carancahua Bay, Jackson Co, ca 2.4km E of Hwy 35 and Hwy 172 intersection (28° 43′ N, 96° 26′ W). Will give ref date of known Pleistocene reef. Coll 1971 by J H McGowen.

Tx-1284. Matagorda SBR/X **1150 ± 70**

From growth position ca 0.6m below ground level at junction of San Bernard R and Intracoastal Waterway (28° 52′ N, 95° 27′ W). Coll 1971 by J H McGowen.

Tx-1291. Matagorda 1/AS **2480 ± 80**

From reef exposed in swash zone, 16.8km E of Sargent's Beach Rd, adjacent to W-most lake of Cedar Lakes group (28° 51′ N, 95° 28′ W).

Tx-1290. Matagorda 2/FS **860 ± 70**

From swash zone at base of forebeach in growth position 10.2km E of Sargent's Beach Rd, S of Choctaw Lake (28° 49′ N, 95° 31′ W).

Tx-1338. Matagorda A/AS **5700 ± 90**

Abraded shell from shoreface near storm channel SW of Brown Cedar Cut (28° 43′ N, 95° 42′ W).

Tx-1337. Matagorda A/FS **4040 ± 80**
Same as Tx-1338, above.

Tx-1281. Matagorda A/AB **3990 ± 80**
Same as Tx-1338, above.

Tx-1283. Matagorda AA/AS **2030 ± 80**
From shoreface erosional scarp in forebeach (28° 42′ N, 95° 44′ W).

Tx-1282. Matagorda AA/FS **11,190 ± 160**
Same as Tx-1283, above.

Tx-1286. Matagorda AA/AB **6170 ± 100**
Same as Tx-1283, above.

Tx-1289. Matagorda AA/FB **4140 ± 80**
Same as Tx-1283, above.

Tx-1288. Matagorda E/AS **6720 ± 100**
From shoreface, E Point triangulation sta (28° 41′ N, 95° 46′ W).

Tx-1285. Matagorda E/FS **37,130 ± 3110**
Same as Tx-1288, above. Should date eroding material, date of existence of bay.

Tx-1292. Matagorda E/AB **15,620 ± 250**
Same as Tx-1288, above. Should give date of reworked shell material from high energy environment, and date of bay's existence.

Tx-1293. Matagorda E/FB **5140 ± 100**
Same as Tx-1288, above. Should determine date of eroding bay materials.

General Comment (JHMcG): dates show that shell and most of sand making up Gulf shoreline features between San Bernard and Colorado R is derived from Pleistocene and Holocene deposits that are being eroded from shoreface and inner continental shelf. ^{14}C dates were used to determine sediment source for shoreline features, direction of sediment transport, and relative rates of subsidence and shoreline retreat prior to historical times.

Matagorda, Wilkinson series

Samples from various locations on Matagorda I. and Peninsula, S central Gulf Coast of Texas, coll and subm 1972, 1975 by B H Wilkinson, Dept. Geol & Min, Univ Michigan, Ann Arbor (Wilkinson, 1973). In sample titles, 1st letter or no. is designation of drill hole; following nos. are depths in ft below ground surface.

Tx-1580. Matagorda D, 39 **$\delta^{14}C = +60.67 \pm 12.1‰$**
Wood fragments from base of gray clay unit, depth 11.7m, E end Matagorda I. 80m from Pass Cavallo next to "Fish Pond" (28° 22′ 30″ N,

96° 22′ 30″ W). *Comment* (BHW): obviously not of use. Reason for anomalous age not known.

Tx-1581. Matagorda MM, 25 to 30 **4490 ± 230**

Plant fragments, depth 7.6 to 9m, S end Matagorda I. 0.8km SW of Winn Ranch (28° 05′ 50″ N, 96° 46′ 50″ W). *Comment* (BHW): anomalously old; not of use in analysis.

Tx-1582. Matagorda J, 15 to 20 **2620 ± 70**

Shell (*Donax* & *Malinia*), depth 4.6 to 6m, E end Matagorda I. 1.2km S of Lighthouse Cove (28° 21′ N, 96° 25′ 05″ W).

Tx-1583. Matagorda II, 15 to 20 **2360 ± 60**

Shell (*Donax* & *Malinia*), depth 4.6 to 6m, S central portion of Matagorda I. 3.2km SW of Panther Point Lake (28° 10′ N, 96° 42′ 25″ W).

Tx-1584. Matagorda A, 15 to 20 **5720 ± 90**

Shell (*Donax* & *Malinia*), depth 4.6 to 6m, N end Matagorda I. 0.4km NE of Matagorda I. Air Force Base (28° 20′ N, 96° 26′ W).

Tx-1585. Matagorda T, 10 to 15 **5360 ± 80**

Shell (*Donax* & *Malinia*), depth 3 to 4.6m, center Matagorda I. 3.2km SE of Long Lake (28° 17′ N, 96° 35′ W).

Tx-1586. Matagorda B, 15 to 20 **2830 ± 50**

Shell (*Donax* & *Malinia*), depth 4.6 to 6, N end of Matagorda I. 3.2km SE of Air Force Base (28° 20′ N, 96° 25′ W).

Tx-1587. Matagorda JJ, 10 to 15 **5050 ± 120**

Shell (*Donax* & *Malinia*), depth 3 to 4.6m, S central portion of Matagorda I. 3.2km NE of Cottonwood Bayou (28° 10′ N, 96° 43′ W).

General Comment on Tx-1582-1587 (BHW): these dates record Holocene progradation of Matagorda I. from ca 6000 BP (Wilkinson, 1973). They confirm sea level positions previously reported by others (Scholl & Stuiver, 1967).

Tx-2129. Matagorda 6, 77 **5300 ± 90**

Shell, depth 23.5m, 3.2km ENE Matagorda Club air field on Matagorda Peninsula (28° 28′ 10″ N, 96° 16′ 30″ W).

Tx-2130. Matagorda 13, 20 **930 ± 60**

Shell, depth 6m, 1.2km W Hooper Bayou, Matagorda Peninsula (28° 36′ 10″ N, 96° 01′ 30″ W).

Tx-2131. Matagorda 33, 25 to 30 **4350 ± 70**

Shell, depth 7.6 to 9m, W Spring Bayou Cove, Matagorda Peninsula (28° 37′ 45″ N, 95° 56′ 45″ W).

Tx-2132. Matagorda 34, 20 to 25 **4350 ± 80**

Shell, depth 13.7 to 15.3m, 1.6km ENE Burkhart Cove, Matagorda Peninsula (28° 38′ 10″ N, 95° 55′ 10″ W).

Tx-2133. Matagorda 28, 45 to 50 **6670 ± 100**

Carbonaceous debris, depth 13.7 to 15.3m, Brown Cedar cut, Matagorda Peninsula (28° 43′ 30″ N, 95° 42′ 15″ W).

General Comment on Tx-2129-2133 (BHW): samples are from beneath Matagorda Peninsula. They record in sequence estuarine depositional events in Matagorda Bay before deposition of barrier sands.

Brazoria series

Samples from buried fluvial and deltaic deposits in Holocene Brazos Delta Plain, ca 13km NE of Freeport, Brazoria Co, Texas coast (29° 02′ N, 95° 17′ W). Coll 1970 by B Cooney and subm by J H McGowen. Nos. in titles indicate depth in ft below surface.

Tx-1068. Brazoria 12 **3580 ± 100**

Shell (*Rangia*), 3.6m depth.

Tx-1069. Brazoria 17 **3590 ± 70**

Wood, 5.2m depth.

Tx-1070. Brazoria 21 **4080 ± 70**

Freshwater clam, 6.4m depth.

General Comment (JHMcG): 1st absolute dates for these deposits, are part of long-term study of sequence of development of coastal zone in Holocene.

San Bernard series

Washed shell from bay-fill sediments from various locations on Cedar and Cow Trap Lakes, W of mouth of San Bernard R, Brazoria Co, S Texas. Dated to study history of lakes, to enable settlement of legal dispute concerning State or private ownership. Coll 1972 and subm by J H McGowen. Nos. in titles refer to depth in ft below lake bottom.

Tx-1561. Cedar Lakes #16, 17, 11, 2.5 to 5.0 **670 ± 130**

Macoma mitchelli, 0.76 to 1.52m depth, 5.4 to 5.6km W of mouth of San Bernard R, 0.48 to 0.8km from shoreline (28° 50′ 30″ N, 95° 29′ W).

Tx-1562. Cedar Lakes 19 & 20, 2.5 to 5.0 **900 ± 80**

Macoma mitchelli, 0.76 to 1.52m depth, 5.4km W of mouth of San Bernard R, 1.1 km from shoreline (28° 51′ N, 95° 29′ W).

Tx-1563. Cow Trap Lakes 26, 0 to 3.5, B **310 ± 90**

Macoma mitchelli, 0 to 1.1m depth, ca 182m from N shore of lakes, 8.6km W of mouth of San Bernard R, 2.4km N of Intracoastal Canal (28° 52′ N, 95° 31′ 30″ W).

Tx-1564. Cow Trap Lakes 26, 0 to 3.5, A **470 ± 120**

Mulinia lateralis, same as Tx-1563, above.

Tx-1565. Cow Trap Lakes 21, 22, 23, 2.5 to 5.0 **510 ± 80**

Macoma mitchelli, 0.76 to 1.5m depth, 6.88km W of mouth of San Bernard R, 0.3 to 1.4km N of Intracoastal Canal (28° 51′ 30″ N, 95° 30′ 44″ W).

Tx-1566. Cedar Lakes 9, 0 to 2 **Modern**

Brachiodontes sp, 0 to 0.6m depth, 45.6m offshore, S shore of Cedar Lakes, 5.3km W of mouth of San Bernard R, 304m from Gulf shoreline (28° 50′ 20″ N, 95° 29′ 40″ W).

General Comment (JHMcG): sediment, fauna, and radiocarbon data were used in this study. Fauna indicated lakes always were connected to Gulf. Origin of lakes dated ca 1000 yr BP, much older than age cited by State's opposition in legal case. Dates provided data enabling State to retain possession of this segment of coastal lands.

Other Texas, New Mexico, Tennessee, Florida

Laubach Cave series, Texas

Bone from Pleistocene assemblages near 3 sealed entrances in Laubach Cave, 400m S of SW corner Georgetown city limits, 90m W of Interstate Hwy 35, Williamson Co, Texas (30° 37′ N, 97° 42′ W). Assemblages are not identical, but no stratigraphic or faunal data are available for ascertaining relative ages. Subm by E L Lundelius, Jr, Dept Geol Sci, Univ Texas, Austin.

Tx-1137. Laubach 1, 40673 **15,850 ± 500**

From Bone Sink #1. Coll 1969 by Lundelius.

Tx-1138. Laubach 2, 40722 **13,970 ± 310**

From surface of steep debris cone and from basin at base. Coll 1966 by Lundelius.

Tx-1139. Laubach 3, 41343 **23,230 ± 490**

From brown silt at surface of passageway at end of left hand trail. Coll 1966 by Lundelius.

Tx-1419. Laubach 3, 41343 **28,340 ± 1710**

From upper fill (red-brown silt) at end of left hand passage, Lunar Landscape Room. Coll 1971 by Billy Davidson.

General Comment (ELL,Jr): dates apply to several extinct and out-of-range extant taxa in Texas, and demonstrate that cave system had long complex history involving several openings to cave (Lundelius & Davidson, 1975).

Khulo series, New Mexico

Samples from Grid Sq IIIB and IIIC, Khulo site (MALB 21), volcanic pit 80km NW of El Paso in Afton Lava flows, Dona Ana Co, New

Mexico (32° 04′ N, 107° 03′ W); subm to establish dates for microtine distributions and reconstruct past conditions in Rio Grande valley of New Mexico and Texas. Coll 1970 by R A Smartt and subm by A H Harris, Mus of Arid Land Biol, Univ Texas, El Paso.

Tx-2020. Khulo, IIIB, Level 4, wood 2250 ± 60

Tx-2021. Khulo, IIIB, Level 5, wood 2600 ± 110

Tx-1558. Khulo, IIIB, Level 8, dung 11,690 ± 170

Tx-2016. Khulo, IIIC, Level 3, wood 3630 ± 80

Tx-2017. Khulo, IIIC, Level 4, wood 1370 ± 60

Tx-1557. Khulo, IIIC, Level 5, wood 1700 ± 70

Tx-2018. Khulo, IIIC, Level 6, wood 1790 ± 190

Tx-1556A. Khulo, IIIC, Levels 6 & 7, wood 1550 ± 60

Tx-1556B. Khulo, IIIC, Levels 6 & 7, charcoal 8210 ± 220

Tx-2019. Khulo, IIIC, Level 7, wood 6710 ± 160

General Comment (AHH): dates indicate unexpectedly great disturbance; thus, caution is indicated in interpreting similar dry cave sites in American SW. Dates also affirm Holocene age of *Microtus pennsylvanicus* (from Level 7 through Level 3, main concentration in Level 6) in Rio Grande valley of S New Mexico. Fauna from all levels is otherwise similar to present fauna of area.

Dry Cave series, New Mexico

Bone from Dry Cave site, McKittrick Hill, ca 22.5km W of Carlsbad, Eddy Co, New Mexico (32° 22′ 25″ N, 104° 28′ 55″ W); dated as part of study of late Pleistocene climatic variation, biotic sequence, and rate of evolution. Coll 1966-1973 and subm by A H Harris.

Tx-1774. Dry Cave, MALB Loc 1 29,290 ± 1060

Under Lost Valley Fissure; assoc with cave fissure fill containing fossil vertebrates indicating interstadial conditions.

Tx-1775. Dry Cave, MALB Loc 5 25,160 ± 1730

Waterlain silts in Sabertooth-Camel Maze downslope from Lost Valley Fissure and Room of Vanishing Floor Fissure on intermediate level of cave. Fauna indicates probable interstadial conditions.

Tx-1773. Dry Cave, MALB Loc 26 & 27 33,590 ± 1550

Two samples combined from cave fissure fill in and above Room of Vanishing Floor; Loc 27 stratigraphically higher in same fissure as Loc 26. Faunal remains from both locations indicate similar interstadial conditions.

General Comment (AHH): dates confirm estimate of interstadial age and approx synchrony for these sites, and rule out possibility of early Wisconsin interstadial age.

Dunmore series, Tennessee

Samples from Dunmore Site 1, 2km E of Greenville, 90m N of US Hwy 11 E in Greene Co, Tennessee (82° 50′ N, 36° 10′ W). Coll 1972 and subm by R M Perhac, Dept Geol, Univ Tennessee, Knoxville.

Tx-1620. Dunmore 1, ORDKD1-BJM1 20,080 ± 370

Organic extract from unweathered Ordovician carbonate rock 350cm below soil surface, 30cm below rock surface.

Tx-1621. Dunmore 1, ORDKD1-BJM2 16,400 ± 410

Carbonate rock residue (soil) from zone adjacent to rock 316 to 318cm below soil surface.

Tx-1622. Dunmore 1, ORDKD1-BJM3 12,490 ± 290

Carbonate rock residue (soil) from zone adjacent to rock ca 259 to 264cm below soil surface.

Tx-1623. Dunmore 1, ORDKD1-BJM4 $\delta^{14}C = +75.28 \pm 4.6‰$

Surface horizon of soil developed from carbonate rock residues.

General Comment (RMP): samples were part of preliminary study of sources and age of organic matter in zone of organic enrichment near carbonate rocks in soils. Dates indicate present surface horizons are not source of much of organic material in enriched zone. Relatively recent age of Tex-1620 is especially surprising.

Key Largo Dry Rocks series, Florida

Coral samples from reef flat, 1m depth, at wreck site on Key Largo Dry Rocks reef, S Florida (25° 15′ N, 80° 18′ W). Coll 1974 and subm by Philip Dustan, Harbor Branch Foundation, Fort Pierce, Florida.

Tx-2134A. M-66, center $\delta^{14}C = +68.68 \pm 4.8‰$

Acropora palmata.

Tx-2134B. M-66, foot $\delta^{14}C = +177.66 \pm 4.1‰$

Same as Tx-2134A, above.

Tx-2135. M-22 $\delta^{14}C = +89.64 \pm 2.9‰$

Montastrea annularis.

Tx-2136. M-0 $\delta^{14}C = +203.6 \pm 3.4‰$

Acropora palmata.

General Comment (PD): samples from centers of largest corals damaged by wreck. All are < 25 yr. Repair of reef will be rapid.

Caribbean

Tx-1896. Chalet Caribe Reef Blast # 1, Jamaica

$\delta^{14}C = +43.5 \pm 5.7‰$

Acropora cervicornus stick coral from 1.2m within coral reef at 13m depth, ca 7m towards shore from drop-off, 100m E of Anchor Canyon, in front of Chalet Carib Hotel, ca 8km W of Montego Bay, Jamaica, West Indies (18° 27′ N, 77° 58′ W). Coll 1973 by Philip Dustan and Judy Land and subm by Dustan, Harbor Branch Foundation, Fort Pierce, Florida. *Comment* (JL): date suggests rate of upward reef growth for an "open framework" coral reef is much more rapid than for most Jamaican reefs.

Discovery Bay Nekton Dive Series I, Jamaica

Samples coll during Nekton submersible dives in Discovery Bay, Jamaica, West Indies (Moore *et al*, 1976). Coll 1972 and subm by L S Land, Dept Geol Sci, Univ Texas, Austin, Texas. Depths are below mean sea level. Comments by Land.

Tx-1646. Discovery Bay N248D **200 ± 60**

Sample of sclerosponge covered with recent lithified sediment from 96m depth on wall of blast site just E of diving buoy (18° 28′ 30″ N, 77° 25′ 24″ W). *Comment*: modern age demonstrates that reef framework is constructed by sclerosponges, and lithified at this depth. Rate of sclerosponge growth and wall accretion is clearly significant, but an absolute rate is not possible to assess.

Tx-1647. Discovery Bay N181M **8600 ± 120**

Sample of lithified rock at base of Holocene reef (Dancing Lady Reef) escarpment, 128m depth (18°28′ 30″ N, 77° 25′ 30″ W). *Comment*: base of lithified wall is not a Pleistocene relict, but modern accretion and lithification appears to be very slow.

Tx-1648. Discovery Bay N202 **11,910 ± 130**

Sample of lithified talus sediment from 180m depth from crack in talus slope, E of diving buoy (18° 28′ 36″ N, 77° 25′ 18″ W). *Comment*: sediment is old and lithification is slow at this depth. May represent processes active during late-glacial rise of sea level, and "shut-off" when thermocline trangressed this depth.

Tx-1649. Discovery Bay N232H **9490 ± 150**

Sample of probable lithified Holocene talus from transplant cliff blast site, 168m depth, just W of diving buoy (18° 28′ 30″ N, 77° 25′ 30″ W). *Comment*: see Tx-1648, above.

Tx-1650. Discovery Bay N244E **12,430 ± 190**

Sample from outcrop equivalent to lithified talus from talus slope, 277m depth, just above "Matterhorn", N of diving buoy (18° 28′ 36″ N, 77° 25′ 30″ W). *Comment*: see Tx-1648, above.

Discovery Bay Nekton Dive Series II, Jamaica

(Ca, Mg)CO_3 from Haystacks #4, Discovery Bay I. slope N of Discovery Bay diving bouy, Jamaica, West Indies (18° 28′ 30″ N, 77° 24′ 36″ W). Subm to establish rate of sedimentation for Jamaican Is. slope on which no modern (post-5000 yr) lithified sediments have been found. Previous dates include Tx-1647-1650 from lithified sediments below present samples. Coll 1972 by Land, Davies, and Hasting from DSRV (submersible) Nekton "Gamma" and subm 1974 by L S Land. Depth in ft follows Nekton dive no. in titles.

Tx-2014. Discovery Bay, Nekton 192, 400 **910 ± 60**
122m depth.

Tx-2013. Discovery Bay, Nekton 192, 510 **1030 ± 60**
155m depth.

Tx-2011. Discovery Bay, Nekton 180, 680 **1360 ± 80**
207m depth.

Tx-2010. Discovery Bay, Nekton 180, 810 **1630 ± 70**
246m depth.

Tx-2012. Discovery Bay, Nekton 180, 960 **1790 ± 70**
292m depth.

Tx-2015. Discovery Bay, Nekton 192, 1010 **3530 ± 230**
307m depth.

Eastward Station series, Jamaica

Core samples of impure pelagic carbonate sediment taken from R/V "Eastward" N of Jamaica, West Indies. Dated to determine modern sedimentation rates on N Jamaican island slope and to assess rate of contribution from fringing reefs. Previous dates include Tx-1300 and -1301 (R, 1975, v 17, p 69). Coll 1973 and subm by L S Land. In sample descriptions, "bswi" = below sediment-water interface.

Tx-1825. Eastward Sta 19463 **>40,000**
Core 412 (18° 48′ 24″ N, 77° 23′ 54″ W), 5225m depth, 55 to 60cm bswi.

Tx-1826. Eastward Sta 19458 **27,960 ± 690**
Core 410 (18° 43′ N, 77° 02′ W), 4200m depth, 59 to 65cm bswi.

Tx-1827. Eastward Sta 19464 **9830 ± 140**
Core 413 (18° 40′ 48″ N, 77° 03′ 48″ W), 4230m depth, 35 to 53cm bswi.

Tx-1828. Eastward Sta 21624 **19,720 ± 250**
Core 503 (19° 12′ 30″ N, 77° 20′ 30″ W), 5100m depth, 37 to 42cm bswi.

Tx-1829. Eastward Sta 21621 **27,140 ± 700**

Core 500 (19° 23′ N, 77° 36′ W), 5300m depth, 56 to 61cm bswi.

General Comment (LSL): sedimentation rates range from <13 to 45mm/1000 yr, and appear to be relatively normal abyssal sedimentation rates. Surprisingly little reef sediment is derived from Jamaica. Sediments, 900m thick, in abyssal basins of Cayman Trench suggest an age of opening ca 45 million yr (L S Land, ms, in preparation).

Tx-2185. Eastward Sta 16283 **36,020 ± 2320**

Core 289 (18° 35′ N, 77° 23′ 42″ W), 2600m depth, half of sample 47cm bswi, remainder 61cm bswi.

Tx-2186. Eastward Sta 16285 **41,820 ± 6830**

Core 290 (18° 33′ 30″ N, 77° 24′ 18″ W), 2135m depth, 1/5 of sample from each of following depths bswi: 95, 107, 114 to 118, 122, & 140 to 143cm. *Comment* (LSL): these are 2 actual reef sediment beds, which are clearly not modern. See discussion of Burne (1974) in Moore *et al* (1976).

Bluehole series, Belize

Aragonite from different layers of massive submarine cement rind developed on stalactite in sink-hole, at 50m depth, from Bluehole, Lighthouse Reef, Belize (17° 19′ N, 87° 33′ W). Stalactite formed during last glacial period. Dates will help establish sequence of events leading to precipitation of this massive aragonite deposit. Coll by F R Dill and subm by L S Land.

Tx-1770. Bluehole, skeletal rind **2919 ± 90**

Tx-1771. Bluehole, inner 1.5cm **10,220 ± 120**

Tx-1772. Bluehole, outer 1.5cm **11,540 ± 180**

General Comment (LSL): massive cementation occurred in short interval during rise of sea level. Ages have been confirmed by U-Th method.

Tx-1752. Puerto Colombia, CH-1, Venezuela **410 ± 40**

Coral from 2km W of Puerto Colombia, Estado Aragua, Venezuela, along trail to Aroa (10° 30′ N, 67° 38′ W). Taken from slabs of coral (too large for introduction by man) overlying metamorphic rocks ca 30m above present sea level. Subm to determine late Quaternary rate of uplift of coastal ranges and elevations of past sea levels. Coll 1973 and subm by C Schubert, Inst Venezolano Investigaciones Cientificas, Caracas, Venezuela. Sample divided into 2 parts, prepared and counted separately: 470 ± 60, 350 ± 60. Final date is average. *Comment* (CS&SVJr): $^{230}Th/^{238}U$ analysis dates sample: 1400 BP. Petrographic analysis indicates partial recrystallization of the aragonite, explaining younger ^{14}C age. If Th/U gives true age, Cordillera of Central coast of Venezuela has uplifted at rate of 1.2cm/yr during last millennium (Schubert *et al*, 1975).

Aruba Island series, Dutch Leeward Islands

Coral coll from top of 2nd terrace of a 3-terrace complex, 5 to 15m alt, from sites on Aruba I. (12° 30′ N, 70° W), subm to date Quaternary events in Dutch Leeward Is. which may be correlated with Venezuelan is. Coll 1972 and subm by C Schubert. Samples were split after pretreatment, the 2 parts prepared and counted separately. Date is average, and individual dates are given in sample description.

Tx-1899. Aruba, ARU-1, 2 **40,335 ± 2830**

Guadirikiri site, NE coast. 41,890 ± 4820, 38,780 ± 2980.

Tx-1900. Aruba, ARU-6 **25,810 ± 350**

E of Ayo locality, NE coast. 26,110 ± 680, 25,500 ± 480.

Tx-1901. Aruba, ARU-7 **32,010 ± 850**

Loc same as ARU-6 (Tx-1900, above). 32,300 ± 1330, 31,720 ± 1050.

Tx-1902. Aruba, ARU-9 **28,990 ± 660**

N of Malmok loc, NW end of i. 29,960 ± 990, 28,010 ± 860.

General Comment (CS&SVJr): range of ^{14}C ages is consistent with that of La Orchila I. series, below. Petrographic and X-ray analyses revealed significant recrystallization of all Aruba samples, except Tx-1902. ^{14}C ages most probably represent recrystallization age.

La Orchila Island series

Samples from La Orchila I., off coast of Venezuela, dated for age and origin of terrace and recent beach deposits (Schubert & Valastro, 1974; 1976). Coll 1972 and subm by C Schubert. Most samples were split after pretreatment, the 2 parts prepared and counted separately: date is average, and individual dates are given in sample description.

Tx-1791. La Orchila, LO-2 **14,020 ± 160**

Beach rock, Site 3, 5km E of military base (11° 48′ 30″ N, 66° 08′ 30″ W), overlying coral rubble terrace 2 to 3m above sea level. 14,280 ± 220, 13,750 ± 240.

Tx-1742. La Orchila, LO-3 **30,530 ± 790**

Shell, Site 1, 5km E of military base (11° 48′ 30″ N, 66° 08′ 30″ W), 1m above salt flat at level of wave-cut notch in hillside.

Lx-1792. La Orchila, LO-5A **19,190 ± 180**

Beach rock with coral fragments, Site 6, 4km E of military base (11° 47′ 30″ N, 66° 09′ 30″ W), overlying terrace consisting of coral and shell fragments, 1.5m above salt flat at elev of wave-cut notch. 18,940 ± 240, 19,430 ± 270.

Tx-1743. La Orchila, LO-5B **18,880 ± 330**

Shell (*Bulla* sp?), Site 6 (see Tx-1792, above).

Tx-1793. La Orchila, LO-6 **14,970 ± 160**

Beach rock with coral fragments, Site 8, 1km SE of military base (11° 48′ N, 66° 12′ W), overlying 2 to 3m terrace. 14,750 ± 210, 15,190 ± 250.

Tx-1794. La Orchila, LO-7 **3680 ± 60**

Beach rock, Site 10, 2km SE of military base (11° 47′ N, 66° 11′ W), at sea level within Holocene beach deposits. 3680 ± 80, 3680 ± 100.

Tx-1795. La Orchila, LO-8 **8060 ± 100**

Beach rock, Site 14, 3km SE of military base (11° 46′ N, 66° 09′ 30″ W), overlying 2 to 3m coral rubble terrace. 8200 ± 150, 7910 ± 120.

Tx-1796. La Orchila, LO-9 **17,160 ± 190**

Coral, Site 14 (see Tx-1795, above). 17,060 ± 300, 17,260 ± 240.

Tx-1744. La Orchila, LO-11 **21,130 ± 240**

Coral and shell, Site 17, 4km SE of military base (11° 47′ N, 66° 09′ 30″ W), overlying 0.6m coral fragment terrace exposed along S shore of i. 20,910 ± 280, 21,560 ± 390.

Tx-1797. La Orchila, LO-12 **14,970 ± 160**

Coral, Site 17, 6km SE of military base (11° 46′ N, 66° 09′ W), near base of top of 2 to 3m terrace. 15,060 ± 240, 14,870 ± 210.

Tx-1798. La Orchila, LO-13 **25,530 ± 520**

Coral, Site 19, 6.5km SE of military base (11° 46′ N, 66° 09′ W), near base of top of 2 to 3m terrace. 25,600 ± 580, 25,460 ± 850.

Tx-1799. La Orchila, LO-14 **29,300 ± 760**

Coral, Site 21, 2km NE of military base (11° 48′ 30″ N, 66° 11′ W), overlying 2 to 3m terrace, overlain by talus deposits of Cerro Walker. 29,010 ± 1190, 29,590 ± 940.

Tx-1800. La Orchila, LO-15 **1290 ± 60**

Beach rock with coral and shell fragments, Site 22, 1.5km NE of military base (11° 49′ N, 66° 11′ W), at sea level within wave zone overlying recent beach rock, N foot of Cerro Walker. 1450 ± 100, 1130 ± 70.

Tx-1745. La Orchila, LO-16 **41,283 ± 5030**

Coral, Site 23, 2km NE of military base (11° 49′ N, 66° 10′ 30″ W), near top of 2 to 3m coral fragment terrace along S shore of lagoon E of Cerro Walker. 39,330 ± 6930, 45,190 ± 7300.

Tx-1801. La Orchila, LO-17 **15,410 ± 170**

Coquinoid beach rock, Site 24, 2.5km E of military base (11° 48′ 30″ N, 66° 10′ W), overlying terrace below wavecut notch in peridotite. 15,520 ± 250, 15,300 ± 220.

Tx-1802. La Orchila, LO-18 **20,900 ± 240**

Beach rock, Site 27, 5km NE of military base, left side of rd to El Mangle (11° 49′ N, 66° 09′ W); overlying 2 to 3m terrace. 20,780 ± 370, 21,020 ± 300.

Tx-1746. La Orchila, LO-19 **27,340 ± 460**

Coral, Site 30, 5km NE of military base and 0.8km W of El Mangle (11° 49′ N, 66° 08′ W); near top of 2 to 3m coral fragment terrace exposed along N shore of i. 27,210 ± 640, 27,600 ± 650.

Tx-1747. La Orchila, LO-20 **28,280 ± 590**

Shell (*Strombus gigas*), Site 31, 9.5km E of military base (11° 49′ 42″ N, 66° 06′ 30″ W); near top of 2 to 3m coral fragment terrace exposed along NE shore of i. 28,010 ± 700, 28,810 ± 950.

Tx-1748. La Orchila, LO-21 **28,600 ± 540**

Shell (*Strombus gigas*), Site 34, 8km E of military base midway between Cerro del Medio and Cerro Angola (11° 49′ N, 66° 07′ W); near top of 2 to 3m terrace, cemented to terrace by carbonate cement. 29,310 ± 800, 28,250 ± 720.

Tx-1803. La Orchila, LO-22 **14,570 ± 150**

Beach rock, Site 34, 10km E of military base (11° 49′ 30″ N, 66° 06′ 30″ W); near top of 2 to 3m terrace on beach cliff. 14,930 ± 240, 14,210 ± 170.

Tx-1804. La Orchila, LO-23 **120 ± 70**

Beach rock, Site 36, 10km E of military base (11° 48′ 30″ N, 66° 06′ W); near sea level from beach rock outcropping beneath beach sand.

Tx-1749. La Orchila, LO-24 **23,520 ± 270**

Coral, Site 38, 10km E of military base, 0.5km from E shore of i. (11° 48′ N, 66° 06′ W), near top of 2 to 3m coral fragment terrace exposed along E shore of i. behind storm beach. 23,170 ± 320, 24,220 ± 440.

Tx-1750. La Orchila, LO-25 **970 ± 50**

Shell (*Strombus gigas*), Site 39, 8.5km SE of military base (11° 46′ 30″ N, 66° 07′ W), near top of 2 to 3m coral fragment terrace exposed along W shore of i.

Tx-1751. La Orchila, LO-26 **2020 ± 50**

Beach rock, Site 39. 1860 ± 80, 2100 ± 70.

General Comment (CS&SVJr): ages range from 8000 to 41,000 yr BP. X-ray diffraction and petrographic data indicate alteration and recrystallization of original aragonite, at least in part, rendering ^{14}C ages too young; dates are, at best, ages of recrystallization. Two $^{230}Th/^{238}U$ dates on coral: ca 131,000 yr. If Th/U date is true age, terrace is probably of Sangamon age.

Gran Roque Island series, Los Roques Archipelago, Venezuela

Shell (*Strombus*) from 0.5km W of Gran Roque, S shore of Gran Roque I. (11° 57′ N, 66° 40′ W), subm to date terrace at +1 to 2m for correlation with similar terrace on La Orchila I. Coll 1972 and subm by C Schubert.

Tx-1897. Gran Roque, GR-1 **29,310 ± 1000**

From E side of promontory.

Tx-1898. Gran Roque, GR-2 **30,000 ± 810**

From W side of promontory. 29,960 ± 990, 30,030 ± 1270.

General Comment (CS&SVJr): X-ray diffraction indicates that samples consist of aragonite and that their ^{14}C age agrees with age of similar shells from similar geol setting on La Orchila I. (see La Orchila I. series, above).

Nullarbor Plain, Australia

Bone and charcoal from now-absent or extinct faunal assemblages on Nullarbor Plain, S central Australia, in states of W and S Australia. Samples date fauna with now disjunct distributions on either side of plain. Dates should also be relevant to problem of extinction of large marsupials in Australia. Coll 1964 by E L Lundelius, Jr, and W D Turnbull, and subm by Lundelius, Dept Geol Sci, Univ Texas, Austin.

Tx-1153. Wombat Cave, S Australia **19,240 ± 400**

Bone from 91 to 107cm below surface in Wombat Cave (TMM 41374), ca 42km W of Koonalola and 0.8km S 32° W from shed tanks on Fyre Hwy (31° 03′ S, 127° 0′ E). *Comment* (ELL,Jr): date is only current evidence for Pleistocene age of this deposit.

Madura Cave series, Western Australia

Bone from late Pleistocene and Holocene fauna in Madura Cave, ca 14.5km S of Madura (32° 02′ S, 127° 00′ E), W Australia.

Tx-1140. Madura Cave 652 **18,990 ± 220**

Pit 4, top 15cm of Unit 2.

Tx-1141. Madura Cave 653 **20,000 ± 430**

Pit 4, middle 15cm of Unit 2.

Tx-1142. Madura Cave 654 **22,400 ± 580**

Pit 3, base of Unit 2, above collapse.

Tx-1143. Madura Cave 655 **37,880 ± 3520**

Pit 4, base of Unit 7.

Tx-1144. Madura Cave 656 **22,220 ± 570**

Pit 4, between Units 4 and 5.

Tx-1145. Madura Cave 657 **15,600 ± 250**
Pit 3, Unit 2.

Tx-1146. Madura Cave 658 **7470 ± 120**
Top 30cm of Unit 1.

General Comment (ELL,Jr): dates confirm late Pleistocene and early Holocene age of this faunal sequence (Lundelius & Turnbull, 1973).

Webb's Cave series, Western Australia

Holocene assoc in N alcove of Webb's Cave (TMM 41209), 9.7km N of Mundrabilla Sta Homestead, 80km E of Madura (31° 48′ S, 127° 56′ E).

Tx-1147. Webb's Cave 906 **5030 ± 90**
Bone, 2.5 to 7.5cm below surface.

Tx-1148. Webb's Cave 907 **1500 ± 70**
Charcoal, 2.5 to 7.5cm below surface.

Tx-1149. Webb's Cave 908 **5690 ± 80**
Charcoal, 7.5 to 15cm below surface.

Tx-1150. Webb's Cave 909 **7950 ± 130**
Bone, 7.5 to 15cm below surface.

Tx-1151. Webb's Cave 910 **11,420 ± 630**
Bone, 15 to 22.5cm below surface.

Tx-1152. Webb's Cave 911 **11,970 ± 200**
Bone, 22.5 to 30cm below surface.

General Comment (ELL,Jr): dates indicate terminal Pleistocene and early Holocene age for faunal sequence.

Other Australia

Bone Cave series, New South Wales

Marsupial bone from Bone Cave, 8km S of Wellington, New South Wales, Australia (32° 30′ S, 149° 00′ E). From Loc 3 (Frank, 1971, p 16, 25). Coll 1967 by R M Frank and subm by E L Lundelius, Jr.

Tx-672. Bone Cave floor **22,570 ± 610**
From Unit 3 (RB), loose material on floor.

Tx-673. Bone Cave, lower **30,610 ± 2110**
From base of Unit 3 (RB).

General Comment (ELL,Jr): dates apply to 1 of longest-known and most diverse Pleistocene fauna in Australia.

II. ARCHAEOLOGIC SAMPLES

Texas

Alfred Mackin series

Charcoal from Alfred Mackin site (41 LR 36; Mallouf, 1976, p 65-303; discussion, p 448), early Caddo village and mound site on Nolan

Creek, 24km NE of Paris, Lamar Co, NE Texas (33° 47′ 53″ N, 95° 20′ 24″ W). Coll 1974 & 1975 and subm by R J Mallouf, Texas Hist Comm, Austin, Texas.

Tx-2167. Alfred Mackin #8 **710 ± 40**

Mound B, N259/E462, Feature VIIb, Level 1, 15cm depth; midden area within burned house; Early Caddoan, Gibson aspect.

Tx-2170. Alfred Mackin #31 **1320 ± 170**

Mound B, N259/E462, Feature VIIc, Postmold #1; should date burning of house; probably pre-Caddoan, Early Ceramic.

Tx-2171. Alfred Mackin #32 **890 ± 60**

Mound A, Trench 1, Units 2 & 3 at contact between Zones A-4 and A-8; subm to establish length of time between phases of mound construction.

Tx-2172. Alfred Mackin #39 **1000 ± 70**

Mound A, Trench 1, Unit 2, Zone A-8, 100.48m alt; major construction phase of mound.

Tx-2173. Alfred Mackin #41 **740 ± 340**

Mound A, Trench 1, Unit 6, Zone A-3, 99.39m alt; premound humus zone, thought to be pre-Caddoan, Early Ceramic.

Tx-2174. Alfred Mackin #44 **1100 ± 70**

Mound A, Trench 1, Unit 2, Feature I, Component 5, 99.81m alt; premound occupation, Early Caddoan.

Tx-2175. Alfred Mackin #47 **940 ± 40**

Mound A, Trench 1, Unit 2, below Component 6 of Feature I, 99.59m alt; premound surface; Early Caddoan.

Tx-2176. Alfred Mackin #48 **970 ± 40**

Mound A, Trench 1, Unit 2, uppermost log of Feature I, 99.83m alt; premound occupation; Early Caddoan.

Tx-2177. Alfred Mackin #34, 47 **770 ± 180**

Mound A, Trench 1, Unit 4, Feature IIIa hearth; major mound construction phase; Early Caddoan.

Tx-2178. Alfred Mackin #24, 29 **1410 ± 150**

Mound B, N255/E463, Zone B-4, top of buried A-horizon, 99.38 to 99.44m alt; premound occupation; pre-Caddoan, Early Ceramic.

Tx-2179. Alfred Mackin #35, 48 **1010 ± 80**

Mound A, Trench 1, Unit 4, Component D-6, Feature IIIe, 100.45m alt; major mound construction phase; Early Caddoan.

General Comment (RJM): except for Tx-2173, which is anomalously late, dates support archaeol sequence: Tx-2170, -2173, -2178, pre-Caddoan;

Tx-2172, -2174 -2177, -2179, Early Caddoan; Tx-2167, later Early Caddoan occupation of mound after burning of house.

Tx-1511. Millican Bench site **500 ± 80**

Charcoal from S175.10/E151.25, base of Level 3, Millican Bench site (41 TV 163), Transitional Archaic site at NW limits of Austin, Texas, on tributary of Bull Creek (30° 22′ 57″ N, 97° 44′ 59″ W). Coll and subm 1971 by F A Weir, Texas Hwy Dept, Austin, Texas. *Comment* (FAW): date significantly later than expected for Transitional Archaic site; latest occupation of site thought to be ca AD 1200. Reason for discrepancy not known.

Loeve-Fox Series II, Texas

Charcoal from Loeve-Fox site (41 WM 230; Prewitt, 1974; these and related dates discussed p 22-30), left bank San Gabriel R, 8km NNE of Taylor, Williamson Co, Texas, in Laneport Reservoir basin (30° 39′ 25″ N, 97° 24′ 58″ W). Coll 1972-73 and subm by E R Prewitt, Texas Archeol Survey, Univ Texas, Austin. For previous dates, see R, 1975, v 17, p 83. Hyphenated nos. in titles refer to depth in ft.

Tx-1925. Loeve-Fox 20, 2.5-3 **870 ± 60**

F-1c burial pit, N1000/W1030, 76 to 91cm depth. Assoc with Scallorn arrow points.

Tx-1923. Loeve-Fox 33 and 56, 3-3.5 **940 ± 60**

F-1c burial pit, 91 to 106cm depth.

Tx-1927. Loeve-Fox 6 and 10, 2.5-3 **1480 ± 80**

F-2 hearth in pit, N1060/W990, 76 to 91cm depth. Assoc with Darl projectile points.

Tx-1924. Loeve-Fox 47 to 48, 3 **2100 ± 880**

F-5 hearth in pit, N895/W1000, 91cm depth. Assoc with Ensor projectile points.

Tx-1922. Loeve-Fox 44, 3.5 **1670 ± 100**

Same as Tx-1924, above; 106cm depth.

Tx-1926. Loeve-Fox 26, 4-4.5 **1300 ± 60**

F-11 hearth and ash pit, N895/W990, 120 to 137cm depth. Assoc with Ensor projectile points.

Tx-1764. Loeve-Fox 13a, 1.5-2 **1080 ± 60**

F-4 (Hearth 2), N895/W990, 45 to 60cm depth.

General Comment (ERP): Tx-1925 and -1923 date Austin phase cemetery beginning ca AD 1000. Tx-1764 confirms assoc of Hearth 2 with Austin phase occupation. Other dates establish AD 200-700 as approx range of Twin Sisters phase in San Gabriel R valley.

Chupik Site series, Texas

Wood and hackberry seed charcoal from Chupik site (41 ML 44), 19.2km NW of Waco, Texas, 2.1km NW of confluence of Brazos R and Aquilla Creek (31° 41′ 10″ N, 97° 10′ 30″ W). Pottery shows relationships with George C. Davis site and other E Texas sites; other artifacts are characteristic of Central Texas aspect. Coll 1972 by D A Story and subm by C E Locke, Texas Archeol Research Lab, Balcones Research Center, Univ Texas, Austin.

Tx-1753. Chupik, Zone II **740 ± 260**

Wood charcoal, N940/W947.5.

Tx-1755. Chupik, F-1-3 **760 ± 320**

Wood charcoal, fill, N936/W948, 99.12m.

Tx-1756. Chupik, F-1-4 **890 ± 340**

Wood and hackberry seed charcoal, N936/W947.5, top of Zone II.

General Comment (CEL): large error in dates due to small sample size; however, dates are fairly consistent, fall within time range expected on basis of artifact assemblages, and coincide with period during which Davis site in E Texas was experiencing internal changes.

Tx-2309. 41 KE 49/N-2 **1120 ± 60**

Charcoal from Site 41 KE 49 on Cibolo Creek, S of Upper Cibolo Rd, 8km NW of Boerne, Kendall Co, Texas (29° 49′ 30″ N, 98° 47′ W). From beneath hearth, Unit N, Level 2, 35cm depth; assoc with La Jita and Bulverde points. Coll 1975 by T C Kelly and subm by T R Hester, Center for Archaeol Research, Univ Texas at San Antonio. *Comment* (TRH): given assoc Early Archaic point types, date should be much earlier (*cf* Hester, 1971, re La Jita type). Charcoal perhaps intrusive via rodent burrowing into hearth area.

Tx-2207. Hinojosa site **580 ± 50**

Charcoal from Hinojosa site (41 JW 8), W bank of Chiltipin Creek, 14km NW of Alice, Jim Wells Co, S Texas (27° 53′ N, 98° 07′ 15″ W). From Unit S20/W3, Level 1, 0 to 15cm depth; assoc with late prehistoric occupation represented by Perdiz points, bone-tempered pottery, small end scrapers, *Bison* and other fauna. Coll 1975 by F A Bass, Jr and subm by T R Hester. *Comment* (TRH): date agrees with others from S Texas late prehistoric sites (Hill & Hester, 1973; Hester & Hill, 1975). Probably a good indication of age of late prehistoric tradition in parts of S Texas (with traits as described above) described in Hester (1975).

Tortuga Flat series, Texas

Charcoal from Tortuga Flat site (41 ZV 155), E floodplain Tortugas Creek, 13km E of Crystal City, Zavala Co, Texas (28° 45′ 30″ N, 99° 45′ 30″ W). Protohistoric occupation, bone-tempered ceramics, varied arrowpoint forms, rich fauna. Coll 1971 by T C Hill, Jr; subm by Hill and T R Hester. Comments by TCH & TRH.

Tx-1514. Tortuga Flat, 1 **170 ± 60**

From Test Pit 1, Level 1, 0 to 6in (0 to 15cm) below surface. *Comment*: assoc with lozenge-shaped arrow point, faunal remains. Date somewhat late, possibly caused by mixing of charcoal from occupation zone with post-occupational deposits.

Tx-1515. Tortuga Flat, 2 **410 ± 60**

From "Bone Pile", accumulation of varied faunal and occupational debris, including triangular arrow points. *Comment*: date is reasonable for protohistoric occupation. Assoc fauna includes antelope and bison, recorded by early Spanish explorers in region but absent in last 200 to 300 yr.

General Comment: absence of evidence of Spanish contact makes Tx-1514 seem late but still possible. In general, dates, especially Tx-1515, corroborate stylistic evidence for protohistoric time. At nearby Site 41 ZV 14, latest ceramic assemblage has ^{14}C date of <300 (UCLA 1821A: Hester & Hill, 1972, p 38, footnote).

Chaparrosa Ranch series, Texas

Charcoal from sites on Turkey Creek, on Chaparrosa Ranch, NW Zavala Co, near La Pryor, Texas. Coll and subm 1970 by T R Hester.

Tx-1525. Chaparrosa 14 **1180 ± 120**

From Test Pit 2, Level 2, 20 to 40cm below surface, at Chaparrosa 14 (41 ZV 11), W floodplain Turkey Creek, 15km SW of La Pryor (28° 51′ N, 99° 58′ W). *Comment* (TRH): date within predicted time span of AD 500 to 1000; represents occupation near middle of depositional sequence at site. Another sample from same pit and level is UCLA-1821C, 1535 ± 100 (Hester, pers commun). No diagnostic artifacts in this level. Higher, in Level 1, were small side-notched points and UCLA-1821B, <300 (Hester, pers commun).

Tx-1526. Chaparrosa 28 **430 ± 60**

From Test Pit 2, Level 3, 50cm below surface, at Chaparrosa 28 (41 ZV 83), E bank main channel Turkey Creek, ca 13km SW of La Pryor (28° 53′ N, 99° 57′ W). Assoc with concave-base lanceolate fragment of point or knife. *Comment* (TRH): date reasonably agrees with UCLA-1821D, <300, from same level (Hester, per commun). Apparently, 50cm alluvium accumulated here in past 300 to 400 yr. Dates indicate that later occupation, Level 1, with stemmed arrowpoints and triangular convex-based arrowpoints, must be within early historic era, although no European artifacts have been found. From deeper level, 4, came UCLA 1821E, 1400 ± 100 (Hester, pers commun).

Tx-1527. Chaparrosa 27 **500 ± 70**

From Test Pit 1, Level 3, 40 to 60cm below surface, at Chaparrosa 27 (41 ZV 82), W floodplain Turkey Creek, ca 20km SW of La Pryor (28° 48′ N, 99° 59′ W). *Comment* (TRH): this is earliest substantial

occupation recognized at site. No diagnostic artifacts assoc; however, final occupation at site has triangular points (dart points?) and several specimens of tentative Zavala type point, of late prehistoric age (Hill & Hester, 1971; Hester & Hill, 1975).

Black Dog Village series

Charcoal, except where noted, from Black Dog Village site (41 HC 30; Keller, 1975; discussion, p 63-64), early Panhandle aspect site at confluence of Cottonwood Creek and Canadian R, 8km N of Borger on State Hwy 207 in Texas Panhandle (35° 43′ 58″ N, 101° 24′ 58″ W). Coll 1971 and subm by F A Weir, Texas Hwy Dept, Austin. Comments by J E Keller.

Tx-1488. Black Dog 1 **390 ± 50**

Tx-1489. Black Dog 2 **510 ± 60**

Tx-1490. Black Dog 3 **470 ± 60**

Tx-1491. Black Dog 4 **460 ± 60**

All above samples from Feature 6, Structure 4, round pit house or earth lodge, not typical of Panhandle aspect, below Structure 2 (see Tx-1493, below). Probably earliest structure on site.

Tx-1493. Black Dog 10 **280 ± 150**

Structure 4, Feature 13, Hearth; 0.46m below surface. Later than Structure 4, Feature 6 (Tx-1488-1491, above).

Tx-1495. Black Dog 12 **300 ± 50**

Structure 5 (Big House): floor fill from SE corner. Only typical Panhandle aspect structure, and probably latest structure at site.

Tx-1496. Black Dog 14 **590 ± 60**

Structure 5; floor fill.

Tx-1497. Black Dog 17 **610 ± 50**

Structure 5; surface of altar.

Tx-1512. Black Dog 16 **980 ± 170**

Structure 5, N Central post hole.

Tx-1513. Black Dog 18 **420 ± 70**

Feature 17; fill of trash pit immediately S of Structure 3, 4.6m E of entry of Structure 5 (Big House); may be assoc with Structure 5.

Tx-1498A. Black Dog 19A **500 ± 70**

Bone apatite.

Tx-1498B. Black Dog 19B **1110 ± 200**

Bone collagen. Feature 17; trash pit.

Tx-1499. Black Dog 20 **350 ± 90**

Feature 17; trash pit.

General Comment: dates indicate 3 periods of settlement, a classic Panhandle aspect occupation and 2 occupations, less well defined. At end of Panhandle aspect occupation, an occupation was assoc with pit house, which, while different architecturally, was similar in artifactual materials. Afterwards, site was reoccupied by a group which built or reutilized Structure 2. Dates do not support a continuous Panhandle aspect occupation.

After above samples were dated, 2nd series was subm, including several portions of same samples as above. Dates range 700 to 1000 yr earlier than those above, but in same general relationships to one another. Storage circumstances were checked. Although specimens were in polyethylene containers, they appear to have been contaminated by dead C in organic insecticide used to fumigate storeroom. Second series, Tx-1710-1719, is considered invalid and is therefore not reported.

Anthon series, Texas

Charcoal from Anthon site (41 UV 60), 6.4km SW of Uvalde city limits on 1st terrace of proposed crossing of Nueces R by FM 481, Uvalde Co, SW Texas (29° 07′ 21″ N, 99° 53′ 13″ W). Coll 1975 and subm by F A Weir. Nos. in titles following sample nos. indicate depth in ft.

Tx-2378. Anthon 7, 1.65-2 **1580 ± 60**

Sq N187.2/E75, 0.5 to 0.6m depth, upper midden, assoc with Frio point and Feature 3 hearth.

Tx-2380. Anthon 23, 3.25-3.5 **2210 ± 60**

Sq N108.8/E118, 0.9 to 1m depth, upper portion of lower midden.

Tx-2381. Anthon 24, 3.95 **3000 ± 60**

Sq N104/E123.5, 1.2m depth, lower midden.

Tx-2383. Anthon 42, 0.5 **830 ± 70**

Sq N101.4/E135.5, 0.15m depth.

Tx-2384. Anthon 43, 2 **1640 ± 60**

Sq N108.4/E117, 0.6m depth, same level as Feature 15 hearth.

Tx-2385. Anthon 62, 3.35-3.5 **3120 ± 70**

Sq N190.6/E204, 1 to 1.1m depth, lower midden, Feature 25, assoc with Kinney and Pedernales points.

Tx-2442. Anthon 16, 3.9 **3520 ± 60**

Sq N105/E82 and surrounding area, ca 1.2m depth, Feature 16 hearths.

Tx-2443. Anthon 46, 1.25-1.75 **800 ± 50**

Sq N95-97/E140-142, .38 to .5m depth, upper midden.

Tx-2444. Anthon 64, 0.8-1 **680 ± 50**

Sq N171.7/E25, 0.2 to 0.3m depth, upper midden, assoc with Ensor points.

General Comment (FAW): earliest deposits of lower midden, dated by Tx-2381, -2385, & -2442, indicate Middle Archaic, Round Rock phase, occupation. Assoc of Tx-2378 & -2384 with Late Archaic, San Marcos and Twin Sisters phases points agrees with other dates for this stage from Central and W Texas. Post-Archaic deposits of upper midden are dated by Tx-2444 & -2383. Tx-2443 is assoc with Post-Archaic and Late Archaic deposits because of depositional disturbance. For definition of Archaic phases, see Weir (1976).

Perro Salvaje site series, Texas

Charcoal from Midden B, Perro Salvaje site (41 SU 2), Late Archaic burned-rock ring midden 4.8km E of Sonora on hill S of dry tributary of Lowrey Draw, Sutton Co, Texas (30° 34′ 34″ N, 100° 37′ 15″ W). Coll 1971 by E R Prewitt and subm by F A Weir.

Tx-1507. Perro Salvaje #2 **910 ± 60**

N470/E940, base of Level 2.

Tx-1508. Perro Salvaje #3 **920 ± 70**

N455/E940, Level 3.

Tx-1509. Perro Salvaje #4 **860 ± 60**

N455/E940, Level 3.

Tx-1510. Perro Salvaje #5 **1040 ± 60**

N450/E940, Level 4.

General Comment (FAW): dates are at least 500 yr later than expected for a Late Archaic site, although not late for ring middens. Possibly change from Archaic to Late Prehistoric took place later here than in Central Texas, or else the 2 stages overlap here.

Three Dog site series, Texas

Charcoal from Three Dog site (41 CX 95), Middle Archaic to Neo-American burned rock middens and assoc hearths, 28.9km W of Ozona at crossing of Howard draw by Interstate Hwy 10, W central Crockett Co, Texas (30° 41′ 32″ N, 101° 26′ 37″ W). Coll and subm 1972 by F A Weir and G L Moore, Texas Hwy Dept, Austin, Texas.

Tx-1703. Three Dog #1 **780 ± 90**

Feature #2, within hearth.

Tx-1704. Three Dog #2 **1980 ± 500**

Feature #21, within hearth.

Tx-1705. Three Dog #3 **1660 ± 70**

Feature #2, outside hearth.

Tx-1706. Three Dog #4 **1020 ± 140**
Feature #6, outside hearth.

Tx-1707. Three Dog #5 **820 ± 70**
Feature #6, within hearth.

Tx-1708. Three Dog #6 **840 ± 70**
Feature #11, within hearth.

Tx-1709. Three Dog #7 **1430 ± 60**
Feature #11, under hearth.

General Comment (FAW): dates apply only to Neo-American occupation; rest of site sequence could not be dated.

Tx-897. Bonfire 338, 439, 593, apatite **9610 ± 130**
Apatite fraction from bison bone, Bonfire Shelter (41 VV 218; Dibble and Lorrain, 1968), E side of Mile Canyon 1.6km from Rio Grande R, E of Langtry, Val Verde Co, SW Texas (29° 48′ N, 101° 33′ W). From Bone Bed 2, Feature 28, Component A, assoc with Folsom and unfluted lanceolate points. Coll 1964 and subm by D S Dibble, Texas Archeol Survey, Univ Texas, Austin. *Comment* (DSD): subm to cross-check apatite dating with previous dates on charcoal samples Tx-153 (10,230 ± 160; R, 1965, v 7, p 304), Tx-657, -658 (9920 ± 150, 10,100 ± 300; R, 1970, v 12, p 269). Present date a little later, but agrees with Tx-657 and -658 within 2σ.

Arenosa Shelter, Series 4, Texas

Charcoal from Arenosa Shelter (41 VV 99), E bank Pecos R, 1.6km upstream from confluence with Rio Grande, Val Verde Co, Texas (29° 42′ N, 101° 22′ W). Subm to provide additional dating control and check of previous dates. Coll 1965-1967 and subm by D S Dibble.

Tx-1977. Arenosa 52, Stratum 11 **2520 ± 50**
Stratum 11 (all levels), N202W210, assoc with Montell projectile points. Previous dates from stratum: Tx-286, 2410 ± 140, Tx-311, 2440 ± 140 (R, 1967, v 9, p 444).

Tx-1975. Arenosa 58, Stratum 23 **3600 ± 70**
Stratum 23, Diagonal Profile N210W200-180, sample from lens in middle of stratum; assoc with Middle Archaic assemblage including Langtry, Val Verde, and Almagre dart points. Previous date from stratum: Tx-287, 4080 ± 380 (R, 1967, v 9, p 444).

Tx-1979. Arenosa F13, Stratum 28 **4450 ± 150**
Hearth, Feature 13, on Stratum 28 living surface, assoc with Early Archaic assemblage including Pandale points. Same sample as SI-1401, 4630 ± 100 (R Stuckenrath, pers commun).

Tx-1976. Arenosa 163, Stratum 28 **5520 ± 280**

Stratum 28, N199W174, on and within living debris; assoc with Pandale dart points. Previous dates: Tx-1979, above, and Tx-660, 4440 ± 110, from underlying Stratum 30 (R, 1970, v 12, p 269).

General Comment (DSD): except Tx-1976 (note inconsistency with Tx-660, noted above), dates in this series are within 2σ of previously dated samples and thus serve to substantiate assumed age of deposits.

Conejo shelter series, Texas

Wood charcoal from Conejo shelter (41 VV 162; Alexander, 1974), 0.5km up from mouth of canyon emptying into Rio Grande 5km above mouth of Pecos R, in Amistad Reservoir basin (29° 44′ N, 101° 24′ W). Coll 1968 by R K Alexander and subm by Alexander and D S Dibble, Texas Archeol Survey, Univ Texas, Austin. No. in title following sample designation indicates depth in in.

Tx-879. Conejo 12, 41-47 **12,280 ± 170**

Units I and II, 1.04 to 1.19m depth.

Tx-880. Conejo 29, 54 **13,920 ± 210**

Unit Ic, 1.37m depth; overlying Bone 32.

Tx-881. Conejo 30 **14,300 ± 220**

As with Tx-880, 0.18m N of Bone 32.

Tx-1757. Conejo H.11 **1810 ± 70**

Agave leaf-bases, Lens H, N85/W106. *Comment* (DSD): date appears appropriate for Late Archaic deposition.

Tx-1758. Conejo 125.7 **6650 ± 110**

Charcoal, Lens 125, N95-100/W105; in basal limestone dust deposit containing Early Barbed points; earliest occupation of site.

Tx-1759. Conejo 38.4 **2690 ± 80**

Charcoal, Lens 38, N85/W105; dates beginning of Ensor point occupation. *Comment* (DSD): date somewhat early when compared with radiocarbon age of Ensor-producing strata at Arenosa shelter (41 VV 99) on Pecos R 5km from Conejo.

Tx-1760. Conejo 115.3 **4890 ± 90**

Charcoal, Lens 115, N95/W95-100; dates approx beginning of Pandale point occupation. *Comment* (DSD): this date, Tx-1762 and -1763, all assoc with Pandale points, overlap within 1σ. Literal interpretation of age correspondence in Pandale-producing layers suggests rapid build-up of deposits during this occupation.

Tx-1761. Conejo 50.2 **3310 ± 90**

Charcoal, Lens 50, N95/W95; major stratum with Val Verde points. *Comment* (DSD): date appears appropriate when compared with strata from Arenosa Shelter which produced Val Verde materials.

Tx-1762A. Conejo 103.3, charcoal **4950 ± 70**

Tx-1762B. Conejo 103.3, agave leaves **4590 ± 90**

Lens 103, N95/W95, approx center of Pandale point occupation. *Comments* (RKA): inconsistency of dates may reflect later introduction of older refuse into campfire; (EMD): fractionation may occur during photosynthesis in agave; this must be checked. However, Tx-1757 date on agave, above, seems appropriate.

Tx-1763. Conejo 87.5 **5020 ± 80**

Charcoal, Lens 87, N95/W100, approx end of Pandale occupation. *Comment* (DSD): age is generally within time range of Pandale point popularity at Arenosa Shelter but appears much too early for late manufacture of this style in region. See also Tx-1760, above.

General Comment (RKA): dates correspond well with sequence of projectile point forms as outlined by Story (1966).

Perry's Ram's Head series, Texas

Charcoal from Perry's Ram's Head site (41 PC 35), Transitional Archaic and late prehistoric burned-rock midden, on N tributary of Fourmile Draw 32km W of Sheffield on U S Hwy 290, Pecos Co, W Texas (30° 50′ 29″ N, 102° 02′ 50″ W). Coll 1971 by E R Prewitt and subm by F A Weir, Texas Hwy Dept, Austin, Texas. Comments by Weir.

Tx-1500. Perry's Ram's Head #1 **940 ± 50**

Midden 1, N490/F550, Level 2, 0.5 to 1 ft (0.15 to 0.3m) below surface, central hearth. *Comment*: agrees with Tx-1507-1510 from Perro Salvaje, above, which also have Late Archaic artifact assoc. See comment for those dates.

Tx-1501. Perry's Ram's Head #2 **340 ± 70**

Midden 2, N490/E470, upper margins of Feature 8, central hearth.

Tx-1502. Perry's Ram's Head #3 **410 ± 60**

Midden 2, N490/E470, upper margins of Feature 8.

Tx-1503. Perry's Ram's Head #4 **240 ± 60**

Midden 2, N490/E470, bottom and E half of Feature 8.

Tx-1504. Perry's Ram's Head #5 **350 ± 50**

Midden 2, N490/E465, bottom and W half of Feature 8.

General Comment on Tx-1501-1504: dates agree with artifact types in indicating Midden 2 represents very late component, some 500 yr later than Midden 1.

Tx-1505. Perry's Ram's Head #6 **560 ± 70**

Midden 2, N480/E475, SE portion of burned-rock ring around central hearth, Level 3, 0.4 to 0.6 ft (0.12 to 0.18m) below surface. *Comment*: earlier than Tx-1501-1504, which are assoc with same hearth, but still within estimated time for late prehistoric artifacts.

Squawteat Peak series

Charcoal from 3 overlapping ring middens and assoc hearths, Squawteat Peak site (41 PC 14), S slope of Squawteat Peak, 53km E of Fort Stockton, Pecos Co, SW Texas (30° 53′ 30″ N, 102° 19′ 50″ W). Late Archaic context including Frio and Ensor dart points and Perdiz and Alba-like arrow points. No ceramics. Coll 1974 and subm by F A Weir. Hyphenated nos. in titles indicate depth in ft.

Tx-2053. Squawteat #1, 1-1.5 **2120 ± 70**

Feature 3, Unit S430/W580, Level 2, 0.3 to 0.45m depth; from hearth adjacent to midden.

Tx-2054. Squawteat #2, 4-4.5 **860 ± 60**

Feature 1, Unit S455/W565, Level 9, 1.2 to 1.4m depth; Midden #1, base of oldest midden.

Tx-2055. Squawteat #3, 4.5-5 **1050 ± 60**

Feature 1, Unit S455/W565, Level 10, 1.4 to 1.5m depth.

Tx-2056. Squawteat #4, 0.5-1 **630 ± 100**

Pit of Midden #1, Unit S455/W545, Level 2, 0.15 to 0.3m depth.

Tx-2057. Squawteat #5, 1-1.5 **980 ± 130**

Same as Tx-2056, above; Level 3, 0.3 to 0.45m depth.

Tx-2058. Squawteat #6, 1.5-2 **420 ± 60**

Same as Tx-2056, above; Level 4, 0.45 to 0.6m depth.

Tx-2059. Squawteat #7, 2-2.5 **420 ± 70**

Same as Tx-2056, above; Level 5, 0.6 to 0.76m depth.

Tx-2060. Squawteat #8, 2.5-3 **610 ± 50**

Same as Tx-2056, above; Level 6, 0.76 to 0.9m depth.

Tx-2061. Squawteat #9, 1-1.5 **450 ± 60**

Pit of Midden #1, Unit S460/W545, Level 3, 0.3 to 0.45m depth.

Tx-2062. Squawteat #10, 1.5-2 **650 ± 70**

Pit of Midden #2, Unit S460/W525, Level 4, 0.45 to 0.6m depth.

Tx-2063. Squawteat #11, 3-3.5 **800 ± 70**

Same as Tx-2056, above; Level 7, 0.9 to 1m depth.

General Comment (FAW): Tx-2053 applies to Late Archaic occupation preceding main activity in late prehistoric, development of ring middens, to which Tx-2054-2063 refer.

Kaw Reservoir Basin, Oklahoma

Charred wood from sites in Kaw Reservoir basin on Arkansas R, Kay Co, N Oklahoma. Coll 1972 and 1975 and subm by C L Rohrbaugh, except as noted.

Tx-1911. Vickery 1 **1520 ± 80**

Feature 1, N5-W2, Area A, 30 to 55cm (12 to 22 in.) depth, L W Vickery site (34 KA 41; Rohrbaugh, 1974a, p 31-74; discussion, p 50), Plains Woodland site, 10.4km N, 2.4km E of Washuga on Little Beaver Creek (36° 52′ 02″ N, 96° 48′ 34″ W). *Comment* (CLR): artifacts indicate same age as Von Elm site (Tx-1907-1910, below). Date is earlier than previous estimates for late Plains Woodland. Agrees with Tx-1910 from Von Elm, but not with other Von Elm dates.

Tx-1782. Freeman C1 **530 ± 80**

Feature 3, below Stratum 2, assoc with flint flakes, Freeman site (34 OS 59; Bastian, 1969, p 59-119; Rohrbaugh, 1974b, p 4), 10.4km S, 1.64km E of Uncas near oxbow lake N of bend in Arkansas R, on E bank terrace, S of Kaw City (42° 29′ 46″ N, 96° 54′ 40″ W). Coll 1967 by Tyler Bastian and subm by C L Rohrbaugh. *Comment* (CLR): date probably represents late Plains Woodland occupation.

Von Elm series

Samples from 2 pits in Area C of Von Elm site (34 KA 10) (Hartley, 1974; discussion, p 77, 80), S side Bear Creek ca 0.5km above confluence with Arkansas R, 3.6km N, 2.4km E of Uncas (36° 40′ 42″ N, 95° 54′ 21″ W).

Tx-1907. Von Elm 1 **1750 ± 80**

Feature 2, Sq W30, fill of pit below 16 in. (40cm) depth.

Tx-1908. Von Elm 2 **1360 ± 60**

Same provenience as Tx-1907, Sq W31.

Tx-1909. Von Elm 3 **1740 ± 60**

Feature 2 baulk, 8 to 30 in. (20 to 75cm) depth.

General Comment on Tx-1907-1909 (JDH): dates consistent with Plains Woodland occupation of N central Oklahoma, though in view of close agreement of Tx-1907 and -1909, -1908 may be falsely late. Dates suggest earlier occurrence of Plains Woodland in N Central Oklahoma than previously recognized.

Tx-1910. Von Elm 4 **1470 ± 50**

Feature 3, Sq S5-W18, 25 to 26 in. (62.5 to 65cm) depth. *Comment* (JDH): date consistent with Plains Woodland occupation.

Daniels series

Samples from Daniels site (34 KA 77; Rohrbaugh, 1973b, p 3-32; Rohrbaugh, 1974b, p 4-5), on bank of Coon Creek 1.6km NW of confluence with Arkansas R, 1.6km E, 0.4km S of Uncas (36° 47′ 30″ N, 96° 55′ W).

Tx-1780. Daniels A **770 ± 70**

Area A; from rocks at base of small hearth, 12 to 14 in. (30 to 35cm) depth, assoc with cord marked and bone tempered sherd and "turtle backed" plano-convex scrapers.

Tx-1781. Daniels B **1060 ± 100**

Area B; in fill of pit, Feature 1, 30 to 36 in. (75 to 90cm) depth, assoc with sand and clay tempered ceramics, Washita and Scallorn points, and bone tools.

General Comment (CLR): dates probably indicate late Plains Woodland component, at least in Area B. Relative lack of ceramics in Area A does not indicate such a late date, but Area A may represent special purpose, aceramic, late Plains Woodland manifestation.

Hammons series

Samples from Hammons site (34 KA 20), ca 12km E and 8km N of Newkirk, along E bank of Chilocco Creek (36° 58′ N, 96° 57′ W). Coll and subm by Wayne Young, Oklahoma R Basin Survey.

Tx-2352. 34Ka-20/330 **1600 ± 80**

Feature 1, Sq S11E5, 24 in. (60cm) depth; trash pit at bottom of midden.

Tx-2353. 34Ka-20/329 **1870 ± 70**

Same location as Tx-2352, above.

Tx-2354. 34Ka-20/136 **1810 ± 190**

Feature 2, Sq S11E4, 24 in. (60cm) depth; concentration of burned limestone at bottom of midden.

Tx-2355. 34Ka-20/159 **1470 ± 130**

Level 9, Sq S12E3, 54 in. (137cm) depth; sandy zone yielding stamped sherds and Williams points.

General Comment (WY): dates, which were expected to reflect separate Plains Village and Middle Woodland occupations, seem to reflect only a general Woodland period occupation.

Bryson-Paddock series

Samples from Bryson-Paddock site (34 KA 5), ca 11km E and 4km N of Newkirk (36° 56′ N, 96° 57′ 30″ W), in Kaw Reservoir basin. All samples assoc with protohistoric occupation with some European trade goods; thought to be Wichita Indians. Coll and subm by J D Hartley.

Tx-2356. Ka-5/500A **Modern**

Grid A, Sqs S6-E4 & S7-E4, Feature 5.

Tx-2357. Ka-5/500B **Modern**

Same location as Tx-2356, above.

Tx-2358. Ka-5/524 **Modern**

Grid A, Sq N9--W11, Structure A, Post Hole #31.

Tx-2359. Ka-5/499 **190 ± 60**

Grid A, intersec of Sqs N9-W3, N10-W2, N9-W4, N10-W4, 16 to 20 in. (45 to 60cm) depth.

Tx-2360. Ka-5/502 **290 ± 70**

Grid B, Sqs S2-E1 & S3-E1, 15 in. (38cm) depth; pit S of Structure B (Feature 8).

Tx-2361. Ka-5/389 **Modern**

Grid B, Sqs 0-E1, Structure B, Level 4, 18 to 24 in. (45 to 60cm) depth; overlying house floor.

General Comment (JDH): rodent activity may be responsible for modern dates of Tx-2358 & -2361. Artifactual data suggest AD 1690 to 1740 time for Tx-2356 & -2357. Related data suggest that context of Tx-2360 was much earlier than rest of site; date supports this. More abundant European trade material from context of Tx-2359 suggests that Grid A area was later than Grid B.

Other Oklahoma, Florida, New Mexico, Montana

Tx-1483. McKensie, 78, Oklahoma **1890 ± 70**

Charred wood from Area A, Sq N9-0, Level 4, McKensie site (34 CH 89), W bank Kiamichi R, 0.8km E of confluence with One Creek, Choctaw Co, SE Oklahoma (34° 09′ 44″ N, 95° 28′ 33″ W). Coll 1972 and subm by C L Rohrbaugh. *Comment* (CLR): initially thought to represent shift from Middle to Late Archaic, but date is much too late and possibly represents contamination from upper levels.

Payne series, Oklahoma

Charred wood from Payne site (34 CH 53; Rohrbaugh, 1973a, p 2-75, 159-166; Rohrbaugh, 1974b, p 2-3), ca 0.8km S of Long Creek, 4.5km upstream from confluence with Kiamichi R, in Hugo Reservoir basin, SE Oklahoma (34° 04′ 13″ N, 95° 26′ 59″ W). Early Caddo (Caddo I), Apple phase. Coll 1972 and subm by C L Rohrbaugh.

Tx-1777. Payne 3 **910 ± 90**

Upper fill (Stratum 1) of large refuse pit, Feature 3.

Tx-1481. Payne 1 **1070 ± 50**

Main fill (Stratum 4) of pit, Feature 3. Separated from upper fill (Tx-1777, above) by baked clay lens.

Tx-1482. Payne 2 **880 ± 40**

Compacted fill (Stratum 5) at bottom of pit, Feature 3. Below and distinct from Stratum 4 (Tx-1481, above).

Tx-1779. Payne 5 **1280 ± 120**

Middle layer (Stratum 1) above main fill of pit, Feature 5.

Tx-1778. Payne 4 **470 ± 80**

Sq N6-E4, Level 4, base of midden deposit.

General Comment (CLR): material culture and features indicate Apple phase context in Red R drainage contemporary with late Alto and Harlan phases. Nelson focus (Bell & Baerreis, 1951, p 48-53) is similar. Ceramics related to Coles Creek; one sherd was Marksville Stamped. Tx-1779 is almost certainly too early, and Tx-1778 too late, for this context; probably do not represent occupation dates. The 3 dates from Feature 3, despite stratigraphic reversal, probably represent whole span of occupation, ca AD 900 to 1100.

Pat Boyd Place series, Oklahoma

Charcoal, except where noted, from Pat Boyd Place (34 CH 113; Rohrbaugh, 1973a, p 77-142, 168-177; Rohrbaugh, 1974b, p 3), late Gibson aspect (Caddo II) site, 1.6km E, 1.6km N of Sawyer, W bank Kiamichi R, in Hugo Reservoir basin, SE Oklahoma (34° 00′ 41″ N, 95° 23′ 51″ W). Coll 1972 and subm by C L Rohrbaugh.

Tx-1484. Pat Boyd 1 **660 ± 40**

Area B, Sqs 0-0 and 0-S1; from upper fill of small pit.

Tx-1485. Pat Boyd 2 **690 ± 50**

Wood; Area B, Sq S1-W1, Post Hole #99.

Tx-1486. Pat Boyd 3 **1340 ± 140**

Graded Strip B, House 1, Post Hole #99.

Tx-1487. Pat Boyd 4 **640 ± 40**

Graded Strip B, House 1, Fire Hearth 1. *Comment* (CLR): archaeomagnetic date from this feature agrees well with this date; probably reflects date of house more accurately than Tx-1486, above.

General Comment (CLR): Nelson focus (Bell & Baerreis, 1951) similar to this site. Tx-1486 undoubtedly too early for Sanders phase component, probably dates between AD 1100 and 1300 in this area; age estimate is supported by Tx-1484-1486.

Little Salt Spring series, Florida

Samples from Little Salt Spring site (8 UW 72) in sink hole within city limits 4.8km SE of center of North Port, S Florida (27° 04′ 26″ N, 82° 14′ W). Coll 1975 and subm by C J Clausen, Little Salt Spring Research Facility, North Port, Florida. Comments by Clausen.

Tx-2335. #2120 **13,450 ± 190**

Bone fragments of extinct variety of giant ground tortoise on ledge 27m below surface. *Comment*: date indicates approx time local ground

water level in this area rose past this elevation (21m below mean sea level) in response to generally rising sea level following late Wisconsin glaciation. Pointed wooden stake assoc with tortoise remains indicates man was present in area.

Tx-2336. #2109 **Modern**

Partially burned stick from upper layer of loose sediment on 27m ledge. *Comment*: unexpectedly modern date destroys hypothesis that recent organic debris could not settle on ledge and suggests that massive water column in feature, thought to be relatively still, contained weak currents capable of laterally displacing slow downward drift of water-logged organic material sufficiently to permit deposition on ledge.

Tx-2337. #2119 **Modern**

Wood fragments on E 21.3m ledge, Sta #8. *Comment*: see Tx-2336, above. Subsequent controlled release of fluoricene dye at various locations and depths in spring indicated discernible movement in water in central cavity of spring.

X29SF2 series, New Mexico

Charcoal from pit structure, Site X29SF2, 3.15km SE of Nambe Pueblo, 0.35km N of confluence of Rio En Medio and Rio Nambe, New Mexico (35° 51′ 57″ N, 105° 56′ 25″ W). Preceramic occupation. Coll 1973 by T N Sanders and subm by M S Henderson, Archaeol Research Lab, Anthropol Dept, Southern Methodist Univ, Dallas, Texas. Comments by Henderson.

Tx-1992. X29SF2, 31-2 **1340 ± 80**

Feature 31, Level 3, occupation level above sterile floor. Sample from possible roof support hole. *Comment*: consistent with Tx-1994, below. Nine small (< 2cm length) obsidian corner- and basal-notched projectile points from fill and occupation level of structure agree with late preceramic date.

Tx-1993. X29SF2, 49-2 **2510 ± 90**

Feature 49, Level 3, N perimeter of occupation surface, 2m below ground surface in pit fill below occupation surface. *Comment*: date suggests early preceramic occupation, but absence of large (> 2cm length), expanding-stem projectile points in site makes date seem too late. Presence of burned corn cupules, kernels, and cobs in flotation sample from this provenience suggests early use of maize; but seeds of Black Medic (*Medicago lupulina*) supposedly of recent European introduction, make context seem mixed. This would explain lack of agreement with Tx-1992 and -1994, which are presumably meaningful for this context.

Tx-1994. X29SF2, 50-2 **1550 ± 60**

Feature 50, Level 3, contiguous with Feature 49, Level 3 (Tx-1993, above). *Comment*: see Tx-1992 and -1993, above.

Tx-2367. Drifters Shelter #1, Montana **1000 ± 80**

Charcoal from Drifters Shelter site (24 BH 1727), Late Prehistoric site, 32km N of Sheridan, Wyoming, on Youngs Creek, Crow Indian Reservation, SE Montana (45° 01′ 34″ N, 107° 00′ 19″ W). Sample from buried hearth, Unit 1N0W, on or below outer edge of shelter overhang, 20 to 30cm depth. Coll 1974 and subm by D & L Fredlund, Min Research Center, Montana Tech Foundation, Butte, Montana. *Comment* (LF): date supports late prehistoric cultural assignment.

Tx-2368. Thrower Seed Ring #1, Montana **Modern**

Charcoal from hearth in center of stone circle, Thrower Seed Ring site (24 BH 149), 40km NE of Hardin on knob hill adjacent to W fork of Sarpy Creek, SE Montana (45° 46′ 22″ N, 107° 07′ 03″ W). Coll and subm by D & L Fredlund. *Comment* (LBF): date indicates historic period. No diagnostic artifact assoc.

Bensons Butte series, Montana

Charcoal from Bensons Butte site (24 BH 1726), 32km N of Sheridan, Wyoming, on Youngs Creek, SE Montana (45′ 01′ 34″ N, 107° 01′ 13″ W). Coll 1975 and subm by D & L Fredlund.

Tx-2362. Bensons Butte #1 **1050 ± 60**

Unit 11N37W, 55 to 90cm depth, base of cultural deposits.

Tx-2363. Bensons Butte #2 **1180 ± 70**

Unit 10N34W, 30 to 40cm depth, assoc with middle and late prehistoric projectile points.

Tx-2364. Bensons Butte #3 **1110 ± 70**

Unit 8N34W, 27 to 37cm depth.

Tx-2365. Bensons Butte #4 **1170 ± 70**

Unit 19N29W, 20 cm depth, assoc with late prehistoric artifact types.

Tx-2366. Bensons Butte #5 **1250 ± 80**

Unit 3S0W and hearth area, 20 to 30cm depth, assoc with late prehistoric projectile points.

General Comment (LF): inconsistency of depths and assocs due to varying depths of fire-hearth pits and of sandy matrix. Dates support artifact assocs.

Nevada

Amy's Shelter series

Charcoal fragments scattered in fill, from Amy's Shelter (26 WP 230), S side Smith Creek Canyon, ca 29km N of crossing of Nevada-Utah border by US Hwy 50 (39° 20′ N, 114° 05′ W). Coll 1972 and subm by Ruth Gruhn, Dept Anthropol, Univ Alberta, Edmonton. Depths are below Stake C11.

Tx-1425. Amy's Shelter, 168 **1550 ± 70**

Brown III zone in C10/C11 baulk, depth ca 15 to 40cm. Beginning of late prehistoric period; small corner-notched or barbed projectile points.

Tx-1426. Amy's Shelter, 222 **2830 ± 80**

Brown V zone in C10/C11 baulk, depth ca 100 to 140cm. Elko corner-notched projectile points.

Tx-1428. Amy's Shelter, 281 **3720 ± 70**

Brown VII zone in C10/C11 baulk, depth ca 180 to 200cm. Stemmed indented-base projectile points and small flake tools.

Tx-1429. Amy's Shelter, 392 **4420 ± 90**

Brown IX zone in Sq C11, depth ca 280 to 310cm. Humboldt concave-based projectile points and small flake tools. Earliest intensive occupation.

Tx-1430. Amy's Shelter, 397 **4950 ± 110**

From surface and fill of Brown X zone in Sqs C10 and C11, depth ca 310 to 320cm. Deepest occupational unit: a few obsidian and chalcedony flakes.

General Comment (RG): series is consistent, indicating beginning of stratigraphic sequence ca 3000 BC. Dates on assoc artifact types correspond with time ranges of such types at other sites in central Great Basin.

Smith Creek Cave series

Charcoal from Lake Mohave culture living floor, Smith Creek Cave (26 WP 46), N side Smith Creek Canyon ca 29km N of Crossing of Nevada-Utah border by US Hwy 50 (39° 21′ N, 114° 05′ W). Coll 1971 and subm by A L Bryan, Dept Anthropol, Univ Alberta, Edmonton.

Tx-1420. Smith Creek Cave 8 **9940 ± 160**

Test Pit 6, Hearth 9, Level 4, 21 to 26cm below surface.

Tx-1421. Smith Creek Cave 10 **11,680 ± 160**

Test Pit 5, scattered fragments from living floor.

Tx-1637. Smith Creek Cave 7 **11,140 ± 200**

Test Pit 4.

Tx-1638. Smith Creek Cave 9 **10,330 ± 190**

Test Pit 6, Hearth 12.

Tx-1639. Smith Creek Cave 12 **28,650 ± 760**

Test Pits 2 and 5, and Baulk Extension 1/2; Layer 5.

General Comment (ALB): 1st 4 dates are from stratified occupation zone 25cm thick at front of cave containing hair of artiodactyl, bison, and guanaco; bones of sheep, antelope, small mammals; tools for processing

skin and bone; and re-used Lake Mohave point bases similar to Cougar Mt points (Layton, 1972, p 13, fig 1, type 1). Later excavation of same occupation area yielded complementary dates GaK-5442-5446: 10,666 ± 220, 10,630 ± 190, 9800 ± 190, 10,570 ± 160, 9280 ± 160 (Bryan, pers commun). Only last date of series seems out of line. Other dates indicate that skin and bone processing activity area was used between 10,500 and 11,000 yr BP, although occasional occupation may have occurred as early as 11,500 and as late as 10,000 yr ago.

Kachina Cave series

Samples from Excavation Unit C-10, Kachina Cave (26 WP 69), N side Smith Creek Canyon, ca 29km N of crossing of Nevada-Utah border by US Hwy 50 (39° 21′ N, 114° 06′ W). Coll 1971 and subm by D R Tuohy, Dept Anthropol, Nevada State Mus, Carson City, Nevada. Depths are below Stake C10.

Tx-1422. Kachina Cave 129 **2090 ± 80**

Charcoal; Feature 4, Layer 8, depth 148 to 175cm. Believed to correlate with Brown V zone of Amy's Shelter (Tx-1426, above). *Comment* (DRT): dates agrees with other evidence, and projectile point series from both sites appear to correlate.

Tx-1424A. Kachina Cave 191a, corncobs **680 ± 70**

Tx-1424B. Kachina Cave 191b, wood **1500 ± 150**

From Parowan Fremont culture living floor and hearth, depth 36cm. *Comment* (DRT): allowing for 200 yr correlation (to AD 1070) due to fractionation in photosynthesis in corn, Tx-1424A is consistent with archaeol assocs. Anomalously early age of Tx-1424B may be due to mixing of floor deposits during earlier excavations (Harrington, 1932, p 150) or to use by aboriginal inhabitants of old wood washed in by creek.

Central and South America

Los Tapiales series, Guatemala

Charcoal from Los Tapiales (906454), Paleo-Indian site, ca 1.5km E of Totonicapán, Guatemala (14° 53′ N, 91° 15′ W). Coll 1972 and subm by A L Bryan.

Tx-1630. Los Tapiales A **8810 ± 110**

Sq H-10, 60 to 65cm depth, assoc with burned wood from dark brown loam above buried soil.

Tx-1631. Los Tapiales B **10,710 ± 170**

Sq I-10, 100 to 110cm depth, lowest occupation zone beneath soil.

General Comment (ALB): dates agree stratigraphically. With other dates now available (GaK-4890, 9860 ± 185; GaK-4886, 4790 ± 100; (Bryan, pers commun) they indicate gradual accumulation of sediments. Tx-1631 is assoc with Paleo-Indian assemblage including base of fluted point,

burins, gravers, biface fragments, endscrapers, sidescrapers, with flake industry mainly of basalt. No faunal remains preserved.

La Piedra de Coyote series, Guatemala

Charcoal from La Piedra de Coyote (873469), near Totonicapán, Guatemala (14° 53′ N, 91° 16′ W); subm to establish temporal correlation with Los Tapiales site (Tx-1630, -1631, above), ca 5km distant. All samples are from oldest occupation level of site. Coll 1972 and subm by A L Bryan.

Tx-1632. La Piedra de Coyote C(1) **10,650 ± 1350**
Sq P-20, 100 to 110cm depth.

Tx-1633. La Piedra de Coyote C(2) **5320 ± 90**
Sq 0-20, 100 to 110cm depth.

Tx-1634. La Piedra de Coyote C(3) **10,020 ± 260**
Sq R-20, 100 to 110cm depth.

Tx-1635. La Piedra de Coyote D **9430 ± 120**
Sq P-20, 90 to 100cm depth.

General Comment (ALB): dates agree stratigraphically. Oldest dates, Tx-1632, -1634, confirm observed relationship in flake typology with Los Tapiales, Tx-1630, -1631, above, and indicate that the 2 sites were neighboring Paleo-Indian camps occupied more or less contemporaneously. Reason for inconsistent date of Tx-1633 is not known.

Ilopango series, El Salvador

Samples from sites in El Salvador beneath Ilopango volcanic ash layer; coll to date eruption at beginning of our era which resulted in widespread destruction of Preclassic highland Maya sites. Coll 1975 and subm by P D Sheets, Dept Anthropol, Univ Colorado, Boulder, Colorado.

Tx-2323. Santiago Texacuango #1 **2500 ± 150**

Charcoal from Santiago Texacuango site (SS12t), 1km E of Santiago Texacuango on rd between Finca Agua Rica and Finca Suiza, 2km SW of Lake Ilopango (13° 38′ N, 89° 07′ W). *Comment* (PDS): apparently dates smaller, hitherto unknown eruption, earlier than one under study.

Tx-2324. Laguna Seca #1 **1970 ± 60**

Humic soil from Test Pit LS1-1, Laguna Seca site (SA2t), at base of Laguna Seca Caldera, 701m alt, 1km SE of Chalchuapa (13° 58′ N, 89° 41′ W). *Comment* (PDS): supports assoc archaeol evidence for date of eruption.

Tx-1555. Miraflores Alto, Ecuador **2580 ± 70**

Charcoal from 3rd stratigraphic level, X, Excavation 1, Miraflores Alto site, on slope of Pichincha volcano near Quito, Ecuador (0° 12′ 57″ S, 78° 29′ 56″ W). Assoc with Panzaleo occupation, a regional develop-

ment in Highlands. Coll and subm by Juan Cueva Jaramillo, Mus Arqueol, Banco Central, Quito, via R E Bell, Dept Anthropol, Univ Oklahoma, Norman. *Comment* (REB): date is comparable to Tx-1134 and -1135 (2060 ± 110, 2170 ± 100; R, 1975, v 17, p 95) from Panzaleo ceramics at Santa Lucia site.

Tx-1824. Pashash J, Peru **1590 ± 60**

Charcoal from Cut 12, Level 4, NE corner inner chamber, La Capilla temple, Pashash site, 2km S of Cabana, Prov Pallasca, Ancash, Peru (08° 24′ S, 78° 03′ W). From fill above late Recuay (Pashash Recauy period, Wari phase) burial; Recuay ceramics. Coll 1973 and subm by Terence Grieder, Dept Art, Univ Texas, Austin. *Comment* (TG): should be same age as Tx-1329, 1400 ± 60 (R, 1975, v 17, p 94) which was from same level in adjoining Cut 10. Earlier age of Tx-1824 suggests this sample was already old (early Recuay, Aurora phase) when it was included in fill.

Cochabamba series, Bolivia

Human bone from excavations in Cochabamba Valley and neighboring mountainside, 3.2km from Cliza, 48km SE of Cochabamba, Bolivia (17° 30′ S, 66° W). Subm by G Bryne de Caballero, Mus Arqueol, Univ Boliviana Mayor de San Simon, Cochabamba, Bolivia.

Tx-1817A. Santa Lucía, apatite **2040 ± 60**

Tx-1817B. Santa Lucía, collagen **1550 ± 330**

Below Tiwanacu stratum, assoc with unpainted pottery, stone and metal artifacts, in Excavación de Santa Lucia. Should establish date for pre-Tiwanacu culture. Site is in eroded part of complex of mounds which also includes Excavación de Cruzpata (Tx-1818, below). Coll 1973 by G Byrne de Caballero. *Comment* (GBC): younger than expected, but not seriously so.

Tx-1818A. Cruzpata, apatite **2320 ± 50**

Tx-1818B. Cruzpata, collagen **2400 ± 80**

2m level in Excavación de Cruzpata, part of large complex of mounds. Should establish date for Tiwanacu pottery. Coll by G Byrne de Caballero and R Urioste. *Comment* (GBC): dates are approx as expected.

Tx-1819A. Mesadilla, apatite **540 ± 110**

Tx-1819B. Mesadilla, collagen **380 ± 200**

Circular grave, 2.5m level. Excavación de Mesadilla, on mountainside 3.2km N of Cochabamba (17° 24′ S, 66° 09′ W); should establish chronologic relationship between this site and Tiwanacu material in Cochabamba valley. Coll 1973 by G Byrne de Caballero and O Gonzalez. *Comment* (GBC): site was thought to be pre-Tiwanacu; date indicates it is Inca.

Europe

Veluška Tumba series, Yugoslavia

Charcoal from Veluška Tumba, early Neolithic tumulus near Porodin, ca 18km S of Bitola, Macedonia, Yugoslavia (40° 54′ N, 21° 22′ E). Tumulus contained 4 cultural strata (phases) separated by deposits of leveling fill. Coll 1972 and subm by Vojislav Sanev, Dir, Natl Mus, Štip, Yugoslavia, via E M Davis, this lab.

Tx-1785. Veluška Tumba #1 **6950 ± 120**

Charred wood from Phase IV house, earliest occupation of site.

Tx-1786. Veluška Tumba #2 **6890 ± 140**

Charred wheat grains from house, Phase II (next to latest).

Tx-1809. Veluška Tumba #3 **6900 ± 90**

Charcoal from posts of house, Phase II.

General Comment (EMD): dates agree closely, and indicate that site was occupied for 250 yr or less.

Tx-1787. Lokalitet Tumba #4, Yugoslavia **6760 ± 110**

Charred wheat grains from early Neolithic house at Lokalitet Tumba, tumulus near Porodin (see Veluška Tumba series, above). Culture stylistically like Phases I and II of Veluška Tumba. Coll 1954 and subm by Vojislav Sanev. *Comment* (EMD): date agrees with Tx-1786--1809, but suggests slightly later age.

Golena Tumba series, Yugoslavia

Charcoal from Golena Tumba, middle Neolithic tumulus near Trn, ca 20km E of Bitola, Macedonia, Yugoslavia (41° 02′ N, 21° 46′ E). Coll 1973 and subm by Vojislav Sanev.

Tx-1788. Golena Tumba, #5 **5640 ± 90**

From Phase I house, latest occupation of site.

Tx-1789. Golena Tumba, #6 **5670 ± 90**

From same house as Tx-1788, above.

Tx-1790. Golena Tumba, #7 **5950 ± 90**

From Phase II house, earliest occupation of site.

General Comment (EMD): Tx-1788 and -1789 agree closely and date Phase I, latest occupation, ca 3700 BC (uncorrected). Tx-1790 indicates Phase II was ca 300 yr earlier.

General Comment on dates Tx-1785-1790, -1809, Bitola area (EMD): dates indicate early Neolithic in this area has ^{14}C age (uncorrected) of early 5th millennium BC; middle Neolithic is in early 4th millennium.

Stobi series II, Yugoslavia

Charcoal obtained by water separation from deposits at Stobi, Hellenistic and Roman site at junction of Crna R with Vardar R, S of Titov Veles, Macedonia, Yugoslavia (41° 33′ N, 21° 59′ E). In comments, "corrected dates" are according to Damon *et al*, 1974. Previous Stobi dates are in R, 1975, v 17, p 96-98.

Tx-2318. Stobi 57X75; Theater **2850 ± 70**

From fill of small pit, bottom of Theater Trench 16, below sterile stratum sealed by 1st and 2nd earthen floors of E Parodos beside podium of scene bldg; Lot 1684. Sherds in same fill are of prehistoric types, but sherd of later type is higher without discontinuity of fill. Dated to determine whether deposit represents prehistoric occupation, hitherto not discovered at site. Coll 1975 by Saržoski & Gebhard; subm by E M Davis, this lab, & E R Gebhard, Dept Classics, Univ Illinois at Chicago Circle, Chicago, Illinois. *Comment* (EMD&ERG): corrected date of 1100 ± 142 BC indicates prehistoric age.

Tx-2454. Stobi 14X73; Theater **1710 ± 60**

From midden fill in S scarp of E Parodos of Theater, Strata 14 & 15. Deposit represents dump after abandonment of theater; numerous coins in fill indicate middle to late 4th century AD. Dated to see if charcoal date agrees with coin date. Coll 1973 and subm by E M Davis. *Comment* (EMD): corrected date of AD 250 ± 136 agrees with coin date, but suggests charcoal may be earlier. Numerous such dates are needed to test relevance of dates on midden charcoal.

Pizzica Series I, Italy

Charcoal from coffins, Pizzica site, 3km NW of Metaponto Scalo, Pizzica Pantanelle area, S Italy (40° 23′ N, 16° 35′ E). Coffins and bodies were burned in earth. Dated to determine whether this unusual burial method was ancient or recent. Coll 1974 and subm by J C Carter, Dept Classics, Univ Texas, Austin.

Tx-2286. Pizzica P2.74.100W **2320 ± 60**

Sq B4, Tomb 1, 40cm depth.

Tx-2287. Pizzica P2.74.106W **2180 ± 60**

Sq B4, Tomb 2, 40cm depth.

General Comment (JCC): dates indicate graves belong to time of decline of Greek colony of Metaponto (late 4th century BC), before later partial revival under Roman rule. Burning of bodies follows Greek practice to prevent spread of contagious disease, which may have played a part in decline of city.

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[RADIOCARBON, VOL. 19, No. 2, 1977, P. 326-331]

UNIVERSITY OF MIAMI RADIOCARBON DATES IX

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The following radiocarbon measurements are a partial list of geologic samples dated since September 1975. The technique used is described in R, v 18, p 210-220. Dates are calculated using a ^{14}C half-life of 5568 yr and errors are reported as one standard deviation. This includes only the counting errors on the sample, background and modern standard.

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SAMPLE DESCRIPTIONS

A. Bahamas

Joulters Cays I series

A piston core of oolites from Joulters Cays, Bahamas (25° 20′ N, 78° 12′ W). Samples coll to determine stratigraphy and date sedimentation rates. Coll 1975 and subm 1976 by P M Harris, RSMAS, Miami, Florida.

General Comment (DP): 1st of 3 projects from Joulters Cays area.

UM-801. 75-2-40A: 128 to 133cm **625 ± 155**
Outer layer.

UM-802. 75-2-40A: 128 to 133cm **760 ± 75**
Duplicate run of UM-801.

UM-803. 75-2-40A: 128 to 133cm **1245 ± 70**
Middle layer.

UM-804. 75-2-40A: 128 to 133cm **2195 ± 75**
Inner layer.

UM-805. 75-2-40B: 217 to 222cm **2000 ± 80**
Outer layer.

UM-806. 75-2-40B: 217 to 222cm **2665 ± 90**
Inner layer.

UM-807. 75-2-40C: 308 to 312cm **2740 ± 85**
Outer layer.

UM-808. 75-2-40C: 308 to 312cm **2675 ± 75**
Inner layer.

UM-809. 75-2-40D: 397 to 402cm **3660 ± 75**
Outer layer.

UM-810. 75-2-40D: 397 to 402cm **3970 ± 95**
Inner layer.

UM-811. 75-2-40E: 430cm **4560 ± 105**
Whole oolite.

Joulters Cays II series

A piston core of oolites from Joulters Cays, Bahamas (25° 18′ N, 78° 13′ W). Samples coll to determine stratigraphy and date sedimentation rates. Coll 1976 by P M Harris, RSMAS, Miami, Florida; subm 1976 by T Dlugos, Univ Miami.

General Comment (DP): 2nd of 3 projects from Joulters Cays area; this correlates to Joulters Cays I series. Only outer 40-50% of oolites were dated.

UM-794. 76-2-67: 0 to 2cm **910 ± 80**

UM-795. 76-2-67: 70 to 72cm **1235 ± 75**

UM-796. 76-2-67: 140 to 143cm **1580 ± 80**

UM-797. 76-2-67: 210 to 212cm **2640 ± 100**

UM-798. 76-2-67: 350 to 352cm **4005 ± 90**

UM-799. 76-2-67: 420 to 422cm **4090 ± 100**

UM-800. 76-2-67: 468 to 470cm **4935 ± 85**
Calcitic mud.

Joulters Cays III series

Hand-picked oolites from S end of Joulters Cay, Bahamas (25° 17° N, 78° 07′ W). Samples coll along a transect at right angles to NW-SE trending island. Where possible, loose ooids were coll under the hardened crust of island. Only the outer 10-15% of ooids in the 250m to 420m range were dated. Study for correlation of island age and formation with active shoal. Coll and subm 1976 by P M Harris and B D Clarke, RSMAS, Miami, Florida.

General Comment (DP): last of 3 projects from Joulters Cays area. Dates are reported in sequential order from E to W.

UM-783. SAM 1 SHO **300 ± 70**
Subtidal shoal in lm water.

UM-784. SAM 2 BEA **1915 ± 75**
Marine beach, intertidal zone.

UM-785. SAM 2 BEA **< 180**
Duplicate run of UM-784.

UM-786. SAM 2 BEA **103.7 ± 1.1% modern**
Triplicate run of UM-784.

UM-787. SAM 3 SWW **<195**
Marine beach ridge crest, supratidal zone.

UM-788. SAM 4 STA 2 **580 ± 75**
Marine beach ridge crest, supratidal zone.

UM-789. SAM 5 STA 2-C **910 ± 85**
Marine beach ridge crest, supratidal zone.

UM-790. SAM 6 STA 3 **390 ± 120**
Marine beach trough, supratidal zone.

UM-791. SAM 7 STA 3-E **500 ± 75**
Marine beach ridge crest, supratidal zone.

UM-792. SAM 8 STA 4 **<230**
Marine beach ridge crest, supratidal zone.

UM-793. SAM 9 STA 6 **430 ± 75**
Marine beach ridge crest, supratidal zone.

Eleuthera Bank series

Several samples of oolites and *Strombus* coll in lithified fragments from submerged shoals on Eleuthera Bank, Bahamas (24° 50′ N, 76° 25′ W). Crust samples found *in situ* on shoal and clast samples found unattached on shoal. Only outer 15% of oolites were dated. Dates to find correlation between crust and clast lithification. Coll 1975 by J Dravis, RSMAS, Miami, Florida; subm 1976 by J Donnellan, Univ Miami.

UM-769. SC-182 **102 ± 1.4% modern**
Sample consists of cementing material around oolites from crust of oolitic shoal. Coll in 1m water, exposed at low tide.

UM-770. SC-202 **495 ± 75**
Oolite crust from similar shoal as UM-769 coll in 0.5m water, not exposed at low tide.

UM-771. E-29-3 **845 ± 80**
Oolite crust coll from shoal flank in water 4m deep.

UM-772. E-29-2 **1545 ± 85**
Oolite clast found near shoal flank in water 5m deep.

UM-773. E-29-1A **550 ± 215**
Strombus embedded in oolites coll as crust in water 4m deep.

UM-776. E-29-1A **895 ± 65**
Duplicate run of UM-773.

UM-774. SC-89B **<175**

Shell material embedded in oolitic clast from water 5m deep.

UM-775. SC-36 **590 ± 80**

Shell material from oolitic crust in water 30cm deep, exposed at low tide.

B. Mid-Atlantic

Mid-Atlantic Abyssal Plain series

Two cores of pelagic ooze coll on opposite sides of the Mid-Atlantic ridge. Date sedimentation rates for regions adjacent to continents and for comparison to Mid-Atlantic Ridge sedimentation rates. Core P6903-56 (16° 36′ N, 58° 03.5′ W) and Core P7008-25 (08° 01.7′ N, 21° 04.3′ W) are both gravity cores from abyssal plain near base of Mid-Atlantic Ridge. Coll 1969 and 1970 by K Boström, RSMAS, Miami, Florida; subm 1976 by T Damon, Univ Miami.

General Comment (TD): samples presumably influenced by continental sediments and may be affected by slumping.

UM-812.	**P7008-25: 10 to 20cm**	**9400 ± 80**
UM-813.	**P7008-25: 50 to 60cm**	$30{,}860^{+945}_{-1085}$
UM-822.	**P7008-25: 80 to 90cm**	$32{,}945^{+1165}_{-1365}$
UM-814.	**P7008-25: 90 to 100cm**	$32{,}495^{+1385}_{-1470}$
UM-823.	**P7008-25: 100 to 110cm**	**>37,645**
UM-815.	**P7008-25: 130 to 140cm**	**26,945 ± 445**
UM-816.	**P7008-25: 160 to 170cm**	$33{,}390^{+1210}_{-1430}$
UM-817.	**P6903-56: 0 to 10cm**	**7615 ± 130**
UM-818.	**P6903-56: 35 to 45cm**	**23,335 ± 320**
UM-821.	**P6903-56: 53 to 63cm**	**>34,945**
UM-819.	**P6903-56: 70 to 80cm**	**25,100 ± 460**
UM-820.	**P6903-56: 105 to 115cm**	$25{,}280^{+625}_{-675}$

Mid-Atlantic Ridge series

Nine gravity cores of pelagic ooze from various locations on the Mid-Atlantic Ridge. Continuation of a study on sedimentation rates along ridge (R, v 18, p 407-412). Coll 1965 and 1970 by K Boström, RSMAS, Miami, Florida; subm 1975 and 1976 by D Grigoriev.

General Comment (DG): elemental analyses indicate terrigenous influence on sediments from ridge flanks.

Core P6511-29. Eastern flank, Mid-Atlantic Ridge (27° 42′ 5″ N, 37° 13′ 0″ W).

UM-888. P6511-29: 0 to 15cm **11,145 ± 115**

UM-889. P6511-29: 25 to 40cm **$27{,}820^{+480}_{-510}$**

UM-890. P6511-29: 25 to 40cm **$29{,}700^{+635}_{-690}$**

Duplicate run of UM-889.

UM-892. P6511-29: 50 to 65cm **$23{,}245^{+655}_{-710}$**

UM-893. P6511-29: 80 to 95cm **$33{,}460^{+1435}_{-1745}$**

Core P6511-31. Eastern flank Mid-Atlantic Ridge (26° 15′ N, 43° 30′ W).

UM-894. P6511-31: 5 to 15cm **$13{,}100^{+740}_{-810}$**

UM-895. P6511-31: 30 to 40cm **21,530 ± 275**

UM-896. P6511-31: 60 to 70cm **$30{,}720^{+740}_{-815}$**

UM-897. P6511-31: 90 to 100cm **> 37,330**

Core P7008-17. Western flank Mid-Atlantic Ridge (0° 48.8′ N, 31° 27′ W).

UM-714. P7008-17: 0 to 15cm **4145 ± 85**

UM-900. P7008-17: 23 to 35cm **13,500 ± 145**

UM-715. P7008-17: 40 to 55cm **16,720 ± 265**

UM-716. P7008-17: 80 to 95cm **$29{,}990^{+1600}_{-2000}$**

UM-717. P7008-17: 115 to 130cm **$31{,}130^{+625}_{-680}$**

Core P7008-18. Western flank Mid-Atlantic Ridge (1° 27.2′ N, 30° 40.1′ W).

UM-898. P7008-18: 20 to 35cm **13,210 ± 165**

Core P7008-21. Eastern flank Mid-Atlantic Ridge (4° 27.3′ N, 25° 09.3′ W).

UM-899. P7008-21: 25 to 35cm **18,750 ± 195**

Core P7008-41. Eastern flank Mid-Atlantic Ridge (12° 52.9′ N, 38° 01.5′ W).

UM-718.	**P7008-41: 0 to 15cm**	**9190 ± 150**
UM-901.	**P7008-41: 25 to 35cm**	**27,350 ± 550**
UM-719.	**P7008-41: 40 to 55cm**	**$22{,}430^{+1220}_{-1440}$**
UM-720.	**P7008-41: 80 to 95cm**	**15,170 ± 540**
UM-721.	**P7008-41: 120 to 135cm**	**23,195 ± 420**

Core P7008-44. Western flank Mid-Atlantic Ridge (12° 56.9′ N, 42° 27.6′ W).

UM-738.	**P7008-44: 0 to 20cm**	**22,600 ± 255**
UM-886.	**P7008-44: 0 to 20cm**	**$32{,}975^{+680}_{-740}$**

Duplicate run of UM-738.

UM-739.	**P7008-44: 45 to 60cm**	**15,410 ± 160**
UM-740.	**P7008-44: 95 to 110cm**	**27,980 ± 450**
UM-741.	**P7008-44: 145 to 160cm**	**30,065 ± 455**

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[RADIOCARBON, VOL. 19, NO. 2, 1977, P. 332-353]

US GEOLOGICAL SURVEY RADIOCARBON DATES XII

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This list contains the results of some measurements made between 1968 and 1974. Samples were counted in the form of acetylene gas, as previously, and ages were computed on the basis of the Libby half-life, 5568 ± 30 years. The error listed, always larger than the 1σ statistical counting error commonly used, takes into account variable laboratory factors but does not include external (field or atmospheric) variations or fractionation.

Unless otherwise stated, collectors of all samples are members of the US Geological Survey.

A. Eastern United States

Cape Lookout series, North Carolina

Shell and peat samples from surficial deposits of the submerged and emerged Coastal Plain prov, Cape Lookout area, North Carolina (Mixon & Pilkey, 1976). Coll and subm 1971 by R B Mixon.

W-2600. **>38,000**

Shells from rim of large Carolina Bay, alt 2 to 3m below MSL, 1.8km ENE of Hwy 70 bridge over Salters Creek, ca 4.2km WNW of Atlantic (35° 10′ N, 76° 20′ W).

W-2601. **18,460 ± 400**

Peat bed 0.9m below surface of Carolina Bay rim, alt 3 to 4m above MSL, 3.4km WNW of Atlantic (35° 10′ N, 76° 20′ W).

General Comment (RBM): dates W-2600 and -2061 indicate that the sand-ridge complex was constructed before the last major transgression of the sea, ca 18,000 to 15,000 yr ago.

W-2611. **>40,000**

Shell bed below well-sorted sand facies of Cedar I. sand, alt ca 3m below MSL, 0.7km S of Roe School on Cedar I. (35° 00′ N, 76° 18′ W).

W-2629. **24,750 ± 700**

Peat from base of fill in depression on Cedar I. barrier, alt ca 1.2m above MSL, at rd junction 0.6km SW of Roe School site, Cedar Island Barrier (35° 00′ N, 76° 18′ W). *Comment* (RBM): sample may be contaminated by ground water containing younger organic colloids; age is minimum for small "Carolina Bays" on Cedar Island (see also W-2611).

W-2628. **>38,000**

Shell bed between Cedar I. and North Bay barriers, alt ca 2.7m below MSL, 0.4km SW of Cedar I. Ferry Landing (35° 01′ N, 76° 20′ W).

Comment (RBM): age is minimum for NE-most (youngest) barrier of Cedar I. barrier complex.

W-2612. **>45,000**

Shell bed below well-sorted sand facies of Beaufort sand, alt 2.5 to 4m below MSL, ca 0.8km S of hwy bridge over straits (34° 40′ N, 76° 35′ W). *Comment* (RBM): date indicates Beaufort sand is Pleistocene rather than Holocene, as previously thought.

W-2627. **7070 ± 250**

Shell hash below Outer Banks sand, alt MSL, S side of hwy, 0.16km SW of fort, Fort Macon State Park on Bogue Banks (34° 38′ N, 76° 40′ W). *Comment* (RBM): dates formation of Outer Barrier.

Allegheny series, Maryland and West Virginia

Peat from unglaciated uplands along the Allegheny structural front (Cameron, 1970). Coll and sub 1968 by Cornelia Cameron.

W-2253. **13,620 ± 600**

Peat coll near base of peat deposit, depth 228 to 239cm, Castleman Basin, Garrett Co (39° 34′ N, 79° 16.5′ W), Maryland. *Comment* (CC): correlates with other basal peats in area.

W-2255. **5250 ± 250**

Peat, depth 122 to 142cm, from Canaan Valley (39° 7.5′ N, 79° 27.5 W), West Virginia. *Comment* (CC): dates beginning of reed-sedge peat formation.

Hudson Highlands series, New York

Peat samples from Hudson Highlands at 366m alt, W side of Rte 9W on Military Reservation boundary, NW of West Point (41° 24′ 15″ N, 73° 59′ 30″ W), New York. Coll and subm 1968 by Cornelia Cameron.

W-2249. **8340 ± 350**

216 to 229cm

W-2251. **11,220 ± 400**

485 to 503cm

W-2252. Vails Gate, New York **8660 ± 350**

Peat from terrace in Hudson Valley at 79m alt, depression on bedrock between drift ridges at base of Hudson Highlands, depth 538 to 554cm, S of Vails Gate (27° N, 94° 4′ W), Cornwall Quad. Coll and subm 1968 by Cornelia Cameron.

B. Western United States

Mount Baker series, Washington

Series dates lahars (volcanic mudflows) that originated from avalanching of hydrothermally altered rock on Mount Baker volcano. Coll and subm 1973 by J H Hyde.

W-2934. **110 ± 200**

Wood from horizon 60cm above base of lahar, W bank of Boulder Creek, ca 100m downstream from Baker Lake Rd bridge, 9.7km SE of Mt Baker volcano (48° 43′ N, 121° 42′ W).

W-2933. **530 ± 200**

Wood buried by lahar, roadcut 0.8km up logging rd from junction with Baker Lake Rd at W end Park Creek bridge, 11.3km SE of Mt Baker (48° 44′ N, 121° 40′ W).

W-2944. **5980 ± 250**

Wood from horizon 4m above base of lahar, roadcut on Middle Fork Nooksack River valley rd, 14.5km upstream from junction with Mt Baker Hwy near mouth of Clearwater Creek, 22.5km W of Mt Baker (48° 46′ N, 122° 02′ W).

W-2971. **6650 ± 350**

Wood from horizon 2m below top of lahar, E side Park Creek valley, roadside exposure 0.8km up logging rd to Baker Hot Spring from junction with Baker Lake Rd, 11.3km SE of Mt Baker (48° 44′ N, 121° 40′ W).

W-2972. **10,350 ± 300**

Carbonized wood from horizon 3cm below top of lower lahar, W bank of Sulphur Creek, ca 1km above trail head, Baker Pass Trail, 8km S of Mt Baker (48° 42′ N, 121° 48′ W).

Mount St Helens series, Washington

Pumice layers composing 4 different sets of tephra beds whose stratigraphy, age, and trend away from Mount St Helens (MSH) are fairly well known, are potentially valuable stratigraphic markers in the NW United States and adjacent part of Canada (Mullineaux *et al,* 1975). This series provides a record of explosive eruptive activity and is part of an appraisal of volcanic hazards at MSH.

W-2874. **460 ± 200**

Charcoal from deposit that contains breadcrusted volcanic bombs and that overlies ca 3m of fluvial deposits, bank of N Fork Toutle R at Spirit Lake Lodge (46° 15′ N, 122° 10′ W). Coll and subm 1972 by D R Crandell. *Comment* (DRC): deposit was previously regarded as that of a hot lahar ca 330 yr old (Mullineaux & Crandell, 1962). The similarity in age of the sample to that of the underlying tephra set W, which has been dated at ca 450 yr by radiocarbon and tree rings, suggests that both deposits were formed during the same eruptive period.

W-2989. **510 ± 200**

Charcoal from unweathered pyroclastic flow deposit which overlies a succession of weathered tephra deposits, quarry on SE slope of Goat Mt, 8.9km SW of MSH (46° 10′ N, 122° 16′ W). Coll and subm 1973 by D R

Crandell. *Comment* (DRC): dates a pyroclastic flow that occurred during an eruptive period at MSH between 600 and 450 yr ago.

W-2993. **1150 ± 200**

Charcoal from lithic tephra at base of set W, roadcut along USFS Rd 100, ca 0.5km from State Hwy 504, ca 6km NE of the top of MSH (46° 14′ N, 122° 09′ W). Coll and subm 1973 by D R Mullineaux.

W-2990. **1620 ± 200**

Charcoal at base of cindery ash that overlies scoria in upper part of Set B, roadcut along State Hwy 504, ca 5km N of top of MSH (46° 16′ N, 122° 11′ W). Coll and subm 1973 by D R Mullineaux. *Comment* (DRM): sample is from above basaltic tephra Layer U. With Sample W-2527 (Pine Creek series), which came from below the layer, it dates Layer U, which overlies tephra Layer I (see W-2863 and -2871).

W-2863. **1890 ± 250**

Peat from 2cm below pumice Layer I, small peat bog in meadow, 0.2km W USFS Rd N920.2, ca 24km E of MSH (46° 13′ N, 121° 56′ W). Coll 1972 and subm by D R Mullineaux.

W-2925. **1850 ± 250**

Complete rerun of Sample W-2863 to check date.

W-2871. **2130 ± 250**

Peat from 2cm above pumice Layer I, same location as W-2863.

W-2924. **1780 ± 250**

Complete rerun of W-2871 to check date.

General Comment (DRM): W-2863 and -2871 date Layer I closely, and match the stratigraphic sequence well.

W-2977. **2060 ± 200**

Charcoal from pyroclastic flow above tephra Set W and below andesite flow, N valley wall of S Fork Toutle R on W flank of MSH (46° 13′ N, 122° 15′ W). Coll and subm 1973 by D R Crandell.

W-2978. **2100 ± 200**

Charcoal from pyroclastic-flow deposit below tephra Set W and above tephra Set B, W valley wall of Studebaker Creek on NW flank of MSH (46° 13′ N, 122° 14′ W). Coll 1972 and subm by D R Crandell.

W-2277. **1860 ± 250**

Charcoal from roots of a tree covered by a pahoehoe flow in small side passage in Lake Cave, ca 11km S of summit of MSH (46° 05.8′ N, 122° 12.9′ W). Coll 1968 by J H Hyde; subm 1969 by D R Crandell. *Comment* (JHH): pahoehoe flow is one of earliest assoc with growth of "modern" cone of MSH (as opposed to "old" MSH represented by Swift Creek assemblage). Date agrees with dates from other parts of lava flow

and indicates that flow was emplaced in a relatively short interval of time.

General Comment (DRC): samples date pyroclastic flows formed during an explosive eruptive period at MSH 2200 to 2000 yr ago. The pyroclastic-flow deposits underlie andesite and basalt lava flows, and overlie a succession of pyroclastic-flow deposits of "old" MSH.

W-2872. **2220 ± 250**

Charcoal from tephra Set B, roadcut in valley of Castle Creek, ca 4.8km NW of base of MSH (46° 15′ N, 122° 15′ W). Coll and subm 1972 by D R Crandell. *Comment* (DRC): shows that mafic volcanism of the modern volcano began before ca 2200 yr ago.

W-2923. **2200 ± 250**

Complete rerun of W-2872 to check date.

W-2439. **2780 ± 200**

Wood from between Layers P and I, Bench Lake area, Mt Rainier Natl Park (46° 46′ N, 121° 42′ W). Coll and subm 1969 by D R Mullineaux.

W-2440. **2780 ± 250**

Wood from between Layers K and Y, same location as W-2439.

General Comment (DRM): W-2439 and -2440 are from above and below a series of 5 or more thin white ash deposits from MSH that directly overlie ash Layer Y. Dates suggest that MSH eruptions were closely spaced in time; from the stratigraphy, I would have expected the date for W-2440 to be closer to a previous date from Layer Y, 2980 ± 250 (W-1118: R, 1964, v 6, p 56) than to date for W-2439.

W-2873. **2840 ± 250**

Charcoal from a pyroclastic-flow in main fill of valley overlain by deposit containing W-2872, borrow pit on W side of valley of Castle Creek ca 4.8km NW of base of MSH (46° 15′ N, 122° 15′ W). Coll and subm 1972 by D R Crandell. *Comment* (DRC): main fill is believed to have accumulated during final period of activity of an old dacitic MSH eruptive center. That period lasted from ca 3000 to 2500 yr ago and is also represented by youngest part of Pine Creek valley-fill assemblage SE of MSH and by tephra Set P (Crandell and Mullineaux, 1973).

W-2875. **2900 ± 250**

Carbonized wood from soil zone between lahar assemblages, gravel pit in N Fork Toutle R valley at mouth of Alder Creek, 35.4km from MSH (46° 21′ N, 122° 33′ W). Coll and subm 1972 by D R Crandell. *Comment* (DRC): dates limit soil development episode between periods of eruptive activity and lahar formation at MSH.

W-2980. **2910 ± 200**

Charcoal from a pumiceous pyroclastic-flow deposit B that is younger than tephra Set GB and older than a lithic pyroclastic flow Deposit A, roadcut in Coldspring Creek valley at W base of MSH (46° 12′ N, 122° 15′ W). Coll and subm 1973 by D R Crandell. *Comment* (DRC): dates pyroclastic flow that occurred during an explosive eruptive period at MSH 3000 to 2500 yr ago. Eruptive deposits of this period were previously recognized on N and SE flanks of volcano, but this is 1st one recognized on the W side.

W-2552. **3180 ± 700**

Wood from sand layer overlying ash layer B and underlying ash layer M, valley wall of Ohanapecosh R, S of Indian Bar, Mt Rainier Natl Park (46° 49′ N, 121° 39′ W). Coll 1967 and subm by D R Mullineaux. *Comment* (DRM): date is younger than expected; stratigraphic position is below another sample, ca 3500 yr old (W-1752, R, 1967, v 9, p 520). Sample was too decomposed to be id and may have been part of a root.

W-2867. **5860 ± 300**

Charcoal from within pumice layer GB, above at least part of pumice Set J, below the Mazama ash, along logging rd 847, 8km W of MSH (46° 11′ N, 122° 16′ W). Coll 1972 and subm by D R Mullineaux. *Comment* (DRM): date is anomalous because Layer GB is overlain by Mazama ash (6600 yr) in many places. Possibly "GB" contains more than 1 bed.

W-2702. **8430 ± 300**

Charcoal from middle of tephra set J, along USFS Rd N92G, 6.4km NE of MSH (46° 14′ N, 122° 07′ W). Coll and subm 1971 by D R Mullineaux. *Comment* (DRM): although part of Set J may be nearly 12,000 yr old, W-2702 age indicates that the only NE-trending thick and coarse pumice layers were erupted during a short period ca 8400 to 8300 yr ago (see W-2587, Swift Creek series).

W-2991. **8900 ± 300**

Charcoal at top of Set J, logging roadcut, ca 10km ESE of top of MSH (46° 09.5′ N, 122° 04′ W). Coll and subm 1973 by D R Mullineaux. *Comment* (DRM): date suggests that all the coarse thick pumice to the SE is older than the oldest coarse thick bed in Set J NE of the volcano, dated at ca 8400 yr old.

W-2832. **11,700 ± 400**

Charcoal at base of tephra Set J, roadcut along logging Rd 822, ca 9.6km ESE of MSH (46° 10′ N, 122° 04′ W). Coll and subm 1972 by D R Mullineaux.

W-2868. **12,110 ± 375**

Charcoal from horizon between 2 pre-J pyroclastic flows, along logging Rd 140, ca 1km from USFS Rd N92, ca 8km E of MSH (46° 12′ N, 122° 05′ W). Coll 1972 and subm by D R Mullineaux.

W-2870. **11,550 ± 400**

Charcoal from base of lowest pre-J pyroclastic flow and above W-2866, same location. Coll 1972 and subm by D R Mullineaux.

W-2866. **11,900 ± 300**

Charcoal in soil zone at top of tephra Set S, below pre-J pyroclastic flow, same location. Coll 1972 and subm by D R Mullineaux.

General Comment (DRM): these 3 samples (W-2866, -2870, -2868) date various parts of sequence of lithic pyroclastic flows and lahars between Sets S and J. Because of oxidation zones, I expected lengthier representation between oldest and youngest flows in this group.

W-2678. **9600 ± 300**

Fragments of charcoal from lower part of a pumiceous ash, and from upper part of soil profile in colluvium underlying ash, roadcut on USFS Rd 111 at Jumbo Creek, 32km NE of MSH (46° 20′ N, 121° 47′ W). Coll and subm 1971 by D R Mullineaux. *Comment* (DRM): sample consisted of bits of carbonized vegetation from within and under pumice Set S and was expected to date older limit for that set. Date is anomalously young, because Set S directly underlies deposits dated from 11,500 to 12,000 yr. Contamination of sampled zone by younger but carbonized root material may be responsible.

W-2551. **17,270 ± 1000**

Organic material in basal part of thick pumice Deposit P, roadcut along hwy, Skamania Co. Coll 1970 by Meyer Rubin, D R Mullineaux and J H Hyde; subm by D R Mullineaux. *Comment* (DRM): date appears to be too young; its stratigraphic position is below and separated by interval of soil from horizon dated between 20,350 and 18,560 yr old. (See W-2540 and W-2413, Swift Creek series.) Dated sample may have included some material carried downward by ground water.

W-2574. **>29,000**

Peat and organic silt, 1st 10cm below pyroclastic layer Unit 2, Fargher Lake (45° 53.5′ N, 122° 30.5′ W). Coll and subm 1970 by J H Hyde and D R Mullineaux. *Comment* (DRM): dates upper limit for a widespread, fairly distinctive pumice deposit extending S and SW from MSH.

Pine Creek series, Mount St Helens, Washington

The Pine Creek volcanic assemblage consists of deposits of hot pyroclasic flows and lahars interbedded with alluvium and tephra. Tephra deposits are divided into several groups, each consisting of several layers

that contain similar mineral suites. Pine Creek assemblage was deposited after eruption of tephra Set S (see Swift Creek series) and before eruption of Set B.

General Comment (DRC & DRM): dates indicate that oldest Pine Creek eruptive episode occurred before ca 12,000 yr ago and youngest, between 3000 and ca 2500 yr ago (Crandell & Mullineaux, 1973).

W-2527. **1740 ± 250**

Charcoal from within tephra Set B, roadcut along USFS Rd N826A, 6.4km SE of MSH volcano (46° 08′ N, 122° 09′ W). Coll and subm 1970 by J H Hyde.

W-2529. **2580 ± 250**

Charcoal from pyroclastic-flow deposit, same location as W-2527. Coll and subm 1970 by J H Hyde and D R Crandell. *Comment* (JHH): dates a pyroclastic flow resulting from an explosive volcanic eruption. This sample and W-2527 bracket several pyroclastic layers and a soil-forming horizon.

W-2541. **2670 ± 250**

Charcoal from pyroclastic-flow deposit, W valley wall Pine Creek, 12.9km SE of summit of MSH (46° 06′ N, 122° 05′ W). Coll and subm 1970 by D R Crandell.

W-2542. **2850 ± 250**

Charcoal from pyroclastic flow deposit, E bank of Pine Creek, 14.5km SE of summit of MSH (46° 06′ N, 122° 04′ W). Coll and subm 1970 by D R Crandell.

W-2675. **2960 ± 250**

Charcoal from base of tephra Set P, roadcut in Smith Creek Valley, 9.7km E of MSH summit, along USFS Rd N92, 1.3km S of Ape Canyon Creek (46° 12′ N, 122° 04′ W). Coll and subm 1971 by D R Mullineaux.

W-2829. **2930 ± 250**

Charcoal from base of tephra Set P, same location as W-2675.

W-2549. **3350 ± 250**

Charcoal from within tephra Set Y, outcrop along E side of USFS Rd N92, NE of MSH. Coll and subm 1970 by D R Mullineaux. *Comment* (DRM): dates a *nuée ardente* from MSH, and with a sample dated 3510 ± 230 (W-1752, R, 1967, v 9, p 520) provides brackets for eruption of 2 largest pumice layers of tephra Set Y from that volcano.

W-2677. **3900 ± 250**

Charcoal from base of tephra Set Y, same location as W-2675. *Comment* (DRM): dates onset of eruption of group of Layer Y pumices.

Swift Creek series, Mount St Helens, Washington

The Swift Creek volcanic assemblage consists of deposits of pyroclastic flows, lahars, and alluvium subdivided and correlated by means of

3 principal sets of tephra deposits. Tephra deposits were erupted before, during, and after assemblage was formed and are distinguished by different heavy-mineral suites (Hyde, 1975).

W-2587. **8300 ± 350**

Charcoal from within upper part of tephra set J, 6.4km NE of summit of MSH, along USFS Rd N926 (46° 14′ N, 122° 07′ W). Coll and subm 1970 by D R Mullineaux. *Comment* (DRM): dates topmost pumice layer of 2 presently recognized in Group J.

W-2655. **11,800 ± 300**

Wood from lahar below tephra Set J, W bank Muddy R, Skamania Co. Coll and subm 1971 by D R Crandell. *Comment* (DRC): dates upper age of a postglacial eruptive episode at MSH during which many hot pyroclastic flows and lahars formed thick fills in valleys on SE side of volcano (Crandell & Mullineaux, 1973). Also dates older limit for tephra Set J.

W-2441. **11,880 ± 350**

Charcoal from ash beneath tephra Set J, roadcut on USFS Rd N92, 8km NE of MSH (46° 14′ N, 122° 07′ W). Coll and subm 1969 by J H Hyde and D R Mullineaux. *Comment* (JHH): date agrees with stratigraphic data. Pyroclastic Layer J is widespread in MSH area, and may have wide distribution to E and S of volcano.

W-2983. **13,130 ± 350**

Charcoal from pyroclastic flow below upper bed of tephra Set S, outcrop at E end of high bridge over Swift Creek, ca 13km S of top of MSH (46° 05.5 N, 122° 12′ W). Coll and subm 1973 by D R Mullineaux.

W-2413. **18,560 ± 550**

Charcoal from pyroclastic-flow deposit beneath tephra Set S, gravel pit beside rd, Lewis R valley, ca 16km S of MSH (46° 03′ N, 122° 12′ W). Coll and subm 1969 by J H Hyde and D R Mullineaux. *Comment* (JHH): date agrees with known geol relationships. Dated deposit may help establish late Wisconsin glacial chronology in area.

W-2540. **20,350 ± 500**

Charcoal from pyroclastic flow below upper bed of tephra Set S, S side of Lewis R near Swift Dam, ca 16km S of MSH (46° 03′ N, 122° 12′ W). Coll and subm 1970 by J H Hyde.

General Comment (JHH): this date, with W-2413, dates 2 episodes of explosive volcanism and brackets a pyroclastic layer and a soil-forming horizon.

W-2653. **36,000 ± 2000**

Wood from lahar, along stream bed of Lewis R, ca 16km S of MSH (46° 03′ N, 122° 12′ W). Coll and subm 1971 by D R Crandell. *Comment* (DRC): date indicates age of a lahar in the Lewis R valley which formed

during oldest known eruptive episode of MSH volcano. The lahar contains pumice mineralogically similar to tephra beds from which W-2661 was obtained.

W-2661. **37,600 ± 1000**

Charcoal from upper part of lowest layer of unnamed tephra set, quarry in Smith Creek-Muddy R valley, ca 11km E of MSH summit (46° 11′ N, 122° 03′ W). Coll and subm 1971 by D R Mullineaux. *Comment* (DRM): dates oldest known coarse and thick pumice deposit of MSH.

W-2976. **36,000 ± 2000**

Charcoal from lower part of coarse pumice lapilli bed, quarry in Smith Creek-Muddy R valley, 11.3km E of MSH (46° 11′ N, 122° 03′ W). Coll and subm 1971 by D R Mullineaux.

W-2421. **>35,000**

Wood exposed at upper surface of block and ash-flow unit, streambed Lewis R, 16km S of MSH (46° 03′ N, 122° 12′ W). Coll 1969 by J H Hyde and D R Mullineaux; subm by J H Hyde.

Kalama River Valley series, Mount St Helens, Washington

Volcanic rocks and unconsolidated geol deposits in upper Kalama R valley were studied to determine the kind of catastrophic geol events that might accompany a future eruption of MSH (Hyde, 1970).

W-2403. **610 ± 200**

Charcoal from horizon 1.8m below top of lower nuée ardente deposit, gravel pit beside rd, Kalama R valley ca 11.3km SW of MSH (46° 08′ N, 122° 19′ W). Coll and subm 1969 by J H Hyde and D R Mullineaux. *Comment* (JHH): indicates that pyroclastic-flow deposits were emplaced between 610 ± 200 yr and ca 300 yr, the age of the oldest tree found growing on the surface of the youngest deposit. Sample horizon directly overlies the basalt flow of Merrill Lake.

W-2436. **2200 ± 200**

Charcoal from horizon, within a mudflow sequence, near base of white pumice bed, roadcut, Kalama R valley, ca 35.4km SW of MSH volcano (46° 06′ N, 122° 36′ W). Coll and subm 1969 by J H Hyde and D R Mullineaux. *Comment* (JHH): indicates deposits probably formed during same period of volcanism as the Silver Lake Lahar assemblage in the Toutle R valley on NW side of volcano.

Mount Rainier National Park series, Washington

Twenty-two layers of tephra-volcanic ash and coarser airfall pyroclastic debris that blanket much of Mount Rainier Natl Park were extensively studied to document the recent eruptive history of Mount Rainier volcano (MR) (Mullineaux, 1974). This series reports the effort to date some of these tephra layers with wood samples from sediments separating layers. Coll and subm 1969 by D R Mullineaux.

W-2437. **5770 ± 250**

Wood overlying tephra Layer D and underlying tephra Layer N, Mount Rainier Natl Park, 0.8km SE of junction of Hwys 410 and 143 at Cayuse Pass (46° 52′ N, 121° 32′ W).

W-2424. **6380 ± 250**

Carbonized wood fragments from between pumice Layers L and D, Cowlitz Park, Mount Rainier Natl Park (46° 49′ N, 121° 38.5′ W).

W-2423. **6440 ± 250**

Wood from between Layers A and L. Same location as W-2437.

W-2422. **6730 ± 250**

Wood from between Layers O and A, same location as W-2437.

General Comment (DRM): samples separate successive major pyroclastic layers O (Mt Mazama ash), A, L, D, and N, respectively, in pyroclastic sequence at Mount Rainier. The 1st 3 dates show that MR erupted layers A, L, D, N intermittently during ca 1000-yr-period rather than during 1 short eruptive episode. Date for W-2422, above Mazama ash, agrees well with 6600- to 6700-yr age commonly cited for Mt Mazama eruption.

Lassen Volcanic National Park series, California

Charcoal from pyroclastic-flow in Chaos Crags-Lassen Peak area. Coll and subm 1968 by D R Crandell and D R Mullineaux.

General Comment (DRC): eruptive episode dated by these pyroclastic flows culminated with extrusion of Chaos Crags dacite plug-domes N of Lassen Peak (Crandell *et al,* 1974).

W-2228. **1000 ± 300**

Charcoal embedded in 2 ash layers believed to be parts of 1 general eruptive episode, Lassen Volcanic Natl Park, between Chaos Crags and Lassen Peak (40° 30.4′ N, 121° 30.5′ W).

W-2235. **1000 ± 300**

Charcoal from lahar that overlies a partly oxidized lahar, believed to be correlative with W-2259, roadcut on S side State Hwy 44 ca 0.24km W of Lassen Park boundary, Lassen Volcanic Natl Park (40° 32′ N, 121° 35′ W).

W-2261. **1010 ± 250**

Charcoal from log embedded in lowest of 4 pyroclastic flows exposed in W bank of Lost Creek (46° 32.5′ N, 121° 29′ W).

W-2257. **1200 ± 300**

Charcoal from log enclosed in pyroclastic flow in S bank of E fork of Manzanita Creek (40° 31′ N, 121° 32′ W).

W-2232. **4600 ± 600**

Peat from top 8cm of peat deposit, W bank of Lost Creek 0.18km downstream from Lassen Park Rd bridge, Lassen Volcanic Natl Park (46° 32.5′ N, 121° 29′ W).

W-2231. **5400 ± 600**

Peat from bottom 5cm of same deposit as W-2232, same location.

General Comment (DRC): W-2231 and -2232 dates period of volcanic dormancy represented by a thick peat accumulation on a valley floor adjacent to Lassen volcano. The upper sample (W-2232) approximately dates a volcanic ash layer that represents renewed volcanic activity.

W-2230. **<200**

Wood enclosed in lahar, W bank of Lost Creek near "Hot Rock," Lassen Volcanic Natl Park (40° 32′ N, 121° 29′ W).

W-2259. **>32,000**

Charcoal from partly oxidized lahar sampled from a streambank of Manzanita Creek (40° 32′ N, 121° 35′ W). *Comment* (DRC): dates a pyroclastic flow representing an early eruption of Lassen Volcano which predates last major glaciation and Lassen Park plug-dome. Its source vent has not been positively id.

W-2814. Mount Shasta, California **9230 ± 300**

Charcoal at base of pyroclastic flows, roadcut on E side of Interstate Hwy 5 near W base of Black Butte (41° 22′ N, 122° 23′ W). Coll and subm 1972 by D R Crandell. *Comment* (DRC): dates deposit of a hot pyroclastic flow, probably formed during building of Shastina, a post-glacial parasitic cone on W side of Mount Shasta volcano. Above this deposit are other pyroclastic-flow deposits, formed during eruption of Shastina's summit plug of hornblende andesite (Crandell, 1973).

Coyote Creek Fault series, Borrego Mountain area, California

Shell and charcoal samples from surface and subsurface strata offset by Coyote Creek fault. Deformation is inferred from vertical displacement of flat-lying sediments deposited in Holocene Lake Cahuilla, which covered parts of the fault until at least 800 yr ago (Clark *et al,* 1972). Coll and subm 1969 by M M Clark.

W-2448. **1230 ± 250**

Gastropod shells from shell-rich deposit, 150mm-thick, of Holocene Lake Cahuilla ca 1m below surface, ca 1km from Holocene shoreline (33° 59.1′ N, 116° 3.21′ W), alt ca +1 to 2m. *Comment* (MMC): this date, combined with those of W-2456 and -2468, below, plus displacement along this same fault plane during Borrego Mt earthquake of April 9, 1968, yields a linear tectonic displacement rate at this site of 5×10^{-4}m/yr over the last 3000 yr, and a recurrence interval for 1968-type earthquake of 100 to 300 yr (Clark and Grantz, 1971).

W-2454. **1650 ± 250**

Shells from strata 2.4m below surface and ca 1.2km from shoreline, collection from wall of trench excavated across a fracture that formed during 1968 Borrego Mt earthquake (33° 5.74′ N, 116° 3.17′ W), alt ca 1 to 2m. *Comment* (MMC): fracture did not previously break these strata, despite connection and proximity (ca 100m) to main Coyote Creek trace and connection with fracture described under W-2448, both of which broke repeatedly during the same period. This demonstrates that some fracturing does not repeat at the same location during every episode of faulting. It also indicates lacustrine conditions 1650 ± 250 yr ago at this site.

W-2455. **1370 ± 250**

Shells from 1m below present ground surface in same trench as in W-2454. Coll level is 30cm below distinctive layer dated by W-2448. *Comment* (MMC): strata exposed in this trench and in nearby (ca 300m away) trench of W-2448, along with dates obtained from them, suggest, but do not prove, continuous lacustrine conditions at these 2 sites from 1650 ± 250 yr ago (W-2454) until Lake Cahuilla disappeared; see W-2456, below.

W-2456. **860 ± 200**

Pelecypod shells from surface exposure of distinctive youngest deposit of former Lake Cahuilla next to 1968 rupture of Coyote Creek fault (33° 5.36′ N, 116° 2.94′ W). This laterally extensive stratum is as much as 0.3m thick at coll site. At trench described under W-2448, base of same stratum was offset vertically 56cm by faulting. *Comment* (MMC): date is somewhat older than youngest ages given by others for Lake Cahuilla (ca 300 yr, eg, Hubbs *et al*, 1960, 1963, 1965).

W-2468. **3080 ± 600**

Gastropod shells from 1.5m below surface in walls of same trench as in W-2448, from lacustrine sediments ca 0.1m below base of layer, offset vertically ca 1.7m by faulting; see W-2448. *Comment* (MMC): strata exposed in trench indicate lacustrine conditions during much of period from at least 3080 ± 600 yr until lake disappeared. But brief lowerings of lake, if not accompanied by significant subaerial erosion or deposition, would be difficult to detect in this exposure.

W-2469. **2450 ± 250**

Shells exposed in wall of a wash that crosses 1968 break of Coyote Creek fault (33° 1.36′ N, 115° 59.36′ W), alt ca −5m. *Comment* (MMC): site lies ca 2km from Holocene shoreline that traverses base of Fish Creek Mts. Sample came from a layer that filled a shallow channel along the fault cut into underlying lacustrine layer. Sampled layer was in turn channeled by post-Lake Cahuilla erosion. This channel cutting was very likely related to episodes of faulting when lake was not present; hence,

exposure records faulting along 1968 break at least 2450 ± 250 yr ago when lake surface probably was lower than —5m.

San Jacinto Valley series, California

Wood from 3 depths in a well in San Jacinto Valley graben (33° 46′ N, 116° 59′ W). Coll 1971 by Eastern Municipal Water Dist and Metropolitan Water Dist. of Southern California; subm by B E Lofgren.

General Comment (BEL): dates rates of deposition that suggest downfaulting averaged ca 2.1 mm/yr from 42,000 to 15,270 yr BP and has increased since 15,270 yr BP, to ca 5.8 mm/yr; see Lofgren and Rubin (1975).

W-2729. Depth, 89m **15,270 ± 450**

W-2827. Depth, 98m **21,260 ± 650**

W-2828. Depth, 146m **42,000 ± 1500**

Yellowstone Lake series, Wyoming

Peat and organic silt in core from N edge of fen ca 4.6m above Yellowstone Lake, ca 2.4km W of Trail Creek Cabin, SE arm of Yellowstone Lake, Yellowstone Natl Park (44° 17′ 30″ N, 110° 15′ 30″ W). Coll 1966 and subm by R G Baker, Center for Climatic Research, Univ Wisconsin, Madison.

General Comment (RGB): samples date climatic fluctuation during postglacial period (Baker, 1969).

W-2280. **2470 ± 250**

Peat, depth 240 to 260cm. *Comment* (RGB): sample was 30cm above a small rise in spruce pollen that suggests cooling trend, and sharp rise in sedge pollen and *Carex* seeds that marks change from small pond to fen conditions.

W-2281. **5390 ± 250**

Peaty mud, depth 442 to 460cm. *Comment* (RGB): date marks onset of slightly cooler conditions following Altithermal.

W-2284. **9240 ± 300**

Organic silt, depth 500 to 541cm. *Comment* (RGB): dates beginning of apparent hiatus during Altithermal time at this site.

W-2285. **11,550 ± 350**

Organic silt, depth 700 to 724cm. *Comment* (RGB): sample was 60cm above boundary separating lower tundra and parkland vegetation zone from upper zone of forest vegetation.

W-2286. Lilypad Pond, Wyoming **5590 ± 250**

Peat in core, depth 276 to 301cm, from N edge of pond ca 12m above Yellowstone Lake, ca 1.6km W of Trail Creek Cabin, SE arm of Yellowstone Lake, Yellowstone Natl Park (44° 17′ 30″ N, 110° 15′ W). Coll 1967 and subm by R G Baker. *Comment* (RGB): peat formation at

fen margin probably began in response to wetter conditions after Altithermal. Date, 5390 ± 250, W-2281, this list, from 4.6m lagoon supports suggestion.

C. Alaska

Bootlegger Cove Clay series, Anchorage, Alaska

Samples dating Bootlegger Cove Clay (BCC), overlying Elmendorf moraine (EM) and underlying brown sand, Knik Arm, Anchorage. Coll and subm 1969 by H R Schmoll and Ernest Dobrovolny.

General Comment (HRS & ED): series indicates that BCC was deposited ca 14,000 yr ago. BCC seems to represent a marine transgression following maximum development of Wisconsin glaciation, rather than interstadial event of middle Wisconsin age or an older glacial or interglacial event (see Schmoll *et al,* 1972).

W-2369. **14,900 ± 350**

Mollusk shells from BCC in sea bluff on S shore of Knik Arm, ca 1.7km ESE of Pt Woronzof (61° 11′ 58″ N, 149° 59′ 00″ W).

W-2367. **14,300 ± 350**

Mollusk shells from BCC in sea bluff on N shore of Knik Arm, ca 1km NE of Pt MacKenzie (61° 14′ 45″ N, 149° 58′ 17″ W).

W-2389. **13,750 ± 500**

Mollusk shells from BCC in sea bluff on NW shore of Knik Arm, 4.5km NE of Pt MacKenzie (61° 15′ 52″ N, 149° 55′ 18″ W).

General Comment (HRS & ED): BCC dates confirm correlation of shell zone within BCC exposed on both sides of Knik Arm and indicate that deposition took place over ca 1000 yr. Dates are also maximum for EM, which overlies this zone ca 3.2km to NE.

W-2375. **11,690 ± 300**

Wood beneath colluvium overlying EM, stratigraphically overlying BCC, NW shore of Knik Arm, ca 4.35km NE of Pt MacKenzie (61° 15′ 51″ N, 149° 55′ 27″ W). *Comment* (HRS & ED): date is minimum for EM and confirms approx correlation with adjacent Anchorage outwash deposits.

W-2366. **>40,000**

Organic fragments within 5cm zone in brown sand unit in sea bluff along N shore of Knik Arm, ca 18.8m NE of Pt MacKenzie (61° 23′ 32″ N, 149° 50′ 21″ W). *Comment* (HRS & ED): date confirms interpretation of Karlstrom (1964) that the part of this sec exposed beneath modern beach stratigraphically underlies main BCC exposure in bluff behind modern beach. However, clay/silt with scattered shells overlying this sample, does not correlate with main body of BCC.

Gastineau Channel series, near Juneau, Alaska

This series is part of a geol study of the Gastineau Channel formation, a sequence of heterogeneous glaciomarine deposits of late Pleistocene and early Holocene age, consisting of pebbles and larger clasts dispersed through a fine-grained matrix of silt and sand (Miller, 1973).

W-2396. **11,920 ± 1000**

Mollusks from stony diamicton overlying bedrock 122m above MSL, along S slope of Salmon Creek, ca 1.5m above RR track and trail to Salmon Creek Reservoir in floor of gully crossed by trestle (58° 20′ 00″ N, 134° 26′ 53″ W). Coll 1969 by Ernest Dobrovolny and H R Schmoll; subm by R D Miller. *Comment* (RDM): slightly younger than expected. Samples from interlayered diamicton-deltaic gravel at only 46m or less above MSL showed ages in 12,800 yr range (W-1830, -1831: R, 1969, v 11, p 222-223).

W-2721. **>39,000**

Peat from stony diamicton, at 114m above MSL in steep bluff on NE side of Montana Creek (58° 25′ 55″ N, 134° 37′ 52″ W). Coll 1971 by R D Miller and Christopher Kenah; subm by R D Miller. *Comment* (RDM): predates marine transgression that deposited Gastineau Channel formation.

W-2719. **2080 ± 250**

Peat from base of 0.6m peat sec overlying till, from excavation site for dam, SE shore of Cropley Lake, Douglas I. (58° 16′ 00″ N, 134° 31′ 24″ W). Coll 1971 by R D Miller and Christopher Kenah; subm by R D Miller. *Comment* (RDM): date is younger than expected. Overlying till is thought to be early Fraser age or older and is believed to predate glaciomarine deposits at lower alts dated at maximum age of 12,000 in this area, but may be contemporaneous.

W-2720. **<200**

Wood from log in alluvium, SE embankment of Gold Creek adjacent to E margin of Evergreen Bowl (58° 18′ 22″ N, 134° 24′ 41″ W), Juneau. Coll 1971 by R D Miller and Christopher Kenah; subm by R D Miller. *Comment* (RDM): sample may date a large rock avalanche that fell from slopes of Mt Juneau.

W-2380. **2740 ± 200**

Peat overlying beach gravel in W wall of gravel pit 34m above MSL, Douglas I, near Eagle Creek (58° 18′ 37″ N, 134° 27′ 22″ W). Coll 1968 and subm by R D Miller. *Comment* (RDM): significance of age uncertain. Peat samples along Douglas I. on emerged beach surface resulted in older age at lower alt, 5730 ± 350 at 23m alt. (W-1949, R, 1970, v 12, p 328). Thus, date seems too young, probably formed after rebound under fresh-water conditions.

W-2394. **10,760 ± 500**

Mollusks from stony diamicton, in floor of gravel pit at 24m above MSL, underlying deltaic gravel, same location as W-2380. Coll 1969 by Ernest Dobrovolny and H R Scholl; subm by R D Miller. *Comment* (RDM): date supports idea that deltas formed at slightly different rates during rather rapid rebound after removal of glacial ice in area.

W-2395. **9150 ± 800**

Mollusks from stony diamicton overlying deltaic gravel, in wall of gravel pit at 32m above MSL. Coll 1969 by Ernest Dobrovolny and H R Schmoll; subm by R D Miller. *Comment* (RDM): dates accumulation of diamicton over deltaic gravels, perhaps owing to slowing of isostatic rebound allowing eustatic rise to equal and overtake it.

W-2392. **9800 ± 300**

Mollusks from gravelly diamicton, 21m above MLLW, E side of Cove Creek, Douglas I. (58° 19′ 22″ N, 134° 36′ 52″ W). Coll 1969 by Ernest Dobrovolny and H R Schmoll; subm by R D Miller. *Comment* (RDM): age is in correct range for late glaciomarine deposition in Juneau area. Represents late phase nearshore shallow-water deposit near mouth of stream carrying coarse debris into ice-free marine environment.

W-2258. **8280 ± 350**

Basal peat at 32m above MSL, overlying beach gravel that in turn overlies shelly diamicton, from SW shore of Auke Lake, near Auke Bay, NW of Juneau (58° 23′ 07″ N, 134° 37′ 54″ W). Coll and subm 1968 by R D Miller. *Comment* (RDM): dates interval between marine deposition and peat formation.

W-2263. **10,630 ± 500**

Mollusks from sandy diamicton, 30m above MSL, overlain by beach gravel, same location as W-2258. Coll and subm 1968 by R D Miller. *Comment* (RDM): age seems to fit near-sea-level diamicton, 10,640 ± 300 (W-1827, R, 1969, v 11, p 222), sampled nearby. Stones in deposit along with complete and articulated shells indicate ice-free conditions but rafting.

W-2393. **9700 ± 800**

Mollusks from sandy diamicton, underlying deltaic deposit on N side of Kowee Creek, N of Douglas Island Bridge between Douglas I. and Juneau (58° 17′ 55″ N, 134° 26′ 03″ W). Coll 1969 by Ernest Dobrovolny and H R Schmoll; subm by R D Miller. *Comment* (RDM): age is younger than anticipated but supports idea that deltas formed at slightly different rates during rather rapid rebound after removal of glacial ice in area.

W-2260. **9070 ± 350**

Wood from black humic zone in embankment on NW side of Lemon Creek near jail site, Juneau area (58° 21′ 46″ N, 134° 28′ 54″ W). Humic

zone overlies diamicton and underlying deltaic sand and gravel. Coll and subm 1968 by R D Miller. *Comment* (RDM): wood probably tidal drift, suggesting date for change in depositional environment.

W-2384. **7150 ± 300**

Peat and woody stems 14m above MLLW, along Glacier Hwy embankment, N side of rd, Juneau area (58° 21′ 37″ N, 134° 32′ 5″ W). *Comment* (RDM): date is one of oldest from basal peat near modern sea level, and indicates near-sea-level stabilization of land after retreat of late Wisconsin ice sheet in Juneau area.

Mendenhall Glacier series, Alaska

Wood from deposits of Mendenhall Glacier near Juneau. Coll 1968 and subm by R D Miller.

General Comment (RDM): age suggests ice advance started near beginning of climatic change, signaling Neoglacial advance.

W-2377. **2780 ± 200**

Wood from loose glacial debris below active ice front of grounded part of Mendenhall Glacier (58° 26′ 13″ N, 134° 33′ 44″ W), Juneau area. *Comment* (RDM): age suggests wood material was overridden and carried to deposition site from growth site.

W-2379. **2800 ± 200**

Wood from lateral moraine on W side of Mendenhall Lake and below Mendenhall Glacier Trail (58° 26′ 06″ N, 134° 33′ 47″ W), Juneau area.

W-2250. Amchitka Island **>38,000**

Carbonized tree trunk (*Gymnosperm*) from tilted sedimentary rock ca 1.8m above present beach level, South Bight, Amchitka I. of Rat Is. rocks (51° 26′ N, 179° 15′ E), Aleutian Is. Coll 1966 by H T Shacklette and R H Morris; subm by H T Shacklette. *Comment* (HTS): tree trunk is in beach deposit of drift wood and indicates sea level.

D. Miscellaneous

Lake Windermere series, England

Organic silt and clay core samples from S basin of Lake Windermere (54° 36′ N, 03° 10′ W). Coll and subm 1969 by F J H Mackereth, Freshwater Biol Assoc, United Kingdom. Lake sediments provide a record of oscillations in geomagnetic declination (Mackereth, 1971). Cores were dated to determine frequency of oscillations. Samples taken at maximum excursion of declination swings.

W-2313. Organic silt, depth 22 to 32cm **800 ± 250**

W-2269. Organic silt, depth 26 to 38cm **1140 ± 250**

W-2274. Organic silt, depth 70 to 80cm **1370 ± 250**

W-2270.	**Organic silt, depth 105 to 115cm**	**2430 ± 250**
W-2273.	**Organic silt, depth 143 to 153cm**	**3430 ± 250**
W-2268.	**Organic silt, depth 183 to 193cm**	**4530 ± 250**
W-2272.	**Organic silt, depth 215 to 225cm**	**6150 ± 250**
W-2267.	**Organic silt, depth 243 to 253cm**	**7370 ± 250**
W-2275.	**Organic clay, depth 288 to 298cm**	**10,130 ± 350**
W-2276.	**Organic clay, depth 360 to 380cm**	**13,400 ± 400**

General Comment: 1st 2 samples are not zero age because of addition of dead carbon to top layer from industrial pollution. Bottom 2 are from clay. If uncorrected ages are used in computation, average period for full wave swing is 2230 yr. Depending what tree ring correction is used, the full wave period may be as much as 2700 yr.

East China Sea series

Eustatic sea-level changes are studied using a series of brackish-water and shallow-water marine mollusks coll from dredgings on shelf in East China Sea. Area is at approx same lat as Atlantic coast of United States and was not subject to heavy glaciation during Pleistocene (Emery *et al,* 1971). Coll 1967-1968 by Hiroshi Niino; subm by K O Emery, Woods Hole Oceanog Inst, Woods Hole, Massachusetts.

W-2214. **Sta 5, *Mytilus corscum*, depth 125m** **11,050 ± 600**
(35° 29′ N, 131° 18′ E)

W-2215. **Sta 6, *Mytilus corscum*, 118m** **10,520 ± 600**
(35° 27′ N, 131° 18′ E)

W-2340. **Sta 7, *Astarte*, 194m** **>33,000**
(35° 27′ 30″ N, 130° 35′ 35″ E)

W-2342. **Sta 7, *Macoma calcarea*, 194m** **>40,000**
(35° 27′ 30″ N, 130° 35′ 35″ E)

W-2343. **Sta 13, *Macoma calcarea*, 219m** **15,740 ± 400**
(34° 40′ 00″ N, 129° 16′ 15″ E)

W-2338. **Sta 15, *Mercenaria stimpsoni*, 120m** **9880 ± 350**
(34° 15′ 15″ N, 129° 07′ 30″ E)

W-2217. **Sta 23, *Mactra chinensis*, 64m** **10,000 ± 600**
(31° 00′ N, 125° 31′ E)

W-2216. **Sta 23, *Corbicula japonica*, 64m** **27,000 ± 1000**
(31° 00′ N, 125° 31′ E)

W-2036. Sta 24, *Ostrea gigas*, 112m **15,200 ± 850**
(29° 30′ N, 126° 15′ E)

W-2220. Sta 28, *Mactra chinensis*, 62m **3000 ± 500**
(28° 29′ N, 125° 13′ E)

W-2254. Sta 28, *Anadara subcrenata*, 62m **13,260 ± 600**
(28° 29′ N, 125° 13′ E)

W-2219. Sta 28, *Corbicula japonica*, 62m **>30,000**
(28° 29′ N, 125° 13′ E)

W-2337. Sta 30, *Ostrea gigas*, 140m **12,200 ± 400**
(26° 30′ N, 123° 00′ E)

W-2341. Sta 30, *Mactra chinensis*, *Pecten albicans*, 140m **23,260 ± 600**
(26° 30′ 00″ N, 123° 00′ 00″ E)

W-2360. Sta 32, *Arca inflata*, 190m **>26,000**
(25° 44′ N, 123° 18′ E)

General Comment (KOE): samples coll from depths greater than ca 140m, maximum extent of sea-level lowering, are old, as expected. Shells of different species in samples from sta 23, 28, and 30, gave significantly different dates. Older shells may be relicts of previous regressive stage of sea. Nevertheless, most of the dates favor a minimum sea level ca 15,000 yr ago.

Atlantic Continental Shelf series

Shells (*Crassostrea virginica* [Gmelin]) from Atlantic Continental Shelf of United States. Coll 1968 by R L Wrigley, Bureau Comm Fisheries, Biol Lab, Woods Hole, Massachusetts; subm by K O Emery, WHOI.

General Comment (KOE): species live only in slightly brackish water, 0 to 3m depth, and thus date past sea level (Emery & Milliman, 1970).

W-2237. Sta 182, 67m **9600 ± 600**
Georges Bank (40° 51.5′ N, 67° 41.5′ W), Atlantic Ocean.

W-2241. Sta 308, 42m **9000 ± 600**
Near Hudson Canyon (39° 51′ N, 73° 15.7′ W), Atlantic Ocean.

W-2262. Sta 231, 69m **11,340 ± 600**
Hudson Canyon region (39° 55′ N, 72° 28′ W), Atlantic Ocean.

Lake Kivu series, Africa

Lake Kivu (01° 45′ S, 29° 06′ E) is smallest, ca 2400km^2, highest, ca 1500m, and one of deepest, ca 500m, of rift lakes in E-central Africa. Its deep water contains ca 50km^3 of methane (STP). Two mixtures of carbon dioxide and methane from deep water were dated to determine

source of methane. Coll and subm 1972 by W G Deuser, WHOI. *Comment* (WGD): decomposing plankton and other organic matter cannot be a main source of methane. Most of the methane was formed by bacteria utilizing carbon dioxide and hydrogen of volcanic origin (Deuser *et al,* 1973).

W-2742. **22,000 ± 4000**

Methane (40%) and CO_2 (60%) from depth 415m.

$\delta^{13}C = -19.3‰$

W-2743. **20,500 ± 2000**

Methane (35%) and CO_2 (65%) from depth 395m.

$\delta^{13}C = -16.5‰$

W-2239. Chaim mine, Saudi Arabia **950 ± 300**

Charcoal from stope in an ancient gold mine, Ishmas area, S Hijas Prov, ca 70km E of Rhyanah (20° 55′ N, 43° 44′ E). Coll and subm by T H Kiilsgaard. *Comment* (THK): date agrees well with previous estimates of age of mine.

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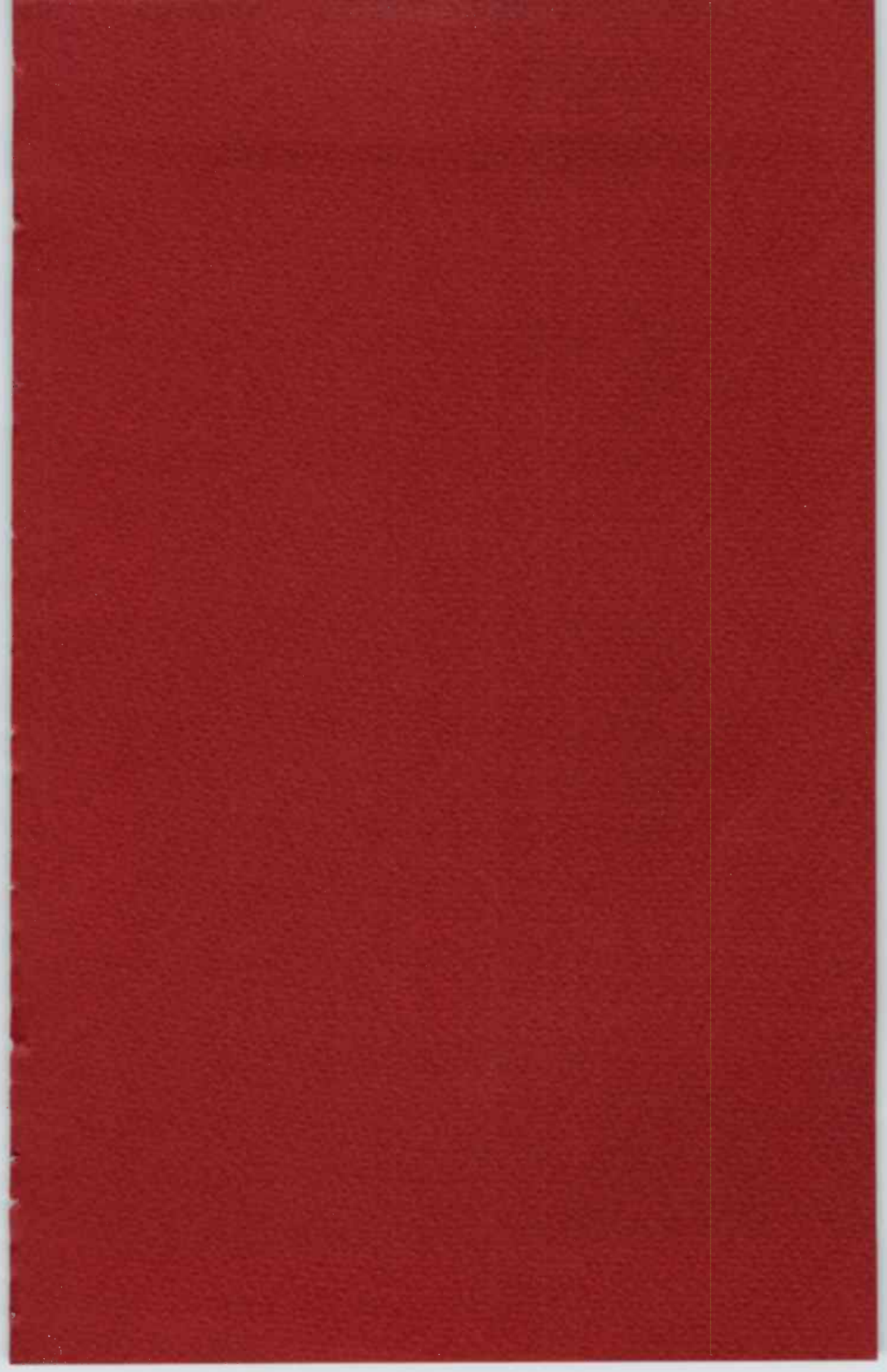

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